coördinatiecommissie
uitvoering
wet verontreiniging
oppervlaktewateren

co-ordination committee
implementation
surface water
pollution act

cuwvo

study group VI

programmes for the reduction of emissions from point sources to surface waters in various sectors of industry in the netherlands

august 1991

Preface

The exchange of information between authorities and organizations of branches of industry from various countries with regard to the emission of harmful substances from companies is calling for attention more and more in recent years. The importance of this exchange will only increase in the years to come, as a result of the European unification and the increasingly intensive consultation within international frameworks to combat the pollution of rivers and seas.

The Coordination Committee Implementation Surface Water Pollution Act (CUWVO) in the Netherlands believes it to be important that foreigners interested into the results of the branch studies carried out in the Netherlands should be able to take note of those results. Internationally, the Dutch information in this field will be more accessible with this English CUWVO report.
Since 1975, branch studies have been carried out by the CUWVO, on the basis of which recommendations were formulated for the approach to reduce pollution caused by the waste water problematic of companies. Mostly, specific branches with large numbers of companies are concerned, companies which have an uniform character regarding their waste water situations, and, often, discharges from those companies take place into municipal sewage systems.

First of all, in this report a specification is given of the function, method of working and composition of the CUWVO, as well as the tasks of study group VI (emissions) which carries out branch studies (chapter 1).
After this, a short specification is given of the points of departure regarding the lines of policy applied in the Netherlands, on the basis of which pollution reduction measures regarding waste water discharges are realized by means of the instrument of permits to be granted (chapter 2).
After this, for each branch study, in CUWVO reports published since 1979, results are represented, as a summary of the concerning report, conclusions of the branch study as well as recommendations for the policy to pursue regarding discharges (chapter 3).

It should be considered that a number of reports are of an early date, and, although included, could be somewhat outdated (3.1 and 3.2) and may be subjected to a renewed study in the near future. A number of reports from the period 1979-1985 have already been revised. The most recent versions of them are included in this report (3.7, 3.10, 3.12, 3.13 and 3.14). The remaining reports are of a rather recent date, and, therefore still topical. Finally, it should be said that a

number of branch reports is in preparation, concerning the waste water problematic of:
- paper and cardboard industry,
- pharmaceutical industry,
- vessel reconditioning industry,
- sewage water overflows,
- cultivation under glass,
- bulb-growing culture,
- car wreck sites and scrapyards,
- water pollution caused by dredging.

Extra copies of this report can be requested at:
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Information about the branch studies can be gathered at:
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1. THE COORDINATION COMMITTEE IMPLEMENTATION SURFACE WATER POLLUTION ACT

1.1 The Surface Water Pollution Act (A law of 12 December 1985, 683)

On 1 December 1970 The Surface Water Pollution Act was put into effect. According to the motives of this law, regulations have been laid down in this law to combat and prevent the pollution of surface water. The Surface Water Pollution Act contains a permit system, as a result of which the discharges of waste, pollutants and harmful substances can be controlled and pushed back, as well as a regulation of levy for the payment of the measures to combat and prevent the pollution of surface water.

In the past years The Surface Water Pollution Act has been altered a few times. On 1 January 1982 there was an important addition, when the law -which was initially geared to the pollution reduction of pollution sources in particular- was aimed at the total management of the surface waters.

In The Surface Water Pollution Act, a distinction is made between surface water under the management of the State (State waters) and surface water that is under the management of others than the State (non-State waters).
The water management of State waters mainly includes (further) rules about management, the planning of management, the granting of permits, imposing and collecting levies, inspecting the quality of the water, taking steps to improve the quality of the water and granting (investment) subsidies to reduce the pollution as a result of discharges into State waters.
In addition to those activities (with the exception of subsidizing), the authorities of the non-State waters have taken up the establishment and exploitation of institutions for the collective purification of waste water.

First of all, in The Surface Water Pollution Act water management of non-State waters has been put with the provinces. However, in the water management regulation Provincial States can delegate the authority with regard to the granting of permits, as well as the implementation and enforcement of the regulation to District Water Boards or municipalities. Actually, in the Netherlands the State, 3 provinces (Friesland, Groningen en Utrecht) and 27 District Water Boards and/or water purification boards are water managers in the sense of The Surface Water Pollution Act. Almost all purification plants for communal waste water are under the management of the 3 provinces mentioned above and the District Water Boards to whom water

management has been delegated. Only in Amsterdam, Bunschoten and Tilburg there are still municipal purification plants for communal waste water.
Besides, municipalities are not directly involved in the implementation of The Surface Water Pollution Act. They nevertheless play a part as authorities of the local sewerages, with which the communal waste water is transported to the purification plants of the waterauthority.

1.2 Coordination

The way in which water management is organized in the Netherlands evoked the need for coordination right from the beginning. This need for coordination induced the Minister of Transport and Public Works shortly after the Surface Water Pollution Act coming into force, to contact his colleague of the then Ministry of Health and Environmental Protection, the Interprovincial Consultation for the Environment, the Union of District Water Boards and the Association of Dutch Municipalities. This led to him installing the Coordinating Committee Surface Water Pollution Act (CUWVO) on 20 September 1973.

The CUWVO got as its task:
1. To consult and conduct studies with a view to the necessary unity of the policy with regard to the subjects which ask for an equal approach in the practical implementation of the Surface Water Pollution Act by the public bodies responsible for it.
2. To formulate guidelines for the policy with regard to the subjects meant under 1.
3. To examine the way in which the necessary unity in the policies of the various government administrations, with regard to the subjects investigated, can be obtained or promoted and of facilities which prove to be advisable or necessary in connection with it.

1.3 The CUWVO in practice

The CUWVO plays a coordinating and stimulating role in the management of Dutch surface waters. It can be characterized as a communal consultative body of the authorities involved in water management. The parties participating in the CUWVO are all equally authorized to question matters for which it appears to be advisable to pursue nationally an uniform or mutually attuned management policy. With the reports and advices of the CUWVO, it is intended to point the way for actions the water authorities should take while implementing the Surface Water Pollution Act.
Furthermore, the CUWVO functions as a sounding board for the intentions of the government which are based on the Surface Water Pollution Act with regard to national water management.

During the 15 years of its existence, the CUWVO developed from a purely coordinating and stimulating 'institutionalized dialogue' of water authorities into a platform of governmental consultation, policy development and gearing, as well as into integral advice to the State with regard to water management in the Netherlands.
With it, the CUWVO actually has a threefold function:

1. coordination and gearing (recommendations to the authorities involved in watermanagement aimed at the unity within the policy of the Surface Water Pollution Act);
2. examining and studying aspects of water management and purification management;
3. advising the State with regard to national water management.

Recently, the CUWVO declared that it shall expressly manifest itself on the total policy scope of water care. This, for instance, goes for enforcing the Surface Water Pollution Act, financing water management and the policy with regard to the water bed.

1.4 The structure of the CUWVO

Within the CUWVO the authorities involved in water quality care are represented on an administrative level.
The composition of the CUWVO is as follows:

- two members on behalf of the Union of District Water Boards
- two members on behalf of the Interprovincial Consultation
- one member on behalf of the Association of Dutch Municipalities
- one member on behalf of the Directorate General Environment (Ministry for Housing, Regional Development and the Environment)
- two members on behalf of Public Works Department 'Rijkswaterstaat' (Ministry of Transport and Public Works).

The chairman is independent and the secretarial work rests with the General Management of 'Rijkswaterstaat' (Ministry of Transport and Public Works). The secretarial work is pursued by three employees of the General Management of 'Rijkswaterstaat'.
The general secretary has to prepare the agenda, and supervises as regards content CUWVO-documents with regard to the administrative and legal aspects and the financing of water quality care (see permanent study groups I/II and III).
The secretary water quality and emissions supervises as regards content CUWVO-documents in the fields of the permanent study groups V and VI and ad hoc study groups for technical and technological policy coordination and advice.
The assistant secretary bears the responsibility for the preparation of meetings, reporting, correspondence, filing and distribution of CUWVO-reports and advices.

1.5 The CUWVO study groups

The work by CUWVO is mainly prepared in study groups coming under the committee.
Each of those study groups accounts for a certain aspect of management.

At the moment, there are four permanent study groups on CUWVO level, that is for:
- administrative and legal affairs (I/II),
- technological and technical aspects with regard to the implementation of the levies(III),
- water quality (V) and
- emissions (VI).

In addition, there are sometimes ad hoc study groups. An example is the Study Group Action Plan Phosphor removal and Nitrogen removal on sewage water purification plants (WAD I and WAD II).

In the past, there also were permanent study groups for 'Costs Purification Plants' (IV) and 'Infosystem Water Management' (VII). Study group IV was discontinued in 1977 and study group VII in 1989.

Sub-study groups are mostly established by study groups for certain subjects.
Representatives of authorities not participating in the CUWVO are also members of the sub-study groups. This with a view to attuning to other policy fields (for instance agriculture and conservation) and/or with a view to exchanging information and attuning the policy of social organizations (for instance organizations from trade and industry).

1.6 Study group VI: emissions

The tasks of the study group Emissions are:
- drawing up programmes or guidelines for each branch of industry to reduce or eliminate discharges of other than oxidizing substances in particular
- making uniform or streamlining technical regulations within the Surface Water Pollution Act-permits for certain branches of industry which qualify for this
- coordinating and stimulating research into diffuse sources of water pollution by other than oxidizing substances in particular, as well as initiating measures to combat this pollution
- coordinating and stimulating the realization and implementation of the policy with regard to phosphate and nitrogen and preparing reports about it to the CUWVO

- functioning as a sounding board in the preparation of issuing rules under the Surface Water Pollution Act, with regard to emissions
- commenting on proposals and developments within international frameworks.

The work of study group VI covers a wide range of activities. The execution of a certain assignment or action therefore takes mostly place in a sub-study group, which may or may not be functioning ad hoc, to which the experts involved and interested parties can contribute.

2. POLICIES CONCERNED WITH WASTE WATER DISCHARGES AND IMPLEMENTATION IN THE NETHERLANDS

2.1 General objectives

The main objectives of the water quality policy being pursued in the Netherlands are concerned with establishing and maintaining the quality of Dutch surface waters, such that they are able to support the diversity of organisms and aquatic communities that would normally be expected to occur in such environments. In addition to satisfying these ecological objectives, surface waters must also meet the demands placed upon them by agricultural, industrial and recreational use as well as providing adequate supplies of drinking water.
The basic tenets of national water quality policy, which have been developed along the lines of relevant EEC regulations, are set out in the Multi-year Programme for Water (IMP) and the Third Policy Document on Water Management. Two principles are fundamental to achieving the objectives on which national policy is based, namely:
- the principle of curbing pollution,
- the stand-still principle.

2.2 Curbing pollution

In general, the principle of curbing pollution means that pollution should be minimised wherever possible - regardless of the type of contaminants involved. This implies that companies should harmonise their production processes and operations to achieve such objectives. If, however, additional pollution control measures are required, consideration should be given to differentiating between discharges of individual substances, where necessary.
For instance, EC directives concerned with particularly hazardous discharges into the aquatic environment of the Community, classify substances on the basis of potential environmental hazards. A similar system has been adopted within the Rhine Convention on Chemicals, with a distinction being made between List I and List II substances. This has resulted in different approaches being adopted to deal with discharges of substances on the black list and other substances, as outlined below.

Black-listed substances
Black-listed substances are those that, in the light of their persistence, high toxicity and propensity for bioaccumulation, pose a serious threat to the environment. To eliminate this type of pollution, efforts should be made to reduce discharges of black-listed substances to zero, using the best technical means. Should it not prove possible to eliminate such discharges with these techniques, assessments must be made of

the acceptability of the residual concentrations to be discharged. If the threat posed to the aquatic environment is considered to be untenable, consideration must be given to banning such discharges.

Other substances
The approach adopted for dealing with discharges of other substances allows distinctions to be made in accordance with the perceived risks. The following categories of substance can be distinguished:
- Substances that are considered to be relatively harmful. These substances are characterised by their persistence, their moderate-to-high toxicity and their propensity to accumulate in sediment and organisms. This group of substances includes the heavy metals that have not already been added to the black list and some of the oxygen-consuming substances. All these substances require pollution control measures to be taken that are not directly related to the desired quality of the surface water into which they are to be discharged. As with substances on the black list, it is required to adopt an emissions approach for dealing with this group of substances. However, in this case, use should be made of the best practicable means for pollution control. Should the desired water quality not be achieved supplementary measures may be necessary.
- Substances that are considered to be relatively harmless. This group is characterised by lower levels of toxicity and includes substances such as sulphate and chloride that occur naturally in surface waters. The need for pollution control measures to limit discharges of these substances is largely a function of the water quality objectives set for the receiving surface water in question.

2.3 Stand-still principle

To facilitate the implementation of the stand-still principle in pollution control policies, a distinction is usually made between substances on the black list and other substances.
- For black-listed substances, the main aim is to ensure that the sum total of all such discharges in a particular area should not increase, regardless of whether the discharges are of a direct or indirect type.
- For other substances, the main aim is to ensure that the water quality should not significantly deteriorate.

2.4 Programmes for the reduction of emissions from point sources

In the Netherlands reducing pollution is regarded as a basic principle of policy. In the approach to emissions, priority is given to eliminating pollution at source, using the best technical means or the best practical means.

In addition to pollution of the aquatic environment which comes from definable and in principle controllable sources, surface water also suffer from diffuse pollution. The most significant difference between pollution from diffuse sources and that from point sources lies in the fact that the Surface Water Pollution Act makes virtually no provision for reducing pollution form the former.
This document is concerned entirely with discharges from point sources.
Point sources are defined as discharges from industry both into sewers and directly to surface waters and treated or untreated discharges from communal sewage systems into surface waters. The approach to reducing discharges from these point sources is determined in the first instance by the nature of the wastes in the effluent.
Discharges from local authority sewage plants or effluent treatment plants mainly contain oxygen-binding and eutrophying substances for which discharge criteria can be formulated. In order to eliminate micropollutants which enter surface waters via this route it will be necessary to tackle the problem at source. This means limiting operational discharge of these substances into the sewers and restricting pollution from diffuse sources.
The discharge criteria for industry relate to a great variety of pollutants. Emissions of most of them have already been tackled, the necessary measures being determined in the first instance by the harm these substance cause to the environment.
In drawing up emission standards, other factors beside the nature of the substances and the effluent are also relevant. These include the nature and size of the production process and the volume and concentration of pollutants in the effluent. It is also important to know whether the discharges are new or whether they have been going on for some time. Thus there are many different circumstances in which the same substances may be present in effluent.
There are also different options as regards how to prevent the substances entering the effluent or, alternatively, how to remove them after the after the event. As an alternative to production processes or flows may be split up and treatment provided for certain or flows may be split up and treatment provided for certain processes. consequently it is often difficult to formulate uniform maximum emission standard per substance or group of substances and to standardise definitions of the best technical means and the best practical means for each substance or group of substances. Usually, emission standards are drawn up for a particular sector of industry or production process.

Emission standards and the concepts of the best practical means and the best technical means

The best technical means are to be used to treat effluent in the case of blacklisted substances, while in the case of other substances to which the emissions approach applies, priority is given to applying the best practical means. These concepts can be defined as follows.

The best practical means
These are technologies by means of which the largest possible reduction in pollution in obtained once due allowance has been made for economic aspects, i.e. what is acceptable from a cost point of view for a normally profitable company.

The best technical means
these are technologies which produce an even greater reduction in pollution at greater expense and which can in practice be applied to the aquatic environment.

A certain residual pollution of the aquatic environment is regarded as acceptable for the purpose of applying the best practical means, provided that the relevant water quality objectives are met. The financial and economic criteria referred to in the definitions indicate that the more harmful a substance is to the environment, the greater will be the financial sacrifice which is in principle deemed acceptable and is demanded. It is not the intension that no account at all should be taken of financial and economic aspects when applying the best technical means. Reference may be made, inter alia, to the official statement by the EC Commission that the economic availability of these best technical means should be taken into account.

Emission standard laid down by law
Since 1 january 1982 it has been possible under the Surface Water Pollution Act to lay down maximum emission standards for designated substances by Order in Council. The uniform emission standards agreed in international fora are first in line for this.

Statutory obligations for various categories of business to obtain licences
A Royal Decree of 4 November 1983 laid down categories of business which must obtain licence under the Surface Water Pollution Act before they discharge wastes, pollutants or noxious substances (this includes discharges into the sewage system). The categories are as follows:
a. the chemical and petrochemical industry;
b. the ore-processing industry;
c. waste storage or treatment plants;
d. surface treatment plants;
e. paint, varnish and printing ink production plants;
f. tanneries;
g. wood impregnation plants;

h. tank and tanker cleaners;
i. the paper and board industry.

The main reason for laying down regulations on this subject in the context of the Pollution of Surface Waters Act lay in the conclusion of the Convention on the Protection of the Rhine against Chemical Pollution and the promulgation of the EC Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Directive no. 76/464/EEC of 4 May 1976). under the Convention and the Directive, discharges of black-list and grey-list substances into sewage systems and to treatment plants are assumed to be subject to licensing.
The explanatory notes on the Decree state that, as there are so many companies which will need licences, the obligation to obtain one will be introduced in stages, for a few categories at a time. At the first stage, categories were designed on the basis of the nature of the waste produced by the sector concerned. Account was also taken of the fact that studies of certain categories of plant had yet to be completed before it could be decided what measures should be taken with regard to them. Them total number of businesses in each category was also a consideration, notably on account of the administrative work anticipated.
The second stage -namely, designation of a second group of categories- have been designated:
j. screen-printing works;
k. photographic plants with laboratories whose production capacity exceeds 20,000 m^2 of paper per annum;
l. textile finishing industry;
m. carpet-lining plants;
n. hospitals (general, teaching and specialised);
o. integrated laboratories which discharge more than 10,000 m^3 of effluent per annum, and analytical laboratories;
p. paint-stripping plants;
q. plants where protective layers of wax are removed from more than 1,000 new cars per annum;
r. engine servicing works.

3. A COMPILATION OF SUMMARIES, CONCLUSIONS AND RECOMMENDATIONS FOR BRANCHES OF INDUSTRY FROM VARIOUS CUWVO-REPORTS

3.1 Paint, varnish and printing ink plants

Recommendations regarding measures to reduce pollution caused by discharges of non-oxidizing and toxic substances by paint, varnish and printing ink plants (1979).

3.1.1 Summary report

Discharges of non-oxidizing and toxic substances from paint, varnish and printing ink plants have been studied by a sub-study group in cooperation with representatives of the "Vereniging van Verf- en Drukinktfabrikanten" (VVVF). Waste water mainly arises when production equipment is cleaned, which is necessary when changing from one product to another. Therefore, there is a variable relationship between the size of the production and the amount of water pollution. Most plants are connected to municipal sewerage systems, and, therefore, waste water is likely to be treated by means of a oxidative-biological purification system.
Among the non-oxidizing and toxic substances used in this branch, compounds of lead and zinc are especially important from a quantitatively point of view, to a lesser extent chromium, copper, cobalt and tin, and to a very slight extent cadmium and nickel. Those metals are mainly present in the pigments that are used. Waste water containing mercury is no longer necessary.
In view of the extreme variability of discharges from these plants, it is impossible to determine exactly what quantities of pollutants are discharged. However, the information available does not suggest that those discharges cause serious pollution, provided waste water is treated in settling tanks. On the other hand, peak discharge rates can be high sometimes.
A survey of VVVF members, who take care of approx. 95% of the total paint production and 50%-70% of the total printing ink production in the Netherlands, showed that the branch used approx. 1,000,000 m^3 of water in 1977. Approx. 440,000 m^3 of it was discharged as waste water, 300,000 m^3 of which was treated with settling tanks.
It appeared that the amount of water used strongly varies from plant to plant. The requirements per 1,000 kg paint or printing ink range from 0.1 m^3 to several tens of m^3, while the average is 4 - 5 m^3.
When considering what measures were possible to prevent or limit the production of polluted waste water, and how waste water could be treated, a distinction was made between water-based paints (latex

paints, calcimines) and paints based on oil or solvents. The financial consequences of the measures which might be taken were taken in consideration as well. It turned out that the technique of processing solid waste resulting from waste water treatment determined the annual costs.
It is recommended that the guideline by the Union of District Water Boards be adhered to, and maximum discharge loads be laid down per plant, as far as discharges of metal pollutants are concerned.
In order to remove settling components, waste water must always be passed through a well designed and operated settling tank. Discharging caustic solutions without a proper preliminary treatment -which is still taking place sometimes- should be ended. Discharging mercury, PCBs and PCTs must be prohibited.
Apart from the necessity of being prescribed how to act, some producers of latex paints (emulsion paints, calcimines) may find it attractive to take measures to reduce discharges of waste water containing emulsions onto the sewerage systems by means of flocculation, in order to reduce the levies they have to pay.
The costs which will have to be incurred in order to bring about a satisfactory waste water situation throughout the sector are estimated at 10 to 15 million guilders.

3.1.2 Recommendations

Considering the fact that waste water released during the production of paint and printing ink mainly consists of washing and rinse water from equipment of the production carried out for each separate product, formulating discharge standards for each separate product, i.e. the quantity of pollutants per unit of weight for paint or printing ink which is allowed to be discharged, is uncalled for. The quantity of pollutants released is more determined, among other things, by the number of changes from one product to another than by the quantities produced. All this, because of the fact that waste water mainly consists of washing and rinse water resulting from changes in production.
It is recommended by far to formulate concentration standards which can be translated per case into quantities of pollutants to be discharges per unit of time, taking into consideration the quantity of waste water released, however, without a dilution with cooling-water. The guidelines laid down by the Union of District Water Boards with regard to the maximum permissible concentrations of metal pollutants present in discharges can be applied then.
The standards proposed for heavy metals present in undiluted waste water from paint and printing ink plants will be for cadmium, chromium, copper, lead, zinc and nickel:

Cd	0.1 mg/l
Cr	2 mg/l
Cu	1 mg/l
Pb	3 mg/l
Zn	3 mg/l
Ni	3 mg/l

It is proposed to use these values as maximum permissible concentrations (without dilution) for paint and printing ink plants.
Furthermore, it is recommended to lay down loads, i.e. the maximum permissible quantity of metal pollutants in discharges per unit of time, in discharge permits.
It is also recommended to include in discharge permits to be granted the following articles with regard to limiting discharges:

- discharging rising, floating, settling or colouring components should be avoided as much as possible; process waste water should always be passed through a well designed and operated settling tank before it is transported;
- it is prohibited to discharge mercury, and mercury compounds PCBs and PCTs;
- discharging caustic solvents from purification activities (lyeing) without an adequate follow-up treatment -as is still taking place at some plants- should be ended. When and how fast this is to take place has to be determined in consultation with the plant and water authority concerned.

3.2 Graphic industry

Recommendations with regard to the limitation on discharges of non-oxidizing and toxic substances into waste water by the graphic industry (March 1982).

3.2.1 Summary report

Size of the branch of industry
The graphic branch includes approx. 3,000 companies (excluding approx. 4,000 so-called small house-printers), half of which with less than 10 employees.
The total number of people working in this branch amounts to approx. 50,000, and the total annual turnover can be estimated at approx. 5,000 million guilders.

Emission polluting substances
According to the production process the following polluting substances can be released: cadmium, chromium, copper, nickel, silver, zinc, magnesium, iron, ferric cyanide, various kinds of organic solvents, gelantine, black japan, detergents and various salt and oxidizing substances.
Those substances released during the processes are not all discharged. A number of companies has equipment to reclaim those substances, and larger companies often use detoxicating installations. Many companies transport liquid waste to processing plants that are specially equipped for this.
It is very difficult to estimate the quantities of substances discharged. There is a rough estimate just for the heavy metals, with the exception of cadmium, i.e. approx. 10 tons per year. Because increasingly less films containing cadmium are supplied for graphical application, we expect the emission of cadmium from this branch to be of a minor importance only.

Combatting at the source
By choosing techniques that are less polluting, the application of ecological materials and ingredients and taking preventive measures to avoid unnecessary losses, it can be achieved that less harmful waste gets into waste water. Thus, the discharge of cadmium in particular can be prevented entirely by not using photographic material containing cadmium anymore.
By using, as much as possible, synthetic or aluminium printing forms or plates, with photo polymere emulsions, the release of heavy metals can be limited considerably.
By using less harmful products such as alcohol and detergents for cleaning, the emission of chlorinated hydrocarbons can be prevented

as much as possible. The application of ink solvable in water plays an important role in this.
Should it be inevitable that waste products are released, then they have to be collected separately and deactivated, either by the companies themselves or by processing plants suitable for this. This particularly goes for spent developers, fixers, organic solvents etc.

Removal of harmful substances from waste water
Should those preventive measures be taken, then it will not be necessary to treat waste water further. It is useful, however, to install at least a gravitation separator in the drainpipes of printing and finishing establishments, in which substances which settle down or rise can be held back.
In some cases the measures mentioned above will prove to be insufficient with regard to the quantities of heavy metals permitted in waste water discharged, to meet the guidelines by the Union of District Water Boards. Whether waste water will have to be subjected to detoxification by the company itself, depends on the quantities discharged up to then and the place where discharges take place. Out of economic reasons, it is often not feasible for small companies in particular to treat waste water. Therefore, it is better to give up such a treatment of waste water, should the discharge of heavy metals amount to no more than 10 kilos per metal per year and the total load to no more than 20 kilos.
An exception to this is cadmium, which -in principle- does not have to be discharged anymore.
Practical detoxicating methods that can be applied in this branch are precipitation and ion exchange. In both cases there will be residues, of which it is obvious that it is not permitted to discharge them. Transport to processing plants suitable to do so is the right procedure.

Chemical Waste Products Act
The previous shows that it is possible to prevent polluting substances from ending up in waste water, if bath liquids, semi-concentrates, solvents etc. were to be collected separately. Residues with a high percentage of harmful substances, of which it is obvious that it is not permitted to discharge them, also arise from the treatment of waste water. It is preferred, in most cases, to transport those substances to processing plants especially equipped to handle them. With the exception of liquids containing silver, the costs of transport and treatment are restraining factors in this development, just like the fact that an organization to collect those liquids is not there. One should consider that the waste products involved apply to the Chemical Waste Products Act.

Financial consequences of demands on discharges
Treating waste water within the company is a rather costly affair. Transporting concentrates and such to, and treating them at central processing plants is often -both financially and technically- much more attractive. Assuming that the measures mentioned before lead to a reduction of 5,000 kilos of heavy metals, and that the costs involved amount to an average of Dfl.1000 per kilo metal removed, it comes down to an amount of Dfl.500,000 for the entire branch per year. The same amount is estimated for the other measures.

3.2.2 Conclusions branch study and recommendations regarding the policy to pursue before permits are granted

In general
The following general conclusions can be drawn from the preceding:

a. Relatively speaking, the graphic branch does not have a particularly large part in the total emission of non-oxidizing and toxic substances in the Netherlands. Thanks to changing technics and processes, this emission also shows a downward tendency. Nevertheless, the nature of the substances is such that measures are necessary to limit discharges further. With it, the emphasis falls on heavy metals and organic solvents.
b. Many companies have already introduced changes in processes and taken additional measures as meant under a, either on the basis of permit regulations or of their own accord. In order to prevent unequal treatment of companies finding themselves in the same conditions, it is desirable that harmonization of the permit policy by applying as much as possible uniform discharge demands.
Those demands should be attuned to the application of the best techniques performable. An exception to this is cadmium, for which a stricter demand goes. The reason to do so is that this metal, generally, does not have to be removed from waste water with the aid of a certain technic, because there are possibilities to prevent cadmium from ending up in waste water that is discharged. Should, as the occasion arises, cadmium should end up in waste water in connection with certain processes applied, the best technics available have to be used to limit the discharge of cadmium.
c. To begin with, the quantity of harmful substances discharged can be limited by using ecological products and production processes. The use of films containing cadmium should be ended. Further research on the influence of photo polymere on the aquatic environment should be considered.
d. A solution has to be found for organizational problems concerning the transport and processing of concentrates, semi-concentrates and useless residues, in order to prevent those substances from entering the environment illegally.

Discharge demands

Heavy metals

Spent bath liquids, etching fluids, drag-out baths etc. are not to be discharged just like that, but have to be collected and transported to processing plants equipped for this, or detoxicated by the company itself. The effluent of the detoxicating installation should then meet the guidelines by the Union of District Water Boards.
With regard to rinse water, there are also guidelines by the Union of District Water Boards. In most cases, this will be achieved by applying good rinse techniques, if necessary combined with reservoirs. Should this not be the case, then rinse water has to be subjected to a detoxicating treatment, too. An exception to this rule can generally be made for companies of whom rinse water, after the application of drag-out baths, contains heavy metals in concentrations higher than stated in the guideline by the Union, but of which the quantity per metal does not exceed 10 kilos per year and the total load is not higher than 20 kilos per year.
This exception does not go for cadmium, considering the fact that waste water that is discharged, in principle, is not allowed to contain cadmium. Should rinse water be treated in an ion exchanger, then the regeneration liquid is not to be discharged. In the same manner as bath liquids, this liquid has to be transported to a processing plant, c.q. detoxicated in the company itself. Here also the guidelines by the Union apply as a discharge demand.
Residues released during detoxication are not to be discharged. The Chemical Waste Act also applies to the keeping, handing to a third party, transporting and treating of concentrates, semi-concentrates and residues mentioned above.

Guidelines by the Union of District Water Boards

cadmium	0.1	mg/l	silver	1	mg/l
chromium(total)	2	mg/l	zinc	3	mg/l
copper	1	mg/l	cyanide[1]	1	mg/l
lead	3	mg/l	sulphate[2]		
nickel	3	mg/l			

[1] Decomposed by chlorine.
[2] A limit value of 300 mg/l is generally adopted for discharges of sulphate into sewage systems. The concentrations given above refer to maximum values obtained from samples which have been averaged out over a 24-hour period; the concentrations found in random samples are permitted to exceed these values by a factor of 3.

Chlorinated hydrocarbons
In principle, it is not allowed to discharge chlorinated hydrocarbons. They have to be collected and transported to processing plants separately. It is recommended to take as discharge demand a limit of 1 mg/l, because it is inevitable that occasionally small quantities of those solvents may end up in waste water as a result of vapour/liquid balances.

Residues
It is not desirable to keep solid and liquid waste, such as concentrates, semi-concentrates, metal sludge etc., in the company itself for a long time. A good organization for periodically gathering this waste has to be realized by common efforts of trade and industry and government. Reducing the pollution of waste water is slowed down as long as a simple transport possibility of small parties of waste products is not yet realized.

Financial consequences
Although it is possible, especially for smaller companies, to encounter problems, we are inclined to think that the costs for the entire branch of the measures recommended are not extremely high. The estimated costs are only a fraction of the total annual turnover. Support measures may be necessary in some individual cases.

3.3 Wood impregnation plants

Recommended pollution control measures to deal with waste water produced in wood impregnation plants (September 1986)

3.3.1 Summary report

In general
In this note, attention will be paid to the impregnation of wood in relation to waste water released during this process.
There are approx. 35 companies in the Netherlands specialized in the impregnation of wood with the vacuum-pressure method, those are the so-called wood impregnation companies.
Companies that impregnate wood differently (by spraying, plunging or brushing) are left aside in this note, considering the fact no clearly apparent waste waster streams are present.
With the so-called vacuum-pressure method, wood is piled up on lorries and those lorries are driven into an autoclave, after which the process of impregnation will take places in the kettle.
Impregnating agents mostly used are creosote oil and inorganic salts, particularly on the basis of copper and chromium, and to a lesser extent arsenic.
The polluted water of a wood impregnation company can be subdivided into polluted waste water during the process (block water, condensation and leakages) and polluted rain-water.

Creosote company
With creosote companies there arises, per cubic metre creosoted wood, an average of approx. 25 litres of condensation containing as its most important pollutants various polycyclic aromatic hydrocarbons (19 of which examined, total grade approx. 200 mg/l) and phenol (approx. 1,000 mg/l). Mixture of this stream with block water (if present) can be prevented by installing a condenser.
After the internal measures mentioned above have been taken, there still remains a stream of waste water containing creosote oil substances after the process, which cannot be discharged just like that. Transport (by tanker) of this waste water for treatment by a third party is the best solution, certainly at the moment.
Treatment in an active sludge installation by the company itself can offer good opportunities, i.e. adsorption of PAH to the sludge and biological decomposition of PAH and phenol. PAH present during the water phase (with more than four benzene rings) are mostly bound to the solid particles present in the water. A considerable reduction of this PAH is -in principle- also possible by removing the solid substance out of the waste water by means of a combination filter, containing elements, for instance, such as sand and anthracite. The

remaining waste water stream will then still contain naphthalene and phenols in particular. In most cases, this stream can be brought to an oxidative-biological purification plant without any problems.
The pre-purifications mentioned above as well as the internal process measures demand a financial effort by the companies. The amount of money, however, both with regard to investments and running costs, mentioned in this report should be considered indicatively. Considering the nature and the quantities of the substances in general, those costs can be considered to be acceptable, but may differ considerably for each company.
Research into the techniques for purification of waste water from creosote establishments released during the process mentioned above, and the practical costs involved still has to be started. The results of this research will be published separately; expectations are this will take place within two years' time.

Salt impregnation companies
With regard to companies impregnating with salt mixtures, it can be stated that -in principle- no waste water needs to be discharged during the process. The installation of a splash guard between the kettle and the vacuum pump is recommended. Waste water collected in here, or otherwise, during the process can be used to dilute or dissolve the salt mixtures supplied.
Losses in impregnates due to leakages arise both with creosote and salt impregnation companies. This especially takes place due to draining dry freshly impregnated sets of wood right after removal from the autoclave, and due to streaming out rests of impregnates out of the autoclave after opening. Generally, there will be a trough behind the kettle to collect the liquid leaking from the kettle, from where re-use or controlled transport is possible.
It is recommended to protect this trough against rain in such a way, also with regard to terrain drainage, that unintentional dilution of the impregnate collected is impossible or hardly possible.

Rain-water
Possibly polluted rain-water is a different subject. During storage of impregnated wood, coming into contact with rain-water, polluted rain-water may arise due to the leaching of impregnate from wood.
Polluted rain-water sinks into the soil or is directly discharged into the surface water through hard surface or the sewerage. Pollution of an environmental compartment takes place in both cases. With regard to limiting the pollution of rain-water or preventing this, nothing can be said with certainty at the moment. Research into the possibilities to do so will have to give clarity. Results of this research will be published separately and are to be expected in two years' time. Attention to the

leaching of impregnates, should impregnated wood be used in hydraulics, is paid in other frameworks.
In general, it can be said that the way in which people work at a company impregnating wood and the size of the company determine the development of waste water and its degree of pollution to a large extent. The consequence is that each company has to be judged separately.

3.3.2 Conclusions branch study

The preceding chapters show that the development of waste water during the process can be prevented or considerably limited by taking a number of internal measures with regard to the process.
Creosoting produces, at an average company with an annual production of 8,000 cubic metres creosoted wood, an average quantity of condensation of approx. 200 cubic metres per year, which contains, as its most important polluting substances, polycyclic aromatic hydrocarbons (PAH 19; approx. 200 mg/l) and phenol (approx. 1,000 mg/l). Mixture of this stream with block water can be prevented by installing a condensor.
Leakages of impregnants arise both with creosote companies and salt impregnation companies. This especially takes place due to the draining dry of freshly impregnated sets of wood, directly after removal from the autoclave, as well as to residues of impregnates streaming out of the autoclave after opening. There will mostly be a trough behind the kettle to collect the leakages from the kettle. Re-use or controlled transport from this trough is possible.
It is recommended to protect the trough against rain, also with regard to terrain drainage, in such a way that unintentional mixture of the impregnants collected (creosote oil in particular) cannot (or hardly) take place.
Waste water remaining at creosote companies after those internal measures (condensation and possibly polluted rain-water coming from the drain track and the drain of the block water) is so polluted that direct discharge into the surface water has to be prevented. The possibilities for processing can be summarized as follows:

a. purification by a third party,
b. transport to a RWZI(sewage water purification plant), after partially removing PAH by floating substance removal and oil separation,
c. purification by the company itself (active sludge or physical/chemical).

The methods mentioned under b and c will have to be examined further to gain a clearer insight into the possible percentage of purification, the effluent values and the costs. For the time being, it will be impossible to give recommendations with regard to target regulations for treatment by the company itself. At the moment, transport of

waste water released during the process for treatment by a third party is preferred by far.
Should not only condensation from the creosote installation, but also polluted rain-water (from product storage) be transported, the measures for processing mentioned under a. will become impossible with regard to the high transport costs. The percentage of pollution and the purification costs will be important, when a choice has to be made concerning the processing of rain-water.
Nothing can be said with certainty with regard to limiting the pollution of rain-water coming from storage at impregnation companies or preventing this. Research into the possibilities will have to give clarity. Results of this research will be published separately.

3.3.3 Recommendations

a. Dealing with the application for a discharge permit for a creosote company, the following internal measures can be desired:
   - the installation of a condensor/splash guard between the kettle and the vacuum pump;
   - the use of a so-called dry vacuum pump or the use of another (cool and) seal medium but water;
   - collecting leakages and re-using them as much as possible;
   - a trough under the kettle.
b. It is recommended to supply the drain track with a trough for leakage liquid, and to cover the drain track and the trough.
c. Waste water from a creosote company remaining after internal measures with regard to the process is not to be discharged just like that.
d. Transport of this minor process water c.q. condensation stream for treatment in a installation by a third party is preferred by far.
e. After pre-purification of the waste water by the company itself, in which PAH most harmful to the environment are removed, transport of waste water through the sewerage to an oxidative-biological purification plant is in principle acceptable.
f. In case of possibly complete purification by the company itself and direct discharge into the surface water, purification by means of an active sludge system can be considered.

cadmium	0.1	mg/l	silver	1	mg/l
chromium(total)	2	mg/l	zinc	3	mg/l
copper	1	mg/l	cyanide[1]	1	mg/l
lead	3	mg/l	sulphate[2]		
nickel	3	mg/l			

[1] Decomposed by chlorine.
[2] A limit value of 300 mg/l is generally adopted for discharges of sulphate into sewage systems. The concentrations given above refer to maximum values obtained from samples which have been averaged out over a 24-hour period; the concentrations found in random samples are permitted to exceed these values by a factor of 3. In addition, the pollution load over a 24-hour period should be determined on the basis of the prevailing flow rate.

g. When dealing with the application for a discharge permit for a salt impregnation company, the following internal measures can be desired:
   - the installation of a splash guard between the kettle and the vacuum pump;
   - collecting and re-using leakage liquid as much as possible;
   - a trough under the kettle.
h. It is recommended to supply the drain track with a trough, and to cover the drain track and the trough.
i. Discharge of waste water during the process, coming from a salt impregnating institution may be prevented entirely by measures during the process and re-use, and, therefore, needs not to be permitted.
j. Awaiting the results of further research into the possibilities of limiting the leaching of impregnated wood, should there be no serious environmental hygienic problems, reservation should be considered with regard to the measures to reduce pollution of rainwater to be discharged.

3.4 Hospitals

Recommendations with regard to the reduction of pollution caused by discharges from hospitals (September 1986)

3.4.1 Summary report

The research based on this report limited itself to general and university hospitals.
A "hospital" is understood to be an institution with intramural health care, with at least one laboratory.
As a result of the many activities taking place in a hospital, and the large number of substances that are being used during those activities, waste water from hospitals can be loaded with a wide range of non-oxidizing substances, albeit in relatively small quantities. Sources which can be pointed to are laboratories, X-ray departments, nursing wards and dispensaries.
In general, it can be said that waste water from hospitals resembles domestic waste water very much; provided that:

- the percentages of some heavy metals is at a higher level in hospital waste water. (Characteristic for hospital waste water is the presence of silver, barium, copper, mercury and -to a lesser extent- zinc.)
- organic micropollutions related to organic solvents, disinfectants and cleaning products used there, are easily demonstrated.
- hospital waste water seems to be less loaded with oxidizing substances, due to the relatively large water consumption in hospitals. (The relation between COD/BOD does not differ noticeably from that of domestic waste water.)

The building of resistance by certain micro-organisms against antibiotics, on the basis of which a deliberate strategy in relation to the application of those medicines has been outlined in the health care, is also established in waste water from hospitals.
The limitation on pollutions with non-oxidizing substances (considering the number of substances and the quantities in which they are present in waste water) is achieved not so much by applying purification technical measures, but even more by taking organizational measures and providing facilities in hospitals. For this, the report contains some recommendations for discharge regulations to be laid down. Attention should be particularly focused on collecting and transporting chemicals, medicines, fixing liquids and developer.
Due to the particular character of each hospital, it turned out to be impossible to quantify the costs of collecting and removing waste products.
The bacteriological state of hospital waste water deserves attention in those cases where discharge into surface water with a specific destina-

tion (for instance recreation) can be established. Disinfection of waste water could then be considered for waste water released during microbiological research, and in case of nursing isolated carriers of infectious diseases.

3.4.2 Conclusions branch study

- By using a large number of substances in the many wards in a hospital, waste water can be loaded with a large number non-oxidizing substances, in a relatively slight quantity of every separate substance. Sources that can be pointed to are laboratories, X-ray departments, nursing wards and dispensaries. In an university hospital -due to the size of the complex- not only the quantity of substances discharged, but also the number of pollution sources is higher in connection with the presence of specific laboratories for research and education and possibly a dental faculty.
- Due to the relatively large water consumption in hospital, waste water is less loaded with oxidizing substances, compared to domestic waste water. Due to the COD/BOD relation of waste water, it can be purified biologically quite well in communal sewage water purification plants.
  The percentage of heavy metals in hospital waste water is almost at the same level as in domestic waste water; however, for some metals this level is higher, particularly silver, barium, copper, mercury and -to a lesser extent- zinc. Also organic micropollutions (relating to the chemicals, cleaning products and disinfectants that are used) are demonstrable. For the protection of the quality of surface water and sewage sludge, attention should be focused on holding back substances on the basis of their harmfulness (toxicity, persistence and bioaccumulation).
- In general, it will be impossible to hold back almost all non-oxidizing substances by means of purification techniques, considering the way in which those substances get into hospital waste water; because the number of substances is too high and the separate quantities too small. A solution must be found in an organizational set-up, to prevent substances from getting into waste water. We should think about chemicals coming from laboratories, medicines, developer and fixer coming from X-ray diagnostics, mercury coming from broken thermometers and amalgam remnants released in dentistry. All this requires internal regulations and facilities that are to be observed with discipline within a hospital, for the limitation of waste products discharged.
- Although it is possible to treat fixing liquids on X-ray departments by means of electrolytic desilvering, the emission of silver from hospitals can be limited further by collecting and transporting to a processing plant. With regard to the desilvering technique applied

in some hospitals, we cannot speak of the best technique performable from the point of view of water quality. Transport of developer to such a processing company also limits a possible cadmium emission from hospitals in connection with the application of film material containing cadmium.
Purification technical measures that can be applied are, for instance, the removal of plaster by means of settling tanks and the removal of amalgam remnants from exhaust systems of dental departments through sedimentation and/or centrifuge.

- Estimates regarding the quantities of substances that are yearly discharged by hospitals in the Netherlands, and the effect on this after introducing collection systems are not considered well-founded, among other things, due to the slight size of the research into the quality of waste water from six hospitals and the possible presence of systems for entirely or partially holding back chemicals etc.
  This insight can only be obtained per hospital after granting a discharge permit, and by controlling the observation of permit regulations. With it, a registration of used (purchased) substances that are collected, processed and/or transported cannot be done without.
- No unanimous judgement can be passed on the desirability of disinfecting hospital waste water based on literature search. Disinfection is recommended or demanded in some countries out of preventive considerations, in other countries such as the Netherlands, this has been left aside up to now. The argument to do so is that carriers of pathogenetic micro-organisms might just as well be outside hospitals. On the basis of preventive considerations, mostly of one's own accord, solid waste and waste water coming from microbiological research is sterilized by means of a thermal treatment (autoclave). In the two isolation wards for the treatment of patients with exotic infectious diseases in the Netherlands, no waste water of those patients is discharged into the sewerage of the hospital at all. The waste water is transported to an incinerator after treatment.
  It appears that there is a reduced sensibility (resistance) to antibiotics within hospital waste water for some micro-organisms. Although those resistant germs may occur in higher numbers than in domestic waste water, this aspect seems to be of less importance with regard to the quality of the water and the sewage sludge, as it is tried to prevent this resistance from increasing too much in connection with the application of those medicines by means of a deliberate strategy from the health care itself regarding the use of antibiotics.
- Due to the unique character and organization of hospitals, costs cannot be displayed. Costs related to collecting and removing waste products strongly depend on the managerial structure of each

hospital; such as purchase policy, gathering systems, treatment methods and established working methods.

3.4.3 Recommendations

- The following points of departure are recommended for formulating regulations with regard to holding back substances for which no emission standards can be given considering their application and the way in which they are released:
- The licensee should see to internal regulations being outlined and/or arrangements being made for the limitation on the discharge of waste products.
- The licensee should see to regulations and arrangements intended being adjusted and/or extended as often as is necessary in connection with changes in tests, studies and working methods to be implemented.
- Regulations and arrangements intended should be subjected to the approval of water authorities, and should be considered as regulations and arrangements prescribed within the framework of the permit.

The point of departure of this policy is that the discharge of those substances that belong to the categories mentioned in list 1 of the guideline by the Council of European Communities of 4 May 1976 (76/464/EEC) should be prevented with the best techniques available. The discharge of the remaining substances should be limited with the best techniques performable (see Indicative Multi-Year Programme for Water 1985-1989).*
This actually means that both so-called black-listed substances and remaining substances should always be held back for collection, as far as is necessary on the basis of their properties such as toxicity, bio-accumulation and persistence. Should this be impossible, and are substances involved such as mentioned in list 1 of the guideline mentioned before, then it should be checked how discharge of those

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* Clarification
Techniques best performable: those techniques which obtain the largest reduction of pollution, bearing in mind economic aspects: that is, acceptable for a normally paying concern from the viewpoint of costs.
Best techniques available: those techniques which obtain an even larger reduction of pollution against higher costs, and which can be applied in practice.

substances can be further prevented by making other arrangements or working methods.
The following reports can be used to formulate internal regulations:
- Collecting chemical waste coming from institutions for research and education (5 June 1984);
- Classifying and labelling chemical waste. Uniform regulation (summer 1985);

both by the National Study Group Chemical Waste and the University Advisory Committee Safety and Environmental Legislation (secr. IAVM, W.J.T. van Alphen, Vrije Universiteit, Dienst voor Veiligheid en Milieu, PO Box 7161, 1,000 MC Amsterdam).
As internal regulations should be counted:
the classification of substances, coding barrels to collect substances, the way in which substances are collected and transported, and registration of substances that are collected and transported.
Internal regulations and arrangements, principly functioning at university hospitals, should be implemented in all hospitals, not only for the protection of the quality of the water, but also for efficiently collecting, transporting and removing hospital waste, which is important within the framework of the policy pursued on the basis of waste products legislation. This policy was laid down in the guideline for provincial plans in particular with regard to the removal of hospital waste (Ministry of Health and the Environment, March 1982).
- For waste products released at laboratories of hospitals, the approach mentioned above is applied unimpaired, and is similar to the approach as laid down in "Recommendations with regard to the reduction of pollution of waste water coming from laboratories"; a report of March 1982, CUWVO, Study group VI.
- The discharge of mercury coming from broken thermometers should principly be ended by replacing clinical thermometers with alternative thermometers, this also on the basis of the guideline by the Council of European Communities from 8 March 1984 (84/156/EEC).

  Obstacles, such as regulations based on the Weights and Measures Act, that block the replacement of thermometers containing mercury, should be removed. As long as this replacement has not yet been realized, internal regulations should be drawn up and observed in hospitals, which prevents mercury coming from broken thermometers from ending up in the sewerage.
- Considering the qualities of substances present in spent developer (possibly cadmium) and fixer (silver), and the possibilities of transporting those concentrates to specialized processing plants, it is recommended not to permit discharge of those substances. The emission of silver coming from X-ray departments can be reduced considerably, by re-using chemicals and limiting transfer to rinse water. For possible further requirements on rinse water, and the

measures to take we refer to "Recommendations with regard to the limitation of discharges of non-oxidizing and toxic substances with waste water from the photographic industry" which is to be published soon.

- The discharge of unused (not usable anymore) medicines should be prevented. The removal of those medicines also falls under the Chemical Waste Act.
- The application in hospitals of apparatuses that grind and dilute waste should be combatted, especially where this process leads to an unnecessary load on surface water or biological purification with non-degradable substances. As a result of this, hospitals will join in with the policy pursued with regard to waste products legislation.
- Concrete purification technical measures should be prescribed for holding back a number of substances in clearly demonstrable waste water streams, especially for:
  mercury, coming from amalgam remnants released from the vacuum system of a dental faculty (separation techniques such as sedimentation and centrifuge);
  plaster, coming from a dental faculty (settling tanks for plaster);
  fat, coming from kitchens (grease traps).
- Diffuse pollution of hospital waste water with copper can only be prevented by replacing pipes on a large scale or by centrally conditioning drinking-water by companies producing drinking-water. It is recommended to include the aspect of water pollution by hospitals, too, because this problematic manifests itself within a much wider scope than just hospitals.
- From the point of view of health based on preventive considerations, water authorities should support the sterilization of waste water released during microbiological research and during the isolated nursing of carriers of infectious diseases.
  More than has been the case up to now, the water authority should pay attention to the bacteriological condition of hospital waste water (the presence of pathogene organisms), particularly in case of discharge into surface water with a specific destination (recreation). Special attention should be paid to the transfer from mixed sewerage and outfalls. It is recommended to consult the Health inspector for research into the bacteriological condition and to answer the question whether disinfection of waste water might be necessary in those cases.
  Should it be considered necessary to disinfect hospital waste water, then -based on practical feasibility and effectivity- one should focus on, for instance, thermal treatment of specific, qua size limited, sanitary waste water streams.
- Controlling the observation of permit regulations -considering the set-up of internal regulations and arrangements- would have to be carried out by registering the quantity of substances used (pur-

chased) and substances collected and processed c.q. transported. With it, one can try to fit in with the duty to report based on the Chemical Waste Act.
Additional arrangements have to be made to subject hospital waste water to measuring and sampling. In some cases, when there are various junctions onto the municipal sewerage, it is almost impossible to measure and sample all waste water adequately. In those cases, it is recommended to make arrangements at the sources in hospitals where relatively many harmful substances can be discharged,so that at least random samples can be taken.
It still is very important, considering the great diversity of harmful substances used in a hospital, that a better insight -more than in the past- into the nature and quantity of substances discharged is obtained. To do so, a central facility to measure and sample has to be equipped, wherever possible.

3.5 Photographic industry

Recommendations with regard to the limitation on discharges of non-oxidizing and toxic substances with waste water arising from photographic processes (February 1987)

3.5.1 Summary report

Structure of the branch
In this report, all those companies occupying themselves with photography as main or supporting activities are understood to be part of the photographic branch.
The "branch" includes approx. 13,000 companies and institutions; only a small part of those companies (approx. 1,000) occupy themselves exclusively with photographic activities.

Emission polluting substances
During the production process, most emission is released through a limited number of substances: developers and fixers. It is estimated that 10 tons of silver is released through waste water from photographic activities (including the activities that have nothing to do with the company). Assuming this, an estimate was made for the emission of the most common developers and fixers.
It turned out to be impossible to specify the emission per type of "company", due to the absence of information.
Important are also the heavy metals cadmium (coming from film) and chromium (coming from cleaning liquids, hardening and bleaching baths).

Combatting at the source
The most appropriate way to prevent the emission of cadmium entirely is using cadmium-free films. Meanwhile, most producers of light sensitive films turned to this. However, it can take some time, until the emission of cadmium will have ended completely.
The emission of the remaining substances should be combatted with the best technique performable. Most companies will turn to collecting their spent baths, and transporting them for processing to companies specialized to do so.
However, should certain conditions be met, then it can be permitted - in individual cases- to discharge black-white developer through the sewerage and a sewage water purification plant.
The best technique performable for rinse water is applying process integrated measures, such as limiting transfer losses, improved rinse techniques, online electrolysis etc.
A maximum concentration of silver of 1mg/l is considered feasible with normal rinse water consumption.

Treatment of rinse water by means of, for instance, ion exchange is applied on a limited scale, but requires the appropriate care which may create problems for smaller companies or photographic departments.

Financial consequences
The costs of transport of photographic waste liquids are largely compensated by the yield of silver from waste fixer.
Financially, the treatment of rinse water is less attractive than process integrated measures in which saving in costs on water and chemicals plays an important role.

Chemical Waste Act
Most companies and institutions occupying themselves with photographic activities will somehow be obliged to transport their photographic waste baths through a third party. Companies, occupying themselves with this, should be obliged -based on efficiency- to take all photographic waste baths offered to them. This should be arranged regarding the Chemical Waste Act-permit. Meanwhile, the Directorate General for the Environment of the Ministry for Housing, Regional Development and the Environment adopted this recommendation.
Each municipality should make arrangements to do so for small quantities (coming from, for instance, dentists, amateur photographers).

Discharge permit
In most cases, the discharge permit will only refer to the discharge of domestic waste water and rinse water from developing machines.
Should the application for a permit give cause to this, then the refusal of the permit demanded to discharge black-white and colour developer, fixer remnants and other photochemicals should be mentioned explicitly in a decision belonging to the permit. Such a refusal also goes for rinse water that is used during a photographic process with light sensitive material containing cadmium.
In the discharge permit for rinse water, one can confine oneself to almost uniform quality regulations.
Granting permits to producers of light sensitive materials and companies processing waste, will ask for an individual approach considering the different processes and purification techniques.

3.5.2 Conclusions branch study and recommendations

1. Because of the qualities of the substances present in spent colour developer, black-white developer, fixer and other waste baths, and the possibilities of transporting those concentrates to specialized processing plants, it is recommended to refuse the discharge of

those substances. Those processing plants should be obliged to take in all photographic waste baths (see commentary).
Considering the tendency that almost no films are being produced containing cadmium, it can be considered that the refusal to discharge black-white developer should not be employed so strictly in some cases. Based on the quantities discharged, the composition of the developer and the certainty which the company may offer with regard to the absence of cadmium and silver, discharge of black-white developer through the sewerage to a purification plant could be permitted under certain conditions.
The granting of a permit will then call for an individual approach. Discharge requirements and measures shall be comparable to the ones of processing plants.
As there is still little known about the effects of discharge onto a purification plant of developer containing 1-phenyl-3-pyrazolidon, further research is recommended.

2. The emission of silver from this branch is mainly caused by discharging fixer (desilvered or not) and rinse water after fixing. The concentrations in rinse water are so high that measures (preferably process integrated) are necessary. In case of normal rinse water consumption, a silver grade of max. 1 mg/l is feasible. The emission of other substances is also sharply reduced by process integrated measures. Thanks to the yield of silver and the saving in chemicals, financial consequences of the measures to take are limited.
3. For most photographic companies, regulations laid down in the permit can be limited to general uniform discharge demands. It is recommended to strive for general rules laid down in the law within the framework of companies under the AMvB category, considering the large number of companies.
4. Out of economic reasons, liquids with a low silver grade (<100 mg/l) are not desilvered more and more, but transported to be incinerated. In this way, silver is withdrawn from the cycle and often ends up in the environment.
   Therefore, it is recommended to collect liquids containing silver separately, and processing should be aimed at re-use.
   Commentary:
   Meanwhile, the Directorate General for the Environment of the Ministry for Housing, Regional Development and the Environment has adopted this recommendation. Chemical Waste Act-permits to be granted to collectors of small chemical waste shall oblige them to collect:
   - fixer
   - developer
   - the remaining small quantities of chemical waste under AMvB ex art. 32WCA released at companies where photographic chemical waste is collected.

(National Policy Document "The removal of photographic chemical waste", board waste products DGMH, March 1987.)

3.6 Dumping sites for domestic waste

Recommendations with regard to the purification of waste water emanating from dumping sites for the disposal of domestic waste mainly (September 1987)

3.6.1 Summary report

A sub-study group was established by study group VI of the 'Coordination Committee Surface Water Pollution Act' (CUWVO), consisting of representatives from the RIVM (State Institute for Health and the Environment), DBW/RIZA (Institute for Inland Water Management and Waste Water Treatment), water authorities and the Ministry for Housing, Regional Development and the Environment.
The assignment from study group VI of the CUWVO to the sub-study group was to investigate the problematic concerning waste water emanating from dumping sites for domestic and industrial waste processed with it ex art. 4, 17, 25 and 26 of the Waste Act. This research included:
- making an inventory of dumping sites where no measures to reduce pollution are being taken;
- investigating the quantity and quality of waste products in waste water emanating from dumping sites;
- giving possibilities to limit the quantities of waste products discharged into waste water emanating from dumping sites;
- providing insight into the costs of treatment methods related to the efficiency of removal;
- describing the best techniques available and performable for the treatment of waste water emanating from dumping sites;
- recommending with regard to the techniques to apply;
- recommending with regard to formulating discharge demands.

In addition to the Surface Water Pollution Act (WVO), in which the quality of the water is central, there are four laws more which have common grounds with the percolation water problematic. Those laws are:
- Soil Protection Act (WBB);
- Waste Products Act (AW);
- Chemical Waste Act (WCA);
- Nuisance Act (HW).

The relation between those laws (WVO, AW, WCA, WBB and HW) has been regulated explicitly.
The quality of waste water emanating from dumping sites is determined, among other things, by the nature of waste products discharged. It was laid down in a permit in accordance with the AW which products may and may not be discharged (acceptance policy).

Should there be any objections to the dumping of certain waste products from the point of view of the quality of the water, then additional demands will have to be laid down in the permit in accordance with the Surface Water Pollution Act relating to measures to be taken to combat serious pollution of waste water emanating from dumping sites. On the basis of article 6 of the Waste Products Act, a Guideline for controlled dumping was issued by the Minister for Housing, Regional Development and the Environment. In the first Guideline (1980) the Minister only spoke about the processing of waste under dry circumstances, that is 50 cm above the highest water table.

Since 1985, when the revised Guideline was published, the policy with regard to the protection of the soil has been tightened, as the Temporary Indicative Multi-Year Programme Soil 1984-1988 proves.

With regard to bringing waste products on or into the soil, the Guideline results in measures, which have to be taken to protect soil and groundwater against pollution, and which have to meet the principles according to this tightened policy; those points of departure are:

1. direct contact between waste products and soil, ground water and surface water has to be avoided;
2. spreading into the soil of polluted waste water emanating from dumping sites has to be prevented;
3. the situation in which substances are brought on or into the soil has to be -and remain so in the future- manageable;
4. regular checks on the situation and on the effectivity of the arrangements made, has to take place.

It is indicated in the Guideline that the dumping of waste products has to take place not only at new dumping sites (equipped according to the points of departure), but also at existing ones, the number of which has to be increased.

The sub-study group made an investigation, consisting of two surveys, into the current Dutch situation with regard to the problematic of waste water emanating from dumping sites used for domestic and industrial waste that has to be processed with it.

Most authorities strive for the collection and transport of emanated waste water to sewage water purification plants or a further treatment of it. Direct discharge of waste water into surface water, however, takes place at various sites.

In case of direct discharge into surface water, regulations with regard to the quality and quantity of emanated waste water are mostly attuned to the quality objectives of the surface water involved.

In case of discharge of waste water onto a water sewage purification plant, regulations are mostly attuned to the capacity of the plant involved.

With regard to heavy metals, the demands laid down in discharge permits vary, both in case of direct discharge into surface water and to a sewage water purification plant.
Often, no regulations with regard to organic micro-pollutions are laid down in permits. Should this be the case, then discharge demands are attuned to the treatment method.
Information obtained from the surveys proves to be insufficient to come to a classification of dumping sites on the basis of some characteristics of the quality and quantity of emanated waste water. It also shows that only a few dumping sites in the Netherlands meet the principles of insulating, checking and supervising as mentioned in the Guideline controlled dumping (1985). Mostly, dumping sites underwent a development from almost uncontrolled dumping to applying more modern techniques.
Various purification techniques can be used for the treatment of waste water emanating from dumping sites. Efficiency is largely based on results from practice obtained with experimental installations. Figures about quality and quantity of waste water released at Dutch dumping sites, however, are on hand sporadically. To be able to give some insight into the working and costs of purification systems, a model waste water with regard to quantity and quality for both the acidic and methanogenic phase has been adopted. This model goes for dumping sites equipped according to the Guideline controlled dumping. It should be considered, however, that waste water released from many existing dumping sites is mixed with seepage and/or surface water.
Calculations show that methanogenic waste water can be treated at much lower costs than acidic waste water. Because of this, the release of acidic waste water should therefore be prevented as much as possible. It is expected that through the application of recirculation, methanogenic waste water can be obtained at an earlier stage.
The aerobic treatment of methanogeniccally stabilized waste water is the cheapest treatment technique. This increasingly prevails, should an adjustment of the levy be applied. The effluent quality of an aerobic treatment can be improved by a combination of techniques installed, or -at approx. the same costs- by changing the treatment by means of hyperfiltration.
With regard to the phase, after ending dumping activities (the after-care), it can be said that it is useful to weigh the costs of treatment against the costs of installing an upper-sealing.
Finally, it should be said that no absolute value may be attached to the outcome of calculations. Calculations are only done to compare objectives, considering the fact we started from a model emanated waste water, costs (derived from practical experiments) are indicative and estimates of efficiency and costs of techniques not tested are included.

Two main points of departure of policy within the IMP-W '85-'89 (Indicative Multi-Year Programme for Water) are mentioned: "reduction of pollution" and "the stand-still principle". With the first point of departure, a distinction is made between the "emission approach" (for black-listed substances and large part of the remaining pollutants) and the "water quality approach" (for relatively harmless pollutants). Furthermore, the second point of departure has been drawn up for black-listed substances on the one hand, and the remaining substances on the other hand. Emanated waste water contains both (potentially) black-listed substances (mercury, cadmium, arsenic, benzene, toluene, ethylbenzene and xylene) and remaining pollutants (oxidizing substances and metals).
In principle, considering the presence of black-listed substances, the best techniques available have to be applied. The percentages of those substances in emanated waste water compared to other pollutants is slight. Therefore, purification techniques will be applied to remove the remaining pollutants. With the application of those techniques, black-listed substances are also removed and with a reasonable efficiency. Additional techniques are considered unnecessary beforehand. On the basis of applying the techniques considered, indicative values have been formulated for requirements in case of discharges into surface water and through the municipal sewerage.
It shows that it is also possible to discharge methanogenic waste water through the municipal sewerage.

3.6.2 Conclusions branch study

The assignment of study group VI of the CUWVO to a sub-study group established by the CUWVO implied:
- an inventory of dumping sites where no measures to reduce pollution are being taken;
- research into the quantity and quality of waste products in waste water emanating from dumping sites;
- indicating possibilities to limit the quantities of waste products discharged into waste water emanating from dumping sites;
- giving insight into the costs of treatment methods in relation to the removal efficiency;
- describing the best techniques available and performable for the treatment of waste water from dumping sites;
- making recommendations with regard to the techniques to apply;
- making recommendations with regard to formulating discharge demands.

On the basis of article 6 of the Waste Products Act (AW), the Minister for Housing, Regional Development and the Environment laid down a Guideline controlled dumping. An obligatory application of a watertight layer at the bottom of the dumping site was not mentioned

in the first Guideline controlled dumping (1980); it was only important that dumping took place under dry circumstances. In the second Guideline (1985), the Minister spoke about combatting pollution, as a result of which a waterproof layer is obligatory in almost all cases (an exception might be a seepage situation).
By means of surveys, we tried to get some insight into the practical situation, among other things with regard to the quantity and quality of waste water that is released at dumping sites. With this, it should be considered that dumping sites used to be equipped more or less uncontrolled, but now the Guideline gives regulations about managerial measures to take. Because of the assumption that closed down dumping sites would yield few concrete facts, and in literature most is known of "younger" dumping sites (with mostly domestic waste), we limited ourselves to the dumping sites still open.
The surveys show that there is insufficient information to get insight into the qualitative and quantitative aspects of waste water emanating from dumping sites. Mostly, a development was experienced from almost uncontrolled dumping to more modern techniques. Especially those more modern techniques are only seldom applied, as a result of which collection and transport of emanated waste water takes place only seldom. In most cases, however, waste water is diluted by rain, surface and/or groundwater. This results in quantitative information being dependent on the (geo)hydrological situation on the spot.
To be still able to estimate the quantitative and qualitative aspects of waste water emanating from dumping sites, literature search has been performed. Qualitatively, a distinction can be made between acidic and methanogenic waste water. Both types are characterized by the degree of a number of specific parameters (COD/BOD) present. Somewhat less characteristic, but still of great importance -as they are present on "grey" or "black" lists- are the heavy metals and organic micropollutants. To be able to pronounce upon the efficiency of treatment techniques, two types of waste water (acidic and methanogenic) have been defined. As waste water emanating from dumping sites is only sporadically treated in the Netherlands, we used results of some experimental tests with whether diluted or not waste water.
In this way, a number of systems have been derived regarding efficiency and costs. It should be considered that no absolute value may be attached to the outcome of those calculations; they have only be performed in order to compare, because:

- we started from a model waste water emanating from dumping sites;
- costs derived from practical experiments are only indicative;
- techniques are included, the estimated efficiency and costs of which are not tested;
- the levy per p.e. is supposed to be Dfl.70.

In practice, it will be necessary to make such calculations per dumping site, especially if the site is not equipped according to the Guideline controlled dumping and waste water gets available in a diluted form. Calculations show that the treatment of methanogenic waste water is preferable to the treatment of acidic waste water by far. The application of recirculation is beforehand for acidic waste water. For the discharge of methanogenic waste water into surface water, hyperfiltration is the best technique available; however, treatment costs are relatively high. The techniques best performable for methanogenic waste water are the aerobic/biological system, a direct discharge through the sewerage and hyperfiltration. The possible application of adjusting levies is important in this.
Indicative values for discharge demands have been formulated on the basis of calculations. It should be considered that purification techniques are primarily applied to remove toxidizing substances and heavy metals (substances not on the black-list). As a result of this, black-listed substances are partly removed, too. However, the percentages of those substances in emanated waste water that is treated with regard to the remaining substances is slight. Also considering costs, it is not beforehand considered to prescribe additional purification techniques. As little is known about preventing organic micro-pollutants, research per case is recommended.
The aftercare-phase needs special attention. Not applying a waterproof upper-sealing probably results into waste water having to be purified for a long time. Experimental sites (lit. 26) show that this will be the case for at least 15 years. However, beforehand it is assumed that further treatment of emanated waste water after closing down a dumping site is cheaper than applying and managing a waterproof upper-sealing.
In connection with a probably reduced supervision and decreasing control, a simple treatment system is called for. This means that it is recommended to discharge through the sewerage then.

3.6.3 Recommendations

1. Although treatment methods and discharge possibilities for waste water emanating from dumping sites have been evaluated in a general sense in this report, again, those considerations have to be made for each dumping site separately.
2. Discharging acidic waste water should be prevented as much as possible. Application of recirculation is beforehand.
3. Initially, the treatment of waste water emanating from dumping sites has to be focused on the removal of oxidizing substances and heavy metals. Additional purification techniques can be described, should this be necessary for the remaining emission (black-listed substances).

4. It is recommended to research into organic micropollutants at each (existing) dumping site.
5. As far as the aftercare phase is concerned, a consideration should be made between a waterproof upper-sealing and further water treatment.
6. As far as the aftercare phase is concerned, such a treatment system should be chosen, that one can confine to little supervision and control. It is recommended to discharge through the municipal sewerage.

Guidelines for the discharge of effluents

Acidic waste water
The discharge of acidic waste water emanating from dumping sites should, serve to accelerate methanogenic activity. If it is not possible to avoid the discharge of acidic waste water during the period when dumping sites are being set up, compliance should be sought with the following requirements:

- Acidic waste water must not discharged directly into surface waters.
- Acidic waste water may be discharged into municipal sewerage systems after it has either been recirculated, treated with an evaporator, or an aerobic or anaerobic purification system combined with a flocculation/precipitation unit, such that the following concentrations of pollutants are achieved:

Cd	50 $\mu g/l$
Hg	5 $\mu g/l$
As	50 $\mu g/l$
Σ (Zn+Cr+Ni+Pb+Cu)	3 mg/l
Σ (benzene, toluene, ethylbenzene and xylene)	500 $\mu g/l$

Methanogenic waste water
- Methanogenic waste water may be discharge into surface waters after it has been treated aerobically in combination with hyperfiltration, or by means of evaporation combined with hyperfiltration techniques, such that the following concentrations of pollutants are achieved:

Cd	2,5 $\mu g/l$
Hg	0,5 $\mu g/l$
As	50 $\mu g/l$
Σ (Zn+Cr+Ni+Pb+Cu)	1 mg/l
Σ (benzene, toluene, ethylbenzene and xylene)	100 $\mu g/l$

Less strict requirements have laid down for the discharge of Cd and Hg into relatively large surface waters, i.e. 5 and 2.5 $\mu g/l$ respectively.

- Methanogenic waste water may be discharged into municipal sewerage systems.
- Limits of 10-20 mg/l are generally adopted for BOD and N-Kj in the case of discharges into surface waters. Less strict requirements could be considered for larger surface waters.
- Under certain circumstances, when setting discharge limits for vulnerable surface waters, it may be necessary to resort to the quality standards specified in the IMP ('85-'89) as a guide to the permitted concentrations of heavy metals and monocyclic aromatic hydrocarbons. these basic quality standards have been replaced by general environmental quality values for water and lake/river beds as set out in the quality objectives for the 2000 in the Third Water Management Policy Document (covering the planning period 1990-1994), as outlined below:

	basic quality standards (water)	general environmental quality
Cd	2.5 $\mu g/l$	0.2 $\mu g/l$
Hg	0.5 $\mu g/l$	0.03 $\mu g/l$
As	50 $\mu g/l$	15 $\mu g/l$
Σ (Zn+Cr+Ni+Pb+Cu)	400 $\mu g/l$	100 $\mu g/l$
Σ (benzene+toluene+ ethylbenzene+xylene)	2 $\mu g/l$	

The values in the table above refer to average concentrations over a 24-hour period.

3.7 Surface treatment of metals

Best techniques performable c.q. existing for the removal of heavy metals and cyanide from waste water from processes for surface treatment of metals in a watery environment (December 1987)

3.7.1 Summary, conclusions and recommendations

Objective of the report
In this report, an interpretation is given of the notion best techniques performable for the removal of heavy metals and cyanide, and best techniques existing for cadmium from waste water, resulting from surface treatment of metal in a watery environment. The recommendations generally formulated are especially for electroplating and processes which can be compared from an environmental technical point of view.

Research method
Recommendations are based on practical research, literature search and model calculations. During our visits to companies, we investigated what the costs and results were of measures already taken by the branch involved. Those measures vary from 'good housekeeping' to advanced purification techniques. Process integrated measures are also applied by most companies, such as drag-out baths, spray and cascade rinsing etc. Only little information from practice is available about certain forms of recirculation techniques and partial current purification, such as electrolysis, inverted osmosis and selective ion exchange. Conclusions related to those techniques are mostly based on information from literature. Research performed by TNO (Dutch organization for Applied Scientific Research) proved that the yearly costs of combinations of techniques that are applied, with which final loads can be achieved of totally between 10 to 50 kilos of heavy metals, mostly vary from hardly anything to approx. Dfl.300 per kilo metal removed (price level 1985). Heavy metals in concentrates held back and processed are included in this, as measures are mostly focused on waste water and concentrates together. Real costs can be considerably lower, as a result of the levy advantage.
It turns out that investments are retrieved more difficult, especially as far as equipment installed before 1980 is involved. It can be indicated that those vary from some tens of thousands to some million guilders. Investments for heavy metals to be removed yearly amounted to an average of Dfl.525 per kilo (price level 1985). The very large spreading also results from the fact that building costs weigh heavily in some cases. High investments may be the cause that one will choose a solution which in itself leads to higher yearly costs.

Points of departure in the approach to reduce pollution

With the information from practice and literature mentioned above, model calculations have been done, in which a distinction is made between the size of companies. As a relation had to be made between efficiency and costs, the size of the company is conveyed in the quantity of heavy metals that would be discharged, should no measures be taken to hold back heavy metals. This so-called potential discharge conveys the size of a company well from an environmental point of view, and also determines costs and efficiency.
On the basis of model calculations, it is investigated whether a final load of 50 kg/y or less for all metals together can be achieved, and a final load of 25 kg/y or less for each metal separately with a set of measures for all compound companies against an annual amount of Dfl.150 per kilo metal removed (max. 300); those figures are considered to be reasonable from practical experience. This is considered to be the final load to strive for. This target value is not meant to be a permit regulation, also because it is doubtful whether it can be maintained. The final values to strive for mentioned above do not go for small companies. As far as potential discharges of less than 100-250 kg/y respectively are concerned, we started from a final load of 20 kg/y or less, an efficiency of 80% or more respectively. Moreover, it should also be realized that very large companies have not been added to these model calculations, and that for those companies the final load of 50 kg/y to strive for sometimes turns out to be not feasible.

Techniques to apply

Selected measures based on model calculations are recommended as best techniques performable in the report. It is assumed that all companies have taken those measures which can be considered to be good housekeeping. In most cases, however, it is about a combination of process integrated measures and final purification, which is almost always cheaper than just final purification and which also leads to lower final loads.
Anyway, it is not always necessary for companies to take such a combination of measures. Very small companies, which discharge less than 20 kg/y of heavy metals through the application of good housekeeping, do not have to take further measures, unless cadmium is involved, which should be held back with the best techniques existing. However, most of the time good housekeeping is not sufficient, and additional process integrated measures are necessary for small companies to achieve the load to strive for. For medium-sized companies, with a potential discharge of more than 250 kg/y, usually a combination of process integrated measures and a continuously working ONO-installation (Detoxicating Neutralizing Draining installation) is the most appropriate way, whereas for large companies (potential dis-

charge >1,500 kg/y) a combination of an integrated approach with ion exchangers and groups of ONO-installations as final purification is most appropriate. The combination last mentioned is the technique best performable for very large companies, because of the circumstances described in this report of not being able to meet the final load to strive for mentioned before.
It should be considered that those recommendations are based on the information and model calculations obtained during visits to companies. Individual cases may more or less differ from these. In those cases, an approach to reduce pollution should be pursued, fitting to the techniques recommended as close as possible. It always goes that alternative measures, equal or better as far as costs and results are concerned, should be considered as best technique performable.
We also pay attention to the fact that it is recommended to apply process integrated techniques as much as possible. Especially the new recirculation techniques may gain advantages as far as costs and results are concerned, not only because the final loads to be discharged into waste water are smaller, but also because less sludge is produced.
For cadmium goes that this metal should be held back with the best techniques existing. It appeared that the ministerial order can be met, in which a monthly average of 0.3 g Cd per kg cadmium processed is permitted, by means of a process integrated approach with drag-out baths and electrolysis and/or partial current treatment with, for instance, ion exchange.

Recommended discharge regulations
Recommendations for all combinations of techniques have been made with regard to the limiting value to be dictated in discharge permits. It is emphasized that the point of departure mentioned before with regard to the final loads to strive for cannot be considered as recommended load demands in permit regulations. They should be deduced from the quantities of waste water to be discharged (mostly in a 24 hours' period), and the percentages of heavy metals and cyanide still present in waste water after application of the techniques recommended. It is indicated in the report what concentrations are to be expected, dependent on the way in which waste water is treated. It may be needless to say that it is not permitted to discharge sludge and (semi)concentrates.

Comparison to the recommendations in the metal report 1981
Slight distinctions have been made in uniform discharge demands, such as mentioned in the metal report 1981. This particularly goes for the guidelines by the Union of District Water Boards, which were mainly based on the expectations of what was to be achieved with the ONO-installations. It is indicated more clearly that with the potential

discharge the metal load is meant, which was to be discharged should no metals be held back, from concentrates neither. Therefore, costs are related to all metals held back.
The recommendation is added that one should start from a final load to strive for when an approach to reduce pollution is chosen. It is maintained in the recommendation laid down in the metal report that permit regulations should not be tightened within a period of 8 years (the economic life span) after a company had to take certain measures to reduce pollution, if as a result of this technical means not yet written down should be replaced. Should there be no urgent reason to accentuate from a environmental point of view, the technical life span can be sustained.

3.7.2 Conclusions and recommendations

Recapitulating briefly, the following conclusions were drawn:

1. Assuming a situation where no measures are being taken to reduce pollution, it is mostly possible to hold back heavy metals and cyanide from waste water to be discharged, or to remove them to an acceptable limiting value against annual costs up to Dfl.300 per kilo metal removed.
   Those costs are calculated by dividing the potential load, reduced with the remaining load strived for, by the total annual costs of the measures taken.
   In this context is meant under potential load, the quantity of metals that would be discharged, if no measures other than good housekeeping were to be taken to limit discharges, provided that concentrates and semiconcentrates from preliminary and follow-up treatment baths are included in the potential load.
2. The techniques best performable depend on the size of the potential load, and may vary from good housekeeping to a combination of (sometimes advanced) reclaiming and purification techniques.
3. Investments can be considerable, and they are sometimes a barrier, when a technique to be applied has to be chosen. This may lead to the fact that a technique is chosen which leads to higher annual costs, but requires less investments.
4. The remaining load to strive for is not meant as a permit regulation, but as a point of departure for chosing an approach to reduce pollution.

The conclusions mentioned above led to the following recommendations:

1. Each company, irrespective of its potential discharge, should take measures which are to be considered as good housekeeping, that is:

- limitation on transfer
- at least one drag-out bath behind heated process baths with a direct back-flow
- not to discharge concentrates and semiconcentrates.

2. Should the remaining load with waste water be less than 20 kg/y by means of good housekeeping, then further measures are not necessary, unless cadmium is involved.
3. In case of potential loads up to 250 kg/y, the efficiency of the measures should be at least 80%, related to the potential load. It is permitted that this percentage is lower, provided the final load is not higher than 20 kg/y.
   Besides good housekeeping, those measures may include extra process integrated measures, neutralization of the rinse water and an ONO-installation working in groups or transport of concentrates to a third party.
4. In case of potential loads over 250 kg/y, the remaining load to strive for should be 50 kg/y or less.
   Companies with potential loads up to approx. 2,000 kg/y can generally achieve this through a combination of process integrated measures and an ONO-installation operating continuously.
   In case of higher potential loads, a combination of process integrated measures, recirculation of rinse water through ion exchangers and an ONO-installation operating in groups for concentrates and regenerates is generally a good solution.
5. The remaining load of 50 kg/y to strive for does not go for all heavy metals together. For each metal separately, 25 kg/y or less can be sustained, with the exception of cadmium.
6. Cadmium should be held back with the best techniques existing. With it, the Ministerial order is to be met, in which the acceptable remaining load of cadmium is determined to a maximum of 0.3 g per kilo cadmium processed.
   To do so, a combination of process integrated measures, and partical current treatment of rinse water (with recirculation) through selective ion exchangers can be applied.
7. The techniques to be applied by a company should be included in the considerations for the permit. Discharge demands should be included in permit regulations themselves, depending on the techniques to apply.
8. For ONO-installations goes that with them, final concentrations can be achieved which depend on the system of flake removal. These values are given in table 5.1.

Table 5.1 Concentrations of heavy metals in effluent of an ONO-installation (maxima in proportional 24 hr-samples)

	concentrations (mg/l)		
	sedimentation in batch-ONO after filterpress	sandfiltration dual-media-filter/ candle filter	ultra-filtration
Cu	2	1	0.5
Cr(total)	2	1	0.5
Zn	3	1.5	0.75
Pb	3	1.5	0.75
Ni	3	1.5	0.75
Ag	1	0.5	0.25
CN (chlorine composable)	1	1	1

9. A final concentration of 0.5 mg/l can be sustained for all separate heavy metals and cyanide in rinse water treated with ion exchangers. In case of selective ion exchangers for cadmium, a final concentration of 0.1 mg/l is feasible.
10. The concentrations mentioned above go for proportional samples within 24 hours or -should they not be available- as a advancing average of 10 successive random samples.
    As a maximum concentration in any random sample can be sustained a value three times as high as the average 24 hours concentration.
11. Apart from concentration demands, load demands should be added as a maximum 24-hour-value (product of the flow necessary at the most, and the concentration).
12. Other waste products than heavy metals and cyanide have not been included in the report. To them, the recommendations from the metal report 1981 still apply:
    not discharging oil-water emulsions and degreasing baths
    maximum concentration of mineral oil 200 mg/l (in case of discharge into the sewerage) and 30 mg/l (in case of discharge into the surface water)
    maximum concentration of chlorinated hydrocarbons (solvents): 1 mg/l.

3.8 Wood stripping companies

Recommendations with regard to discharges of non-oxidizing substances with waste water from wood stripping companies (January 1988)

3.8.1 Summary

Non-oxidizing and toxic substances are, directly or indirectly, transported to surface water with waste water from wood stripping companies. Caustic soda or methyl chloride is used for the stripping of wood, that is the removal of old layers of paint. As far as lye companies are concerned, it is about the emission of heavy metals, particularly zinc and lead. Apart from heavy metals, methyl chloride companies discharge methyl chloride, too.
The emission of those polluting substances should be considered unacceptable. Especially locally, problems may arise, particularly regarding the quality of sewage sludge.
The limitation on the emission of heavy metals may come about through the application of flocculation/sedimentation, as far as effectivity and costs are concerned. In principle, there are two ways available to realize this.
The limitation on the emission of methyl chloride can be accomplished best by aerating or air-stripping waste water. The treatment of air polluted with methyl chloride can take place with active carbon. Regarding this, we should point to the fact that the air emission of methyl chloride to the air during the wood stripping process is much more extensive compared to water emission. The application of the purification techniques mentioned above will lead to acceptable effluent concentrations. Costs will amount to some hundreds of guilders per kilo metal removed.
Recommendations are made regarding measures to take with wood stripping companies, and regarding discharge regulations for permits to be granted.

3.8.2 Conclusions branch study

1. Polluted waste water arises with the removal of old layers of paint from wooden objects. The nature of the pollution depends on the stripping process.
   In case of treating wood with lye, waste water with strong concentrations -some hundreds of mg/l- of heavy metals, particularly zinc and lead.
   Should wood stripping take place with methyl chloride, then the waste water to discharge contains, apart from zinc and lead, methyl chloride in concentrations of some hundreds of mg/l, too.

2. The emission of those pollutions by wood stripping companies is considered to be unacceptable. Problems will arise, especially locally. Most discharges take place into the sewerage, which mostly results into an unwanted load on the sewage sludge, the deposit of which may be in danger as a result of it.
3. Only a few water authorities pay attention to the branch of wood stripping companies, so that a clear picture about the number of companies and the size of discharges is lacking.
   It is assumed that there are approx. 100 lye companies in the Netherlands, approx. 90 of which small companies and approx. 10 larger ones. The small companies with a waste water flow of 150 cubic metres per year, discharge approx. 40 kilos of heavy metals yearly. The large companies with a waste water flow of 400 cubic metres per year, discharge approx. 100 kilos of heavy metals yearly. In addition, there are approx. 30 methyl chloride companies with a waste water discharge of approx. 200 cubic metres per year, and an emission of heavy metals and methyl chloride of approx. 50 kilos per year.
4. Research has shown that a reduction in the emission of heavy metals is possible by applying flocculation. With an automated compact installation, the content of heavy metals in the effluent can be reduced to some milligrams per litre. With a simple hand-driven installation, provided it is operated with due care, effluent concentrations of max. 9 mg/l (in random samples) can be achieved for lead. Comparable results can be achieved with diaphragm filtration. Costs of applying diaphragm filtration are considerably higher than the costs of flocculation.
5. A reduction in the emission of methyl chloride is possible by aerating or air-stripping waste water. With it, an effluent concentration of 1 mg/l methyl chloride (in random samples) can be achieved.
6. The most important emission of methyl chloride by wood stripping companies takes place to the air, particularly during the wood stripping process, but also during the aerating c.q. air-stripping waste water. Methyl chloride can be removed from polluted air with active carbon adsorption.
7. The costs of the additional purification measures can be calculated globally. The costs of removing heavy metals with flocculation amount to approx. Dfl.250/Dfl.375 per kilo heavy metal removed. Total costs to reduce pollution by removing methyl chloride and heavy metals at methyl chloride companies amount to approx. Dfl.250 per kilo pollution removed.

3.8.3 Recommendations

1. Wood stripping companies are obliged to take a number of internal measures to accomplish a first purification of waste water.

It is not permitted to discharge spent bath fluids, but they are to be collected and transported to processing plants with permits within the framework of the Chemical Waste Act.

2. Small lye companies, which discharge approx. 40 kilos of heavy metals per year, should at least place a simple hand-driven flocculation installation for the removal of heavy metals. Such an installation should be provided with continuously pH-monitoring. The installation should be operated with due care as far as the quantity of chemicals and pH-adjustment are concerned. Expertise and involvement of the operator are necessary conditions for this. Attention should be paid to security aspects whenever quantities of chemicals are transported and measured. The effluent of the purification installation (random samples) should meet the guideline by the Union of District Water Boards three times.
3. Large lye companies, which discharge approx. 100 kilos of heavy metals per year, should place an automated compact flocculation installation. The effluent of the purification installation should meet the guidelines by the Union of District Water Boards.
4. Methyl chloride companies should take additional measures, both regarding the reduction of the emission of heavy metals and methyl chloride. The effluent of the purification installation should meet the guideline by the Union of District Water Boards three times (as far as the percentage of heavy metals is concerned). For methyl chloride a proportion of 1 mg/l should be sustained in random samples.
5. For the application of discharge permits within the framework of the Surface Water Pollution Act, a standard questionnaire should be used, corresponding to enclosure V in this report.
6. For the permit requirements within the framework of the Surface Water Pollution Act, the model permit regulations should be used, corresponding to enclosure VI in this report.

3.9 Textile finishing industry

Recommendations regarding measures to reduce pollution caused by waste water discharges from the textile finishing industry (December 1988)

3.9.1 Summary

A number of steps is distinguished during the preparation of textile products. On the one hand, there is the production of threads, fuses and cloth. On the other hand, there are the non-mechanic processes of fibres and (intermediate) products; which can be distinguished in ,among other things, bleaching, dyeing, printing, dressing and impregnating with the purpose to bring about certain qualities: the finishing of textile.
Companies carrying out the activities mentioned above, including the stage of the ready cloth, belong to the textile finishing companies.
The discharge of polluted waste water from the textile industry takes almost exclusively place at textile finishing companies. With the finishing of carpets, waste water is discharged during the application of backing layers, too.
Therefore, attention is exclusively paid in this report to the finishing and application of "backing layers" in the carpet industry.
There are approx. 200 major textile finishing companies in the Netherlands, which discharge 50-100 m^3/y. In addition, there are many smaller companies. Almost all companies discharge their waste water through the sewerage onto a communal purification plant (rwzi).
Textile finishing companies are characterized by using many different chemicals, and doing many different processes (batch and continuous).
Within those processes, the following distinctions can be made:
- preliminary treatment;
- dyeing and printing;
- follow-up treatment;
- applying backing layers.

Preliminary treatment
The preliminary treatment is mainly about the removal of starch-like substances, cleansing, improving the possibilities to dye by means of a lye treatment (mercerize) and bleaching.
The cleansing step results into a vast quantity of waste water which mainly contains material that is biologically decomposable.
The discharge of mercerized waste water is responsible for a high pH of waste water.
A lot of chloride is still being used during bleaching. It can be replaced by hydrogen peroxide in all discontinuous processes, in which no polyacrylicnitril is bleached, as a result of which no chlorinated

compounds can be formed. After pH-correction (if necessary), waste water from the preliminary treatment can be discharged onto the sewerage connected to a rwzi.

Dyeing and printing

Dyestuffs are applied with dyeing and printing. This can take place in batch or continuous processes. The spent dye bath, in case of a batch process, and the remaining dye bath, in case of a continuous process, are presently discharged. Remnants of printing paste are occasionally re-used to print darker colours, but apart from that mainly drained off with waste water.

Rinse water from the equipment, and washing water of the material dyed are discharged as well.

The emission of colorants formed in this way is estimated on more than 200 tons per year. The colorant groups that can be distinguished are removed in a rwzi on different manners; the over-all efficiency is approx. 50%.

A drastic limitation on the discharge of those substances is necessary, considering the persistence of colorants and the toxicity which differs from substance to substance, in which decomposition products can be harmful to the environment as well. The quantities to be discharged can be limited by means of adjustments in the processes, such as another ratio between the quantity of the remaining bath and the quantity of the cloth that has to be dyed (water ratio).

To improve the possibility of dyeing polyester, or mixtures of it, so-called carriers are being used.

Carriers are mostly small (halogenated) aromatic compounds, the discharge of which has to be reduced. This can be realizd by applying the HT-dye process (High Temperature). This process cannot be applied to mixtures of wool and polyester. Here, carriers least harmful to the environment -the non-halogenated- can be used. Other process measures would have to be developed.

Transporting and processing by a third party of remnants of dye baths appears to be very costly.

Therefore, only purification of waste water containing colorants can result into a limitation on emission at the moment. There is no practical experience in the Netherlands with the purification of waste water containing colorants from the textile industry. Based on literature and qualities of the substance, coagulation/flocculation and adsorption techniques seem to offer good opportunities.

Clarity about the removal results of each type of colorant with each purification technique that can be distinguished has to be obtained by means of model research and practical research in particular, before purification plants are built.

Remnants of colour paste that cannot be re-used, can be transported as chemical waste.

Follow-up treatment
During the follow-up treatment, or dressing, substances are applied on the textile as a result of which certain qualities are given to it, such as: anti-crease, shrink-proof, anti-rot, anti-moth agents, fungicides and fire retardants. Generally, remnants of baths are discharged, as well as rinse water from the equipment. The quantity of dressing means transported with it is estimated on approx. 4 tons per year. Especially anti-rot, anti-moth agents and fungicides and a large number of fire retardants are very harmful, and emissions have to be combatted with the best techniques existing. It is preferred to transport remaining baths.
In the wool and carpet industry, anti-moth is often added to the colour bath, and, as a result of it, discharged simultaneously with waste water containing colorants. A purification technique has to be developed for this as well.

The application of backing layers
Applying backing layers under carpets is principly a dry process. Companies that apply latex layers, however, discharge rinse water from equipment. This waste water is polluted with latex flakes, mostly containing zinc. Very harmful dithiocarbametes are applied as well. This should be prevented by replacing this substance or extreme purification. This deserves further attention as well. Waste water can be purified by means of coagulation/flocculation. With it, grades of 2 mg of zinc per litre, and 20 mg of floating substance per litre are feasible.
Re-use of part of the purified waste water is principly possible.

In general
Considering the large number of additives that are applied by the textile finishing companies, it cannot be ruled out that one or more harmful additives are applied in processes where mainly harmless additives are used. Checking the list of additives and substances used on their harmful qualities to the environment may give some clarity. For this, the branch organization 'Fenetextiel' will start a file of substances and their environmental qualities. Based on criteria not yet determined, it shall be examined what substances can be replaced. It is expected that those criteria will be reported separately by DBW/RIZA (Institute for Inland Water Management and Waste Water Treatment) before 1 January 1989.
To begin with, the limitation of emissions would have to be obtained by applying other, less polluting, processes.
The application of process integrated measures and 'clean technology' hardly takes place at the moment, and would have to be stimulated. As a result of the lack in process integrated measures, purification techniques for the reduction of pollution of colorants in particular

have to be investigated further. Based on this investigation, it will have to be determined what (combination of) purification techniques will have to be applied, and what the costs are. Results of the research will be reported separately, and will be the basis for a completion, or a revision, of the present report. The research that is to be implemented centrally will take approx. one year and a half, after which another year and a half will be needed before the actual building of installations can begin.
The estimate of costs based on model calculations are considered to be not feasible and disastrous by the branch out of considerations pertaining to business economics and competition.
Possibilities to obtain a compensation for costs to be made will be examined by the branch in consultation with the government.
Regarding the international competitive position, attuning emission demands will take place as good as possible within the framework of the Rhine Action Plan (RAP). The first steps to do so have already been taken.
Considering the previous, this report gives no picture with regard to the future situation at textile finishing companies, after measures to reduce pollution have been taken.
Therefore, it is recommended in this report:
1. to demand measures directly possible (good housekeeping);
2. to demand further measures regarding a number of substances (carriers, fungicides, fire retardants, anti-moth and anti-rot agents), a demand regarding the reduction of pollution;
3. to include the obligation, should (temporary) permits be granted, regarding a research into the possibilities to reduce pollution by colorants in particular. The deadline set for this has to be attuned, among other things, to the research which has to be carried out centrally. A deadline of 3 years is considered reasonable;
4. to judge the additives used on their harmfulness to the environment, and to replace, if possible, the mostly harmful ones.

The total approach to reduce emissions from textile finishing companies can schematically be represented as follows:

1. approach substances	from end 1988
2. centrally examining purification techniques	from end 1988 until mid 1990
3. investigating financing	from mid 1988 until end 1990
4. international tuning	from mid 1988
5. laying down discharge situation, and including reduction demand in case of temporary permit	from end 1988 until end 1989
6. plan to reduce pollution by companies	from end 1988 until end 1991

7. new permit: final situation — from end 1991 until end 1992
8. clean technology. — from end 1988

3.9.2 Conclusions branch study

Introduction

1. The textile industry consists of approx. 1,500 companies. With regard to the discharges of waste water, only the textile finishing companies, approx. 350, and carpet companies, approx. 30, matter.
2. Almost all textile finishing companies and carpet companies discharge their waste water through a communal water purification installation.
3. Waste water in the textile finishing industry comes from three main treatments, that is:
   - preliminary treatment;
   - dyeing and printing;
   - follow-up treatment.
4. The application of backing layers under carpets is a specific waste water process in the carpet industry.

Preliminary treatment

5. Waste water from the preliminary treatment mainly contains pollutants which can be easily removed in an aerobic biological purification.
6. According to a limited exploratory research into the substances examined, the pollution of waste water with biocides, applied in imported textile, from the preliminary treatment amounts to some kilos per year for the entire branch, and is left aside considering its slight load.
7. By using hyperchlorite during the bleaching process, chlorinated hydrocarbons may be built in waste water. It is possible, in principle, to replace them with hydrogen peroxide. The use of hyperchlorite cannot be prevented entirely, because no high whiteness (in excess of 76% Berger) can be achieved with continuously bleaching, and because polyacrylonitril can only be bleached with hyperchlorite.

Dyeing and printing

8. Waste water released during the dye and printing process contains large quantities of colorants, and carriers in some cases (aromatic dye additives).
9. Now, remnants of colour baths are discharged. Remnants of printing pastes are mostly washed down, too. Washing water of textile products and rinse water from the equipment are also discharged.

10. The total emission of colorants from the Dutch textile finishing industry yearly amounts to 200 tons at least. Calculations with model companies and some practical information give the impression that this quantity is considerably larger.
11. The groups of colorants that can be distinguished are removed in an aerobic biological purification installation (rwzi) in various ways. The overall percentage regarding colorants amounts to 50 - 60%.
12. Based on their persistence, many colorants are harmful to the environment. Toxicity differs from substance to substance. Apart from the colorants themselves, decomposition products can be harmful to the environment as well.
13. Replacing colorants with substances less harmful to the environment is impossible in most cases, in connection with their specific colour qualities.
14. Considering the nature of the substances, combatting at the source with the "best techniques performable" is necessary for colorants. Further filling-in has to take place yet. Regarding the vast number of colorants and their generally harmfulness to the environment, an approach as a group according to "emission approach", is the most obvious.
15. By choosing production equipment (water ratio), or adopting the equipment (impeller), the volume of remaining baths can mostly be limited.
16. There is no practical experience with the purification of waste water from the textile industry containing colorants in the Netherlands. Based on literature and substance qualities, coagulation/flocculation and adsorption techniques in one or multistage purification techniques seem to offer good opportunities. Before those techniques can be applied, additional research has to be carried out.
17. Carriers are mostly small (halogenated) aromatic compounds, the discharge of which has to be reduced. This can be realized by applying the HT-dye process. For mixtures of wool/polyester, this process cannot be applied. However, it is possible to chose carriers least harmful to the environment (non-halogenated).
18. Potassium bichromate can be replaced with other oxidants during the dyeing of cotton.
19. Sulphates and chlorides may occur in waste water in strong concentrations.
20. Antimony may be released when HT-polyester (mixture) is dyed.

Follow-up treatment

21. During the follow-up treatment of textile, substances are applied which vary from harmless to very harmful as far as their environmental qualities are concerned.

22. Belonging to the group of very harmful additives are almost all anti-rot and anti-moth agents and fungicides, and a large number of fire retardants. We can name pentachlorinephenyllaurate and permethrin.
23. Residue baths and rinse water of equipment are mostly discharged at the moment.
24. In the wool and carpet industry, anti-moth agents are often added to the colour bath, and, as a result of it, simultaneously discharged with waste water containing colorants. For this as well, the purification efficiency -in case of treating waste water containing colorants- has to be determined, and, if necessary, improved.

Applying backing layers

25. Applying backing layers under carpets principly is a dry process. However, companies applying backing layers discharge rinse water of equipment. This waste water is polluted with latex flakes mostly containing zinc. As a catalyst, dithiocarbamates harmful to the environment can be discharged.
26. Waste water can be purified by means of coagulation/flocculation. With it, grades of 2 mg/l zinc and 20 mg/l floating substances are feasible.
27. It is possible -in principle- to re-use part of the purified water.

In general

28. Generally, it can be stated that the application of "clean technology" is preferable to other measures to reduce pollution. Concrete plans for this are not yet available.
29. Heavy metals discharged by the textile industry are zinc, nickel, chromium and copper in particular. The loads discharged may run from some dozens to some hundreds of kilos per metal per year. Sources are colorants containing metal (copper and chromium) and a catalyst in the follow-up treatment (zinc).
30. Salts and/or tensides are added to many process baths in textile finishing. Therefore, those substances may be present in waste water in large quantities.
31. Considering the large number of additives applied by the textile finishing companies, it cannot be ruled out that one or more harmful substances are applied in processes during which mainly harmless additives are used. Checking the list of additives used on their harmful qualities to the environment may give some clarity.

Costs

32. Costs for the purification of waste water containing colorants measured as yearly costs per kilo substance removed amount to

approx. Dfl. 20-50. However, high costs will arise due to the large quantities of substances that are to be removed. A downward adjustment may be possible after obtaining some practical experience. Nevertheless, it should not be ruled out that costs will still be a considerable part of the added value in this branch, with which feasibility remains uncertain.

33. To protect the international competitive position of this branch, which is mainly focused on Europe, it is important that an international tuning regarding measures to reduce pollution will take place.
34. The costs for treating waste water released during the application of backing layers amount from approx. Dfl.40/m^3 to Dfl.100/m^3 in case of treating concentrated waste water, or from Dfl.80 to Dfl.250 per kg zinc. It is reasonable that those costs are demanded.

3.9.3 Recommendations

Substance approach

1) It is recommended that anyone who applies for a permit will have to provide information about the additives he uses, excluding colorants. This information is about:
   - chemical composition;
   - decomposability;
   - toxicity to aquatic organisms;
   - bioaccumulation;
   - potential carcinogenity.
2) Based on this information, the acceptability of discharging additives can be checked by the water authority.
3) Should it be so that whiteness in excess of 76% Berger has to be achieved in case of continuously bleaching, or polyacrylnitril is treated, then bleaching with hyperchlorite can be permitted. In other cases, it is possible to bleach with hydrogen peroxide.
4) Should heavy metals be added to waste water through processes, then it should be considered whether this emission can be limited or prevented by using other additives.

Process integrated and purification technical facilities

5) Before purification technical facilities are installed, it is recommended to determine to what extent the application of process integrated measures (c.q. clean technology), possibly combined with purification technical measures, offers a better or cheaper alternative.
6) The use of carriers, when dyeing polyester and mixtures of polyester with other fibres, should be reduced. This is principly possible in case of replacing or increasing equipment by applying

HT-dye process. This is impossible in case of dyeing wool/polyester mixtures. With it, the least harmful carriers (non-halogenated) will have to be selected, based on substance information.

7) Whenever the application of the HT-dye process causes antimony in waste water, it should be determined to what extent reduction of the antimony load occurs resulting from the measures to reduce pollution which have to be taken for waste water containing colorants. Should it turn out to be insufficient, then one can choose the application of a non-halogenated carrier.

8) The discharge of waste water, containing the following substances, should be combatted with the best techniques existing:
   - anti-rot, anti-moth agents and fungicides;
   - fire retardants.

   Exceptions can be made for separate substances, after approval by the water authority, based on information about the substances.

9) It is unwelcome to prescribe concrete reduction measures regarding the discharge of colorants at the moment. It is recommended to demand a reduction plan in the permit, aimed at reducing the emission of colorants harmful to the environment as much as possible. We are thinking of a reduction by 90% or more.

10) Latex containing rinse water, coming from cleaning equipment used for applying backing layers under carpets, should undergo an efficient purification before it is permitted to be discharged. The purification should be aimed at removing zinc and undissolved components, and should minimally achieve comparable results as flocculation/sedimentation/filtration, being: zinc < 3 mg/l and undissolved components < 20 mg/l. Depending on the flow, it is reasonable to demand a zinc load of less than 10 kg/y.

11) The discharge of dithiocarbamates should be combatted with the best techniques existing.

In general

12) It can be desired that measures are taken which are considered to be "good housekeeping". Most of the following measures can be applied in companies without many problems:
    - holding back printing pastes from stencil plates, before they are purified;
    - (partially) re-using remnants of printing pastes for darker colours;
    - transporting remnants of printing pastes as chemical waste;
    - preparing colour baths in minimally necessary quantities;
    - re-using not perishable remnants of dressing.

13) It is recommended to grant a temporary permit, in connection with the uncertainty about the efficiency of reduction measures with regard to waste water containing colorants in particular. Whenever a date of maturity is determined for this permit, the time needed for the availability of further research, formulating a reduction plan and the WABM procedures which have to be passed through will have to be taken into account. It is expected that a three-year-period as from 1 January 1989 will be sufficient.
14) Partial current will have to be taken into account in case of equipping new companies, or adopting existing companies, anticipating the results of the research to be done.

3.10 Mushroom farms

Recommendations regarding measures to reduce pollution caused by waste water discharges from mushroom farms (August 1985/February 1989)

3.10.1 Conclusions branch study and recommendations

1. Herbicides and disinfectants belonging to potentially black-listed substances are used at mushroom farms. Among the most important agents are sodium pentachlorophenolate (NaPCF), used as a disinfectant for wood in culture beds, and endosulphan, a pesticide.
2. Part of those substances is transported with waste water; according to global measuring, approx. 1.5% or approx. 25-30% respectively of the quantities used is transported with waste water, depending on the use of endosulphan and NaPCF. Measured in annual loads, it comes down to approx. 50 kg of endosulphan and 2,000-2,500 kg NaPCF.
3. The possibility of taking measures to reduce pollution has to be found in the use of racks and culture beds made out of metal instead of wood, as a result of which the use of NaPCF will decline.
   Continuing or increasing subsidy schemes could stimulate those reduction measures. A possibility is allowing an environmental surcharge on the WIR premium (WIR is Dutch legislation encouraging industrial investment). Would it be so, that such a surcharge is to be allowed for a limited number of years, then the switch will be established faster.
4. Newer regulations on quantities have led to the use of NaPCF falling by a factor of 8; the quantity is 0.5 kg NaPCF per 100 m^2 culture surface.
5. As NaPCF belongs to potentially black-listed substances, agreement will have to be reached with mushroom farms within whatever deadline the rebuilding from wooden to metal racks has to take place. The aspects that are important for determining the deadline are, among other things, financial consequences (see 13) and the quality of surface water. The need for reduction measures will be urgent in areas where those farms are strongly concentrated. Also considering the fact that the agricultural advisory service has been pointing to problems connected with the use of disinfectants for some time now, a period not longer than five year is considered to be well-founded. Rebuilding has to be realized before 1 January 1990 at the latest. A shorter period is also possible in certain situations with a serious degree of pollution.

At the moment, approx. 35% of the wooden racks have been rebuilt to metal ones.
Parallel to the reduction of this substance, from the point of view of water quality management, there is the admittance policy for NaPCF within the framework of the Pesticides Act. The deadline of not more than five years can also be laid down within the framework of the admittance policy of the Act on Herbicides and Pesticides. At the moment, the final date for the use of NaPCF is 31 December 1989.

6. Using developed compost -produced in tunnels- limits the use of endosulphan and NaPCF. The use of endosulphan -after inoculating compost- will not be necessary anymore. Then, NaPCF has to be used only once every two cultures.
   At the moment, approx. 50% of the total mushroom production in the Netherlands comes from developed compost. A further rise is up.
7. At the moment, there is no alternative to the herbicide endosulphan. It is recommended to continue researching into, possible other, less harmful agents. In this respect, atomizing is preferable to spraying.
8. At the moment, no effective control on the use of herbicides and disinfectants is possible. Within the framework of the Merchandise Act, mushrooms are checked on possible residual concentrations of herbicides and disinfectants. On the one hand, the Pesticides Act has a so-called precision standard, aimed at guarding the use of those agents as best as possible.
9. After 1 January 1990, waste water containing NaPCF is not permitted anymore. Discharge of NaPCF has to be limited as much as possible until that date. The latter also goes for endosulphans. Because research indicated that both NaPCF and endosulphan attach to sludge substances, discharge through a settling institution functioning well is a first requirement.
   Within the frame work of the Pesticides Act, a settling institution can be prescribed. In addition, a deadline is desired -in case of granting a discharge permit- on the quantities of deposit and floating substance in waste water to be discharged.
10. Wherever possible, the effluent from the settling institution should be discharged onto a central sewerage. As the existing farms are often situated outside built-up areas, a separate connection to the sewerage can be a costly affair. Perhaps the sewerage systems that are installed in rural areas open up more perspectives in this respect.
11. Sludge from settling institutions may contain endosulphan -and also NaPCF for the time being- in such concentrations that it falls under the standards of the substances and processes provision under the Chemical Waste Act. Incidental measuring points

into this direction. Further research into the concentrations of this substance in sludge will be carried out to get a definite answer to this question.

12. To prevent the use of sludge from settling institutions in agriculture, we are considering the transport of sludge to dumping sites together with the so-called mushroom-'feet'.
13. A financial inventory of the proposed reduction measures indicates that costs are not extremely high. Rebuilding from wooden to metal beds is cost-effective as far as operating costs are involved; the writing-off period of existing facilities should be reckoned with, an advanced writing-off will lead to extra costs. The costs for building a settling pit and a connection to the sewerage are calculable.

3.10.2 Additional recommendations

These recommendations are a combination of recommendations from the CUWVO report of 1985 and this additional note.

1. The use of sodium pentachlorophenolate is not permitted anymore as from 1 January 1990. In order to be able to effectuate this ban, all wooden racks and culture beds have to be replaced with metal ones before that date.
2. Within the framework of activities of combatting at the source, it can be reported that the use of endosulphans in the mushroom culture is banned as from 1 January 1988.
   At the moment, no effective control on the use of herbicides and disinfectants by water quality authorities is possible. Within the framework of the Merchandise Act, checking takes place on possible residual concentrations of herbicides and disinfectants in mushrooms. On the other hand, the Pesticides Act has a so-called precision standard aimed at guarding the use of those agents as good as possible.
   It is recommended to demand access to the use of the kinds and quantities of herbicides, should a Surface Water Pollution Act permit be granted.
   At the moment, two alternatives for endosulphan have been handed over for approval within the framework of the Pesticides Act. Those agents do not belong to potentially black-listed substances.
3. According to the statements in the CUWVO report, a settling pit has to be compulsory in case of transport of waste water from a mushroom farm. A settling pit can also be prescribed within the framework of the Pesticides Act.
   All waste water streams from the company have to be connected to the settling pit. Non-polluted cooling-water and rain-water must not

be transported through the settling facility, to prevent the settling pit from overloading.
From the viewpoint of good management of the pit, a good method for control has to be developed by the water quality authority. It is also desired to set a limit -in the discharge permit to be granted- to the quantities of settling and floating substances in waste water to be discharged. A standard of a maximum settling substance could be considered. The degrees vary from 0.5 to 3 or 4 ml/l water with settling pits functioning well.

4. Connection to the sewerage is absolutely essential, considering the information from the DBW/RIZA (Institute for Inland Water Management and Waste Water Treatment) report mentioned before, and in accordance with the CUWVO note.
   Direct connection to the sewerage has to take place, should new farms be built or old ones expanded (6 or more cells).
   Connection should take place after consultation within 1 to 3 years, should smaller farms be expanded (less than 6 cells).
   Existing farms should, if possible, be connected to the sewerage. This stand results into the fact that no expansion of direct discharges into surface water shall be permitted.
   Should connection to the sewerage not be possible directly, then an alternative solution has to be found. Considering the nature of the waste water (the presence of black-listed substances), measures to limit emissions have to be enforced as indicated in the IMP Water '85-'89 (Indicative Multi-Year Programme for Water), in which the phrases best techniques performable and existing are primarily used.
5. Considering the high costs of essential adjustments, a certain degree of phasing in the further approach of reduction measures is promoted with existing farms. This relates to adjusting the cooling system, and the separation of waste water streams. Those measures directly apply to new farms and those that intend to expand.
6. Deadlines before reduction measures have to be carried out should be made concrete in more detail in a Surface Water Pollution Act permit to be granted. Considering the results of further research into the composition of sludge, it is not advisable to use it on farmlands. The sludge should at least be processed at a regional dumping site (IBC dumping site).
7. Further research into alternatives (for instance the settling pit) is advisable or essential should potentially black-listed substances or other harmful substances to the quality of the water still be used in the future, after the ban on the use of endosulphan (1 January 1988) and sodiumpentachlorophenolate (1 January 1990).

3.11 Soil clean-up operations

Recommendations regarding the discharge of non-oxidizing substances with groundwater coming from soil clean-up operations (April 1989)

3.11.1 Summary report

A study group of the Coordination Committee Implementation Surface Water Pollution Act (CUWVO) has established a sub-study group "Treatment of groundwater from the clean-up of polluted sites". This sub-study group consists of representatives from the Ministry for Housing, Regional Development and the Environment, District Water Boards, provinces, the Dutch Association of Process Based Soil Treatment Companies (NVPG) and the Institute for Inland Water Management and Waste Water Treatment (DBW/RIZA).
The terms of reference of the sub-study group, as established by study group VI of the CUWVO, were to examine technical and legal aspects of groundwater from the clean-up of polluted soil.
Research into technical aspects consisted of:
1. An inventory of groundwater treatment projects per type of pollution source.
2. A selection of a number of those projects per type of pollution source based on this inventory. The projects selected were studied upon:
   - the quality and quantity of groundwater that is extracted;
   - treatment system(s) used;
   - requirements in discharge permits;
   - treatment costs.
3. A recommendation for the possible treatment techniques, requirements in discharge permits and treatment costs related to removal efficiency.

Research into legal aspects consisted of:
1. An inventory of existing policies on legal aspects of groundwater discharges from the clean-up of polluted sites.
2. Recommendations based on this inventory concerning:
   - different categories of discharges, and permit application procedures connected with it;
   - general discharge requirements;
   - an adaptation of the permit application form;
   - a general draft of the permit.

To carry out this task, the sub-study group focused its attention on groundwater from: excavation, removal, treatment and isolation of polluted groundwater. The various pollutants found in soil and groundwater at polluted sites are generally connected with former and present (production) processes, storage, spills etc. The concentration of pollutants in groundwater depends on local geological,

hydrogeological and hydrological conditions. An inventory shows that priorities should be given to certain sites, should decisions be made about clean-up operations. At the moment, it appears that the following pollution sources are important:
- former gaswork sites;
- garages, transport companies, fuel storage and distribution sites;
- electroplating, electronics and metal products;
- chemical laundries;
- dumping sites.

An inventory showed that a total of approx. 500 - 550 soil cleaning-up projects have been performed which entailed the extraction of groundwater between 1980 to 1988. Those projects were carried out within the framework of the Soil Clean-up (Interim) Act (IBS-project), as well as within other frameworks (such as town renovations, changes in development plans and the granting and enforcement of permits under environmental acts). In about 60% of those projects, it was necessary to treat extracted groundwater on the spot, before it could be discharged. A large increase in the number of groundwater abstractions and groundwater treatments is to be expected. Particularly those projects that are to be carried out within other frameworks than the Soil Clean-up (Interim) Act will increase.

Before it is possible to clean-up a possibly polluted site, information about quality and quantity of polluted soil and groundwater has to be obtained. This should be done in a proper and systematic way. There are, however, some problems whenever sites are examined:
- Analysis of groundwater. Groundwater samples are sometimes polluted with floating layers, sediment and undissolved substances. Present analytical procedures are not clear on the handling of groundwater samples.
- Pollutants that are not connected with the (production) process (such as iron (Fe), manganese (Mn), carbonate (CO_3^{2-}), etc). Whenever groundwater that is extracted has to be treated on the spot before it can be discharged, those secondary pollutants may affect the operation of the treatment system. In case of groundwater sampling and analysis, more attention has to be paid to those secondary pollutants.
- Predicting influent concentrations, and time needed for extracting groundwater during clean-up operations. The usual method of predicting groundwater clean-ups mostly results in too high concentrations and too short extraction periods compared to practical experience. Using a standarized computerized calculation method may improve the reliability of predictions.

It is clear that few data are available, especially as far as the actual effluent concentrations, removal efficiency of treatment systems and costs related to treatment are concerned. Often, the effluent quality is just measured to verify whether permit requirements are met. Less

attention is paid to the actual removal efficiency of the treatment system that is used. Less attention is also paid to costs relating to treatment.
As far as the elaboration of the policy on discharges of groundwater from cleaning-up polluted sites is concerned, the sub-study group has chosen a substance or group of substances approach, instead of approaching the polluting sources. Substances or groups of substances have been classified into three groups, regarding their degree of pollution. This classification (slightly, seriously and very seriously polluted) is based on information about influent concentrations of those substances or groups of substances. Both in case of discharges onto sewer systems connected to a sewage treatment plant, and in case of discharges into vast surface water a number of treatment systems can be selected which can be used for the treatment of groundwater that is classified as being slightly, seriously and very seriously polluted. Permit requirements for substances or groups of substances were established on the basis of:
- the type of pollutants that are found in groundwater;
- the concentration of pollutants in groundwater that is abstracted;
- the quantity of groundwater that is extracted;
- the removal efficiency of treatment systems that are used;
- costs associated with the treatment;
- the effect of the discharge.

At the beginning of 1988, an inquiry was made into legal aspects of discharges of groundwater from polluted sites that were cleaned-up. The inquiry among District Water Boards indicated that policies regarding permit application procedures differed very much at that moment. Particularly, whenever discharges lasted only a short period, or whenever discharges were of a limited quantity; legislation on discharges of groundwater should be more clear, or adapted.

3.11.2 Conclusions branch study

Conclusions in accordance with policy

1. Generally, there are almost always (potentially) black-listed substances present in constantly varying concentrations, when measures are taken to reduce groundwater pollution. Often, there are vast discharges with a relatively low concentration of pollutants. Due to the enormous flow, considerable loads of pollutants can still be discharged.
2. Measures aimed at the source to prevent pollution are not or hardly applied. Often, quality and quantity of groundwater that is extracted are details: "reducing pollution" is only possible by means of final purification.
3. Due to the relatively low concentration of pollutants, and the presence of additional pollutants -which may affect the purifica-

tion result negatively- purification of groundwater is not a simple matter. The composition may change considerably through the years. There are temporary discharges as well. (This temporariness, however, may vary from some days to several years.)
A result of it is that the approach slightly differs from discharges by companies.

4. General points of departure for the policy to pursue within the framework of the Surface Water Pollution Act are laid down in chapter 7; specifically for discharges of groundwater from cleaning-up polluted sites based on:
   - the nature of substances present in groundwater;
   - the concentrations of substances present in groundwater that is extracted;
   - groundwater-abstraction flow;
   - the efficiency of purification techniques available for the treatment of groundwater;
   - costs of purification techniques available for the treatment of groundwater;
   - the effect of the (residual) discharge.

   For separate substances or groups of substances, possibly present in groundwater, the pollution reduction effort is determined, as well as indicative discharge demands derived from this.
5. Discharge standards can be determined on the basis of the (expected) composition of groundwater that is extracted, it should be examined whether this groundwater as far as the degree of pollution is concerned can be labelled as slightly, seriously or very seriously polluted with regard to that specific substance or group of substances.
   Based on this, the recommended reduction pollution effort should be determined for each substance or group of substances separately. For this, paragraph 7.3 combined with table 7.4.1 can be used (see enclosure). The indicative discharge standards are laid down in table 7.4.1 for the separate substances or groups of substances. Those indicative discharge demands are directly linked to the techniques which can be applied.

Procedural conclusions

6. An inquiry, which was conducted at the beginning of 1988 among water quality authorities, into the permit procedures regarding discharges of groundwater from cleaning-up polluted sites showed that there was no univocal policy on this issue.

General conclusions

7. There is only little practical knowledge available as far as effluent concentrations, efficiency and costs of techniques are concerned. Often, the quality of the effluent is just determined to

find out whether the regulations as described in the Surface Water Pollution Act permit are met. To a lesser extent, the actual effect of the techniques applied are being examined. Furthermore, costs related to the purification of groundwater are not, or hardly, evaluated in practice. It appeared that the availability of figures about reduction measures that had been carried out was limited when this report was formulated, which is all the more reason why one should be reserved whenever information is to be interpreted.

8. Sources of pollution frequently occurring at the moment, or in the future, are:
   - former gaswork sites;
   - garages and transport companies, fuel storage and distribution and related companies;
   - metal industry, graphic industry and related industries;
   - chemical laundries;
   - former dumping sites.
9. It appeared that between 1980-1988 approx. 500 - 550 projects to clean-up polluted sites had been carried out, or were in progress, in which the extraction of groundwater had taken place (Both IBS projects and non-IBS projects). There was purification on the spot in approx. 60% of those projects. It is expected that the number of extractions of groundwater and pollution reduction measures for groundwater, and particularly those projects not carried out within the framework of the IBS, will increase sharply. With this, it should be said that projects carried out outside the framework of the IBS often are very urgent. The number of urgent groundwater extractions will increase sharply.

Technical conclusions

10. It appeared that in practice soil and groundwater are not always sampled and analyzed in the same manner. An uniform procedure is important whenever soil and groundwater are sampled or analyzed.
11. It has not been laid down univocally how one should approach the presence of floating layers, crude sediment and undissolved substances in groundwater. This is particularly important whenever groundwater is sampled or analyzed, and a purification plant is designed.
12. Whenever groundwater is treated on the spot before it can be discharged, side-pollutants may affect the operation of the treatment installation negatively. More attention should be paid to the parameters iron (Fe), manganese (Mn), calcium (Ca), magnesium (Mg), chloride (Cl), sulphate (SO_4^{2-}), carbonate

(CO_3^{2-}), pH, organic substances, humus-like compounds, floating and settling substances, whenever groundwater is sampled and analyzed.

13. Prediction methods used until now to determine the influent concentration and the time needed for extraction lead to a predicted influent concentration which is almost always (much) higher than the actual concentration, while in practice the predicted time needed for extraction is almost always (much) too short. It is expected that the application of instruments to predict will produce an improvement of predictions regarding the usual methods.
14. Carrying out a test-extraction (pump-test) may improve the reliability of the practical information available, and with it the reliability of the prediction. A purification plant that may be realized can also be dimensioned better by means of a test-extraction. Up to now, not much is done with test-extractions in practice.
15. Whenever coagulation/flocculation or precipitation is applied, a pH change may sometimes result into a precipitation of calcium-carbonate (lime) due to a change in the lime-carbonate equilibrium.
16. Desorption of substances may take place whenever active carbon adsorption is applied. This phenomenon may especially occur, when groundwater with high concentrations of pollutants is firstly treated, and subsequently groundwater with low concentrations of pollutants. Then one should switch to a separate treatment of concentrated waste water. It is recommended to execute active carbon adsorption rerinsable with long-term projects.
17. Chemical oxidation by means of chloride or chloride dioxide may lead to the forming of unwanted final products (for instance organochloride compounds).
18. Due to the presence of much iron and/or manganese, sediments on the filling-substances or the perforated plate may occur whenever air-strippers are applied. Those sediments should be removed regularly to guarantee the efficiency of the air-stripper.
19. A good pre-research into hardness, salt concentrations and pH is necessary before diaphragm techniques can be used for purification of groundwater. Pilot-plant research with diaphragm modules on the spot is also necessary to prevent and determine diaphragm pollution.
20. The application of ion exchangers may limit the ion exchange selectivity through higher salt concentrations in groundwater, as a result of which purification efficiency will decrease. The stream that is to be treated should not contain floating material or other substances either, which can pollute the ion exchanger. Antici-

pating the use of an ion exchanger, groundwater has to be treated by means of (sand) filtration.

21. Biological treatment of polluted groundwater on location is very applicable for long-term projects. In practice, however, biological treatment on location is not yet applied much.

3.11.3 Recommendations

Recommendations in accordance with policy

1. An additional evaluation of practical experience, as far as the effluent concentrations achieved are concerned, efficiency and costs is considered to be necessary. With it, also other polluting sources which may become important in the future, as well as the polluting sources evaluated for this report, will be examined, too.
   To make this evaluation possible, it is necessary that information regarding the effluent concentrations achieved, efficiency and costs of purification techniques are structurally measured and gathered in practice. In addition to this, it has to be examined whether the data file pollution reduction measures of DBW/-RIZA can be used as a central storage of practical experience regarding measures that are being taken to reduce groundwater pollution. Perhaps it is possible to join in with the research project "Evaluation practice groundwater purification in case of cleaning-up polluted sites" that has recently been initiated by order of Project group Research Groundwater Purification in case of Cleaning-up Polluted sites (POGB).
   It could also be considered to formulate a standard evaluation form for measures to reduce groundwater pollution (analogue to the evaluation form formulated for cleaning-up polluted sites).
2. A number of studies in the field of groundwater purification from cleaning-up polluted sites are still being carried out at the moment. In addition to this, it is proposed to carry out an additional evaluation of practical experiences. As soon as more is known about this, it could be considered to adapt this report, which may be seen as an initiative to an evaluation of the policy, to the actual stand of affairs.

Procedural recommendations

3. It is considered to be necessary to mention explicitly as an explanation to the implementing order category C that soil clean-up projects belong to category C. Soil clean-up projects should fall under the implementing order category C institutions with regard to which the WABM (Environmental Protection (General Provisions) Act) procedure should be followed.

4. For the time being, formulating a implementing order substances can be abandoned as well as a change of article 7, second paragraph Surface Water Pollution Act, in order to have discharges of polluted groundwater from cleaning-up polluted sites fall under it.a
5. Incidentally, use can be made of a model uniform permit which is to be developed nationally on CUWVO level.
6. With regard to slight short-term discharges, the possibility to formulate general rules should be considered, so that the WABM need not to be carried on through. For this, the Surface Water Pollution Act would have to be changed first. With the intended change of the WABM (chapter permits and general rules), and the connecting change of the Surface Water Pollution Act will be dealt with -as is expected- in 1992.
7. The possibility should be examined to provide within the WABM for a very swift and simple permit procedure for urgent soil clean-up projects.
8. Awaiting a structural solution to the real urgent cases, one should act on one's own findings in practice, which may sometimes lead to situations that are tolerated unintentionally. However, from the point of view of maintainance, it is recommended to put those tolerated situations down in writing, anticipating the granting of a possible Surface Water Pollution Act permit.

General recommendations regarding the policy to pursue before permits are granted

9. Further research into the behaviour of substances in sewerage systems and sewage water purification plants is desired.
10. Further development is desired of new and existing purification techniques aimed at the destruction of substances and/or the production of slighter quantities of residual products.
11. Further research into the effectivity of off-gas treatment systems is desired.
12. It is recommended to involve the water quality authority in the technical judgement and approach of a possibly polluted site, at the moment when alternatives for measures to reduce pollution are being formulated and judged.

Technical recommendations

13. Whenever soil and groundwater is sampled or analyzed, it is desired to proceed as uniformly as possible. It is recommended to employ the VPR for sampling soil and groundwater, for analysis one should start from ISO regulations (see enclosure 13). Should no ISO regulations be available, then one can start from the VPR (Preliminary Practical Guidelines).

14. Whenever groundwater samples are sampled and analyzed, as well as when groundwater is treated, one should reckon with the presence of floating layers, crude sediment and undissolved components. How one should deal with them is not laid down univocally. Further research into this is desired.
15. Whenever groundwater is to be extracted and treated, one should pay attention to the parameters iron (Fe), manganese (Mn), calcium (Ca), magnesium (Mg), chlorine (Cl), sulphate (SO_4^{2-}), carbonate (CO_3^{2-}), pH, organic substance, humus-like compounds, floating and settling substances, as they may affect the operation of the treatment installation negatively.
16. To predict the quality of the groundwater that is going to be pumped up (influent concentration), and the time during which acceptable residual concentrations are measured in groundwater (necessary abstraction duration), one should work with a prediction model as much as possible.
17. It is recommended to improve the reliability of the prediction of influent concentration and extraction duration by means of a test extraction (pump-test). By means of a test extraction combined with a test purification, a purification installation which may be realized can be dimensioned better, too. However, it is recommended to pay attention to the presence of undissolved components and pollutants adsorbed to them.
18. Should chemical oxidation be applied by means of chlorine or chlorine dioxide, then it is recommended to place it always as final purification step in a purification system.

Table 7.4.1

Pollution control measures and norms for discharging extracted waste water into sewerage systems or very large surface waters.

Parameter	SLIGHT CONTAMINATION			SERIOUS CONTAMINATION			VERY SERIOUS CONTAMINATION		
	Influent (µg/l)	Efficiency (%)	Discharge norm (µg/l)	Influent (µg/l)	Efficiency (%)	Discharge norm (µg/l)	Influent (µg/l)	Efficiency (%)	Discharge norm (µg/l)
MONOCYCLIC AROMATIC HYDROCARBONS									
- Benzene	< 50	*/**		50 - 500	> 90	10	> 500	> 99	10
- Toluene	< 500	*/**		500 - 5,000	> 90	50	> 5,000	> 99	50
- Ethylbenzene	< 600	*/**		600 - 6,000	> 90	50	> 6,000	> 99	50
- Xylenes	< 600	*/**		600 - 6,000	> 90	50	> 6,000	> 99	50
- BTEX (sum)	< 1,000	*/**		1,000 - 10,000	> 90	100	> 10,000	> 99	100
POLYCYCLIC AROMATIC HYDROCARBONS									
- Naphthalene	< 300	**		300 - 3,000	> 90	40	> 3,000	> 99	40
- Other PAHs (EPA)	< 400	> 90	50	400 - 4,000	> 99	50	> 4,000	> 99	50
PHENOL/PHENOLS	< 500	**		500 - 5,000	*/**		> 5,000	> 99	50
CYANIDE (decomposed by chlorine)	< 1,000	**		1,000 - 10,000	> 90	100	> 10,000	> 99	100
CYANIDE (Complex)	< 2,000	***		2,000 - 20,000	***		> 20,000	***	
METALS									
- Mercury (Hg)	< 20	n.a.		20 - 200	*	4	> 200	> 98	4
- Cadmium (Cd)	< 100	*	20	100 - 1,000	*	20	> 1,000	> 98	20

Pollution control measures and norms for discharging extracted waste water into sewerage systems or very large surface waters (cont.).

Parameter	SLIGHT CONTAMINATION			SERIOUS CONTAMINATION			VERY SERIOUS CONTAMINATION		
	Influent (μg/l)	Efficiency (%)	Discharge norm (μg/l)	Influent (μg/l)	Efficiency (%)	Discharge norm (μg/l)	Influent (μg/l)	Efficiency (%)	Discharge norm (μg/l)
METALS									
- Arsenic (As)	< 1,000		200	1,000 - 10,000		200	> 10,000	> 98	200
- Chromium (Cr)	< 2,000		500	2,000 - 20,000		500	> 20,000	> 98	500
- Copper (Cu)	< 2,000		500	2,000 - 20,000		500	> 20,000	> 98	500
- Nickel (Ni)	< 2,000		500	2,000 - 20,000		500	> 20,000	> 98	500
- Lead (Pb)	< 2,000		500	2,000 - 20,000		500	> 20,000	> 98	500
- Tin (Sn)	< 1,500		500	1,500 - 15,000		500	> 15,000	> 98	500
- Zinc (Zn)	< 8,000		500	8,000 - 80,000		500	> 80,000	> 98	500
VOLATILE CHLORINATED HYDROCARBONS									
- Individual aliphatic chlorinated hydrocarbons	< 500	> 99	10	500 - 5,000	> 99	10	> 5,000	> 99	10
- Total aliphatic chlorinated hydrocarbons	< 700	> 99	20	700 - 7,000	> 99	20	> 7,000	> 99	20
- Individual aromatic chlorinated hydrocarbons	< 100	> 99	10	100 - 1,000	> 99	10	> 1,000	> 99	10
- Total aromatic chlorinated hydrocarbons	< 200	> 99	20	200 - 2,000	> 99	20	> 2,000	> 99	20
MINERAL OIL (PETROL, DIESEL OIL)	< 6,000		< 6,000	6,000 - 60,000		6,000 - 20,000	> 60,000		20,000

3.12 Laboratories

Recommendations regarding measures to reduce pollution caused by waste water discharges from laboratories (June 1989)

3.12.1 Summary report

Oxidizing, toxic and hardly decomposable substances harmful to the environment can be found in waste water from laboratories. The direct emission approach (see IMP water -Multi Year Programme for Water-1985-1989) goes for many of those substances. It is investigated in this report, how one can limit the discharge of waste products from laboratories.

In a CUWVO-VI report published before regarding the waste water problematic of laboratories (1982), no distinction was made between the various categories of laboratories, whereas at the same time it was impossible to gain a clear insight into the waste water situation of this branch. With the introduction of the first phase of implementing order institutions, it was indicated that during the second phase laboratories might be pointed out as a company category obliged to have a permit. So, it was recommended to gain a better insight into laboratories and their waste water situation. Which was particularly important to be able to point out those laboratories in the second phase implementing order, for whom a Surface Water Pollution Act permit had the highest priority from an environmental hygienic point of view, and whenever it was sufficient to issue general rules in the future.

An inventory carried out in 1987 indicated that the number of laboratories in the Netherlands can be estimated at approx. 2,000. Control laboratories of production companies are not included in this, because the waste water situation at those laboratories usually does not differ much from the waste water situation from the concerning production company.

The number of approx. 2,000 laboratories can be subdivided as follows:

- medical (including hospitals)	820
- secondary education	535
- dental	236
- remaining	350

Regarding the treatment of waste products and waste water in the various laboratories, the following can be said.

Secondary education (not vocational training) is not pointed out in the second phase of implementing order. A "security card" for this category was issued by the VNCI (Association Dutch Chemical Industry) and the section Chemistry Didactics of the "Rijksuniversiteit Utrecht", which is included in this report. This security card provided with a need as far as a large number of small potential discharge situations was concerned. No attention was paid to this category in this report.

In this study, dental laboratories were not considered to be laboratories, but production companies, and as such subjected to a CUWVO study into the branch dental care. This category could therefore be left aside. Hospital laboratories fall under the category medical laboratories. Those laboratories will be obliged to apply for a permit after hospitals are pointed out in the second phase of implementing order, within the framework of the Surface Water Pollution Act, and, therefore, they do not need to be pointed out separately. In the CUWVO report concerning the waste water problematic of hospitals is referred to this report as far as waste water from laboratories is concerned. The waste water situation in hospital laboratories can be approached in the same way as in laboratories from the category remaining, which is worked out elaborately in this report.
Based on the inventory carried out in 1987, pointing out laboratories in the second phase of implementing order has been limited to major integrated and analytic laboratories within the category "remaining laboratories".
Anyway, the measures mentioned in this report are not limited to the laboratories considered in this report, but can be considered to apply to almost all situations in which there are laboratory activities (so, also control laboratories at production companies).
It is investigated whether a category division may be a means for characterizing a waste water situation, and/or specific measures can be deduced for each category of laboratories to prevent the pollution of waste water. The classification of laboratories into categories did not result into more or less univocal sets of activities, chemicals that are being used or the composition of waste water that is being discharged. Therefore, a classification into categories of laboratories considered in this report did not produce the result desired.
Only a rough survey can be given of the quantities, nature and concentrations of waste products in waste water from laboratories. This is caused by the great number of laboratories, the diversity of activities taking place there and the wide range of chemicals that are used. A survey among the branch held in 1987, and waste water research at a limited number of laboratories carried out afterwards showed that the composition of polluting components strongly varies, and that concentrations are low more often than not. Due to this changing composition of the polluting components, and their mostly low concentrations, the application of recirculation equipment will often turn out to be impossible.
Therefore, the policy to pursue by the water quality authority should be aimed at "combatting at source" by means of internal measures. With it, one may think of separately collecting and transporting waste products, polluted liquids, solvents and mixtures containing black-listed substances, and, wherever possible, holding back other polluting waste streams. To accomplish this, laboratories should formulate internal regulations which

indicate which categories of substances should be held back, and how they can be collected, stored and processed or nullified. In internal regulations, the following measures to reduce pollution can also be included in internal regulations and facilities:
- pre-flushing glassware and equipment;
- applying condensing vessels on water jet driven vacuum systems (for instance in case of film evaporation);
- precipitation/ion exchange to remove specific components (for instance metals).

It is calculated that the costs resulting from holding back those substances do not exceed the costs in other branches for holding back comparable substances, and those costs can usually be regarded as integral part of the costs for normal management (good housekeeping). It is also important to prevent or reduce the presence of waste streams harmful to the environment as much as possible by:
- limiting the number of regulations/synthesises to the most necessary numbers;
- avoiding the use of black-listed substances as much as possible;
- developing substitutes for regulations/methods whenever the use of momentarily black-listed substances cannot be prevented.

3.12.2 Conclusions branch study

1. There is a large number of laboratories (approx. 2,000) with a large diversity of activities, and a wide range of chemicals that are being used. As a result of this, as well as the big scattering in analysis results and waste water research, only a rough survey can be given on the quantities, nature and concentrations of waste products in waste water from laboratories.

Emissions with laboratory waste water of a number of groups of substances.

GROUPS OF SUBSTANCES	EMISSION (kg/y)		CONCENTRATION
	per laboratory	per staff member	(in µg/l)
metals, nonmetals and compounds of them	0.03 - 40	0.003 - 4	< 0.1 - 4,000
non-halogenated, moderately to hardly biologically decomposable	0 - 300	0 - 5	< 0.2 - 600
non-halogenated, biologically decomposable	5 - 300	0.1 - 20	< 1 - 750*
halogenated aromatics	-	-	< 0.02 - 75
remaining halogenated compounds	0 - 100	0 - 2	< 1 - 1.500
remaining substances:			
acids	10 - 2,500	0.1 - 100	-
bases	1 - 1,000	0.1 - 30	-

* as BOD_5 in mg O_2/l.

Flows with various research.

minimal m^3/y	maximal m^3/y	average m^3/y
16	48,000	approx. 8,000

2. Results of the research carried out showed that sometimes high contents of a number of substances, such as chlorinated hydrocarbons and some metals, are found in waste water (see table with conclusion 1).
3. It turned out to be almost impracticable to make a classification of laboratories in various categories in such a way that a distinction can be made between various waste water situations.
4. Collecting waste products in laboratories should be considered as part of the "principles for a good laboratory practice". Handling and removing waste arisen during research has to be carried out in correspondence to governmental regulations concerned. To accomplish this, arrangements have to be made for properly collecting, storing and transporting, decontaminating and transporting methods, and keeping up to date a register of those activities.
5. Separately collecting, processing and transporting waste products, polluted liquids, solvents and mixtures is the most important way in which discharge of toxic and non-oxidizing substances can be prevented.
6. Due to the changing composition of polluting components and their usually low concentrations, the application of recirculation equipment will be possible to a limited extent, provided routine research.
7. The costs involved with the measures mentioned in this report can be considered as integral part of normal management.
   - transport and processing: approx. Dfl.1 - Dfl.3 per kg.
   - neutralization: mostly desired to protect the sewerage, usually no extra costs resulting from the requirement based on the Surface Water Pollution Act.
   - precipitation of metals: by regularly processing small quantities this can be done by simple means (often already present); due to volume reduction often cost-cutting (less transporting and processing costs).
   - ion exchange: approx. Dfl.110 per kilo metal removed; by preparing demi-water with the same installation (operates with cassettes) as well, costs for writing-off and interest for holding back pollutants can be reduced even further.
   - condensing vessels on water jet pumps: costs for a condensing vessel are minimal, and bear no relation to the cost price of the equipment of which the condensing vessel is part then (for instance a film evaporator).

3.12.3 Recommendations

1. It is recommended to investigate whether there are possibilities within the laboratory to limit the presence or the harmfulness to the environment of waste streams as much as possible, by:
   - limiting the number of regulations/synthesises to the number minimally required;
   - avoiding the use of black-listed substances as much as possible;
   - should it be inevitable to use black-listed substances, then new methods for analysis/synthesis have to be developed.
2. The discharge of polluting components belonging to the families and groups of substances mentioned in enclosure 7, should be limited with the best techniques existing, unless those components are relatively hardly harmful to the aquatic environment, or are rapidly converted into relatively hardly harmful substances, then the discharge should be limited with the best techniques performable. To determine the degree of the above-mentioned harmlessness of a polluting component, attention should be paid to the toxicity, persistence and degree of bioaccumulation in particular.
3. The discharge of polluting components not belonging to the families and groups of substances mentioned in enclosure 7 should be limited with the best techniques performable.
4. It is recommended that internal regulations are formulated and internal arrangements are made for each laboratory, which should be presented to the water quality authority for approval.
5. An important measure in the internal regulations and arrangements is a system to collect certain categories of waste products.
6. The scheme for such a system principly contains the following items:
   - classifying waste products into groups;
   - colour coding and labelling;
   - method of storage;
   - method of collecting bearing in mind:
     . safety aspects
     . possibilities of processing
     . quantity and quality of waste products.
7. To organize such a system, the report "Collecting chemical waste from institutions for research and education" by the National Study Group Chemical Waste should be used.
8. Other items that may be part of internal regulations and arrangements are about:
   - pre-flushing glassware and equipment;
   - the application of a condensing vessel (cool-stage) whenever water jet driven vacuum systems are being used (for instance in case of film evaporation);

- the application of precipitation/ion exchange to remove specific components (such as for instance metals).

9. As processes at laboratories are usually discontinuous, on a small scale and very diverse, it generally only makes sense to include discharge demands in the permit.
10. Considering the wide range of substances that is being used in laboratories, discharge demands (concentration demands) -apart from some pollutants specific to the concerning laboratory- can be formulated best with so-called parameters.
11. To get an idea whether permit regulations are observed, one should demand, among other things, the registration and access to, or reporting of substances collected and processed c.q. transported, considering the scheme of internal regulations and facilities for holding back substances. With it, one can join in with the obligation to register as mentioned in the principles for a good laboratory practice (GLP), and the obligation to report based on the Chemical Waste Act (WCA).

Guidelines for discharging effluents
Where possible, discharge standards should be based on research findings or detailed assessments of individual circumstances. If this is not feasible, the following limits can be used as a guideline for random sampling:

mercury	0.01	mg/l
cadmium	0.02	mg/l
other metals (Σ 5 metals)[1]	5	mg/l
extractable halogenated organic compounds	0.1	mg/l

[1] The sum of any 5 metals in the following series: Zn, Cu, Ni, Cr, Pb, Se, As, Mb, Ti, Sn, Ba, Be, B, U, V, Co, Th, Te, Ag.

3.13 Pesticides manufacturers

Recommended pollution control measures dealing with waste water discharges from manufacturers of pesticides for agricultural use in particular (September 1989)

3.13.1 Summary

This report reviews pollution aspects of pesticides manufacturers. As such, it follows a first report on the same subject issued by the Coordination Committee Implementation Surface Water Pollution Act in 1980.
Major reasons for the preparation of this review are:
- the need for updating an inventory of pesticides that are used,
- to register changes in discharges into surface water, quantitatively as well as qualitatively,
- the 1983 legislative requirement for permits to discharge polluted water, even when discharged through public sewage treatment plants, and,
- the growing concern of governmental bodies, water authorities and manufacturers of drinking-water for certain classes of pollutants, in which pesticides are high on their lists.

Manufacturing pesticides includes the handling of all ingredients (excluding chemical synthesis) required for the preparation of a wide range of products ready for use in the complex field of agriculture. Major processes involved are dissolving, melting, mixing, grinding and packing.
There are approx. 20 pesticides manufacturers in the Netherlands. Six of them together manufacture 70% of the active ingredients (a.i.), those companies are also involved in the chemical synthesis of active ingredients. Of the remaining 30%, there are five companies that just manufacture pesticides. The other companies have additional activities as well.
The total amount of pesticides for agricultural use manufactured in the Netherlands is approx. 31,000 tons a.i./y.
Pollution of water with pesticides is mainly caused by cleaning equipment and process air scrubbing. Additional pollution sources may result from raining on uncovered 'hot spots' such as storage and vessel sites, and loading bays, and from losses onto roads during transportation of pesticides.
Since pesticides are classified as priority pollutants, the elimination of 'point source discharges' is a logic way to reduce pollution. Therefore, similar to some other regions, zero discharge of production waste water from pesticides manufacturers is one of the short-term objectives.
This implicates a maximum effort to prevent pollution, and should it be unavoidable, treatment of waste water according to the best techniques available.

Information became available that measures aimed at limiting water usage during manufacturing operations may result into amounts required between 1 to 5000 l per ton a.i. This reduction will facilitate the elimination of waste water through incineration at installations available (waste incineration Rijnmond).
Implementing the recommendations from the previous CUWVO report (1980) has already resulted in a significant reduction of pollution caused by pesticides manufacturers. The total discharge of pesticides into waste water is of a much lower level than the estimated amount that is being discharged into surface water by applying pesticides for agricultural use.
Up to now, further reduction measures have been taken for the discharge permits of some plants, based on an individual approach. Those waste water discharge permits were developed in consultation between the local and water authorities involved, and the manufacturers.
Measures to be taken, and control systems are included.
Whether waste water treatment by the manufacturers themselves -basically based on flocculation and active carbon adsorption- is feasible, taking into account the ever growing need for further prevention of environmental pollution, is the subject now to optimize the quality of waste water from pesticides manufacturers. Treatment costs are estimated on Dfl.40 - Dfl.90 m^3 for a treatment facility ranging down from 10,000 to 2,000 m^3/y.
The objective of this policy to pursue for existing companies is to achieve complete termination of the discharge of polluted production water within a period as short as possible. No discharge permits will be granted to new plants or sites. Alternatives to treat waste water through incineration are sufficiently available, and economically feasible. Costs for treating this class of pollutants are considered to be reasonable.
Should a site still contain 'hot spots' as mentioned before, for instance uncovered storage areas or loading bays, then rain-water from those areas has to be collected separately, and is to be treated in the same way as production waste water. Rain-water from other places, for instance transport roads, has to be collected and discharged following the outcome of a specified biological test.
However, outside the scope of this report, recommendations for contingency planning in case of calamities -such as fire and/or explosions as a result of which water will be polluted- are nearing completion.

3.13.2 Conclusions branch study

1. A study into the size of the waste water situation caused by pesticides manufacturers in the Netherlands shows that there is an overlapping and relation with synthesis companies. Active substances (a.s.) produced by synthesis companies or purchased from a third party are manufactured into commercial products in the same way. Therefore, it is not realistic to leave synthesis companies aside

in a study into pesticides manufacturers. As far as the size of the production and the quantity of waste water polluted with pesticides are concerned, synthesis companies are of more significance than the independent pesticides companies. Which is presented in the diagram below.

company cat.	number of companies	size of production (ton as/y)	size of formulation (ton as/y)	waste water load (m3)
synthesis	2	45,000	21,000(70%)	ca.800,000
combine synth/form	6			
formulation	16	-	10,000(30%)	ca.14,000
total		45,000	30,000	

2. An individual approach to reduce pollution is and will be pursued with synthesis companies, considering the specific processes applied there. With it, it usually appeared to be impossible or undesirable to specify and/or treat waste water streams from a possible formulation activity separately.
3. To reduce pollution caused by waste water discharges from synthesis companies mostly took place by applying physico-chemical purification methods (stripping, extraction, flocculation, active carbon adsorption), and, in addition to this, sometimes a biological follow-up treatment. The demands laid down in discharge permits are usually related to specific chemical (group) parameters and/or fish-toxicity.
4. There are approx. 20 companies in the Netherlands which manufacture pesticides. Six of them are synthesis companies as well, those are the larger companies in particular (>1,000,000 kg a.s./y). For a number of other smaller companies, manufacturing pesticides is just a minor part of their total activities. Figured to reasonable size, there are 4 or 5 independent pesticides manufacturing companies of some size (100,000 - 4,000,000 kg a.s./y), where synthesis of active substances does not take place as well.
5. Polluted waste water in pesticides manufacturing companies usually arises as a result of:
   - cleaning charge changes;
   - wet gas washing of the exhausted air from working accomodations;
   - rain-water from storage sites and loading and unloading bays.
6. Most pesticides manufacturing companies, especially the larger ones, have been granted a Surface Water Pollution Act permit, or are following the normal procedures for application.

This also goes for synthesis companies. The demands laid down in discharge permits of pesticides manufacturing companies are usually (fish-)toxicity demands with regard to waste water or possibly polluted rain-water. However, criterions laid down may differ considerably.

7. Of the independent pesticides manufacturing companies of some size mentioned in conclusion 4, only one company purifies its waste water (10,000 m^3/y) on its own account, and subsequently discharges it onto the municipal sewerage. The other companies transport their company waste water for incineration.
   One company intends to purify its waste water on its own account in the future, too. Most combined synthesis and pesticides manufacturing companies purify waste water on their own account, and discharge into surface water. The other smaller companies either produce no waste water, or treat waste water together with waste water from their main activities, or transport it for incineration.
8. Measures to reduce pollution caused by pesticides manufacturing companies by taking measures in the field of management (internal pollution reduction measures) may limit the presence of waste water sharply. This pollution reduction approach can be characterized as the 'best technique existing', and makes that it can be more attractive (from an economical point of view), and is preferable (from an integral environmental point of view) to transporting company waste water for incineration, instead of treating it on one's own account.
9. External purification measures mainly consist of systems based on flocculation and adsorption to active carbon. Adsorption and desorption phenomenons are strongly influenced by the presence of solvents. Therefore, it is preferable to removing possibly present solvents by for instance extraction or stripping. A treatment installation consisting of stripping, flocculation, filtration and a follow-up treatment with an active carbon adsorption respectively may provide a relatively good purification result. Such successive treatments (as far as the successive steps are concerned) are comparable to a treatment installation applied for groundwater that is released in case of cleaning-up the polluted site of a former pesticides manufacturing company.
10. Investment costs for such a treatment installation are globally estimated on Dfl.850,000 (capacity 2,000 m^3/y) and Dfl.2,000,000 (capacity 10,000 m^3/y). With it, the annual costs are approx. Dfl.185,000 and Dfl.430,000 respectively. Treatment costs are approx. Dfl.40 - Dfl.90 per m^3.
    For smaller waste water volumes (less than approx. 600 m^3/y), the costs for treatment by the company itself will not exceed the costs for transport. Transport costs per m^3 are between Dfl.300 and Dfl.600.

11. It can be estimated that present purification costs per kg pesticide vary from some dozens to hundreds of guilders, based on some indicative calculations. The costs per kilo metal removed in case of transport for incineration are approx. some dozens of guilders, as it is offered 'more concentrated' in case of incineration. Considering the nature of the substances, those costs are not thought to be out of all proportion.
12. The concentration of active substances in the effluent to be discharged is at most estimated on a level of 50 mg/l. This means that those sort of discharges may affect the biological purification process within a purification plant (rwzi), considering the fact that those are continuous point-source discharges.
13. The idea obtained in other countries, as far as approach and permit conditions for this specific branch are concerned, is too fragmentary and incomplete to be able to compare it to the Dutch situation. There was a regulation in the United States which provided an emission demand for pesticides manufacturers that no discharge of waste water was permitted to take place anymore. Substance specific effluent values were formulated for synthesis companies based on physico-chemical purification. However, at the moment the regulation is not generally effective.
14. Manufacturers of pesticides for agricultural use are given more emphasis in this report, too, compared to manufacturers of pesticides for other applications. The reasons were the heterogeneous composition of that branch, the nature of the substances mainly processed there, and the fact that already attention was paid to a number of activities in other branch studies, for instance paint and varnish factories.
15. The size of the pesticides manufacturing branch is so slight, and the approach to reduce pollution is rather specific for each individual company that it was decided to give up formulating a model permit. It is strived for tailor-made regulations as far as permits to be granted are concerned, in which the building stones are reflected in this report. It should be emphasized that laying down a zero-discharge by means of a Surface Water Pollution Act permit is recommended, based on the fact that it is possible that rain-water will be polluted. A model has been formulated for a application form, because there will always be new companies for whom renewed applications have to be made.
16. The emission of pesticides resulting from the application in agriculture is roughly estimated on 160 - 320 tons of active substance. Compared to this, present discharges by pesticides manufacturers are quantitatively of a minor order (based on a worst-case assumption of max. 500 kg a.s./y). No complete picture can be drawn for synthesis companies, but one should reckon with a discharge of some dozens of tons.

3.13.3 Evaluation

1. Evaluation of the information from the CUWVO report of 1980 showed that considerable changes have taken place with regard to the inventory made up then (1976). It appears that synthesis is quantitatively of greater importance than the manufacturing of pesticides for both waste water quantity and size of the products. The quantity of the manufactured active substance in the Netherlands is higher than estimated at that time as well (more than 30,000 tons/y now against 15,000 tons/y then). The total quantity of discharged waste water, however, is considerably lower than estimated at that time (approx. 10,000 m^3/y now against approx. 30,000 m^3/y then). The number of companies remained roughly the same.
2. The recommendations mentioned in the CUWVO report concerning the approach to reduce pollution have generally been followed. Often, a considerable number of companies manufacturing pesticides have even been able to end the discharge of company waste water by taking internal measures to reduce pollution. Should discharges still take place, then the effluent quality is examined by means of a fish-toxicity test.
3. Requirements for the vistoxicity test are less univocal, and mesh less with the recommended demand from the previous CUWVO report as well. This particularly goes for waste water streams for which they have been formulated. This goes for the final control of the effluent to be discharged from a treatment installation, the control on the possibilities to treat waste water streams and the examination of rain-water for discharge. Partly, this can be explained by the fact that the previous CUWVO report had not reached an univocal conclusion on this.
4. Purification techniques which may be applied have not been altered much as well. Practice shows that usually techniques grafted onto flocculation and adsorption to active carbon are applied for final purification. Techniques such as selective adsorption to resins are actually not applied by manufacturers of pesticides at the moment, because of the fact that the field of action is too narrow.

3.13.4 Recommendations

1. Measures to reduce pollution caused by pesticides manufacturers can and should primarily take place by taking measures at the source. As a target value for minimizing the presence of polluted waste water, 0.1-0.5 m^3 waste water per ton a.s. processed can be employed. Within the range of what is considered to be acceptable, as far as costs are concerned, removing pesticides, transporting company waste water for incineration can be applied well, and from an integral environmental point of view, preferable to purification. With it, a total ending is strived for of discharges of company waste water from

manufacturers of pesticides. It is strived for to realize this as fast as possible. Right from the start, new companies are not permitted to discharge company waste water.

2. It is recommended to follow the aspects of this approach as far as source measures and rain-water are concerned; this also goes for formulation departments of combined synthesis/formulation and independent synthesis companies.
3. Formulating national emission limiting values for the discharge of black-listed substances -as determined in EEC guidelines- can thus take place for the branch in question on zero kg per kg substance processed. Considering this absolute discharge ban on company waste water, no conflict will arise with international and/or future limiting values.
4. Treating waste water during this pollution reduction period should at least take place with a physico-chemical purification installation. Indispensable elements in such a purification installation are flocculation and adsorption to active carbon. Depending on the fact whether organic solvents may be present in waste water, a preliminary treatment in the field of extraction or stripping may be desirable. Discharge should always take place through a communal purification installation, and not directly into surface water.
5. Formulating discharge criterions the effluent should meet, can only be applied with a very limited number of companies at the moment. As a criterion for the company waste water from such companies is proposed to include a demand based on a maximum concentration of halogenated aromatic compounds (max. 100 $\mu g/l$), and a biological demand based on nitrification retardation based on the capacity of the collecting rwzi in relation with the maximum waste water flow.
6. However, the discharge of rain-water from paved sites of pesticides manufacturers in particular still is a potential pollution source. It is primarily recommended to desire such an organization and management that rain-water can be prevented from being polluted. In fact, prevention is the best technique existing to reduce pollution. Rain-water from uncovered 'hot spots' should be included in the company waste water circuit. Discharge of the remaining rain-water streaming from the site, dependent on the local situation, preferable to the sewerage, should only take place after control and possible treatment. To do so, it is necessary that collection facilities of rain-water for discharges are provided. It is expected that costs for transport of polluted rain-water instead of treatment will be unacceptably high.
7. As a criterion for allowing the discharge of rain-water from pesticides manufacturers is proposed a demand based on fish-toxicity, that is: "evidence should be obtained of no significant increases in mortality (>10%) having occurred in a tank of guppies exposed to undiluted rain-water for a period of 96 hours".

8. Fire extinguishing water and polluted rain-water should be treated as company waste water in case of calamities.
9. The total emission of pesticides from this branch to surface water is just a minor part of the total estimated emission from pesticides - synthesis companies, and from the actual application in agriculture and horticulture. With a view to the reduction of pollution with pesticides of surface water it makes sense to intensify research into the possibilities to reduce emission. Within this framework a CUWVO VI sub-study group "Agricultural companies and pesticides" was established.

3.14 Motor and allied trades

Recommended pollution control measures dealing with waste water discharges from motor and allied trades (September 1989)

3.14.1 Summary Report

The group of companies involved in the motor and allied trades is large, and consists of several categories. Their total number in the Netherlands amounts to 11,000. The number of companies where engines are reconditioned, cars are deconserved and anti-corrosive treatments are carried out amounts to 70, 1,300 and 1,600 respectively. Those activities are not carried out in approx. 8,000 companies.

The pollution from this branch has been described based on activities within the companies themselves. It is estimated that the total emission from this branch amounts to:

oxidizing substances	300,000 p.e.
mineral oil	4,000 tons/y
metals	1,250 kg/y
mono-aromatic hydrocarbons	40 tons/y
poly-aromatic hydrocarbons	100 kg/y

The most important emissions are caused by the following activities:

- deconserving cars covered with layers of paraffin wax:
  mineral oil 1,300 tons/y
- reconditioning engines:
  metals 1,000 kg/y
- the following figure relates to an estimated emission to water, air and soil:
  chlorinated hydrocarbons 9,000 kg/y

One or more possibilities to reduce pollution are indicated for every (water)polluting activity. The measures to reduce pollution can be aimed at both preventing and limiting water pollution, and treating waste water. The recommended technique to reduce pollution and the discharge demand have been formulated for every activity. Taking into account:

- the nature of the substances (black/grey-listed);
- the form in which pollution occurs (deconserving results into oil emulsion, while there is polluted rain-water with an oil-water mixture in case of fuel residues);
- the presence of new waste products after waste water has been purified;
- maintenance and management by companies of their own purification equipment;
- costs per kilo pollution removed;
- particularly the parameter that is reduced by purification equipment, and additional pollutants in waste water.

The recommendations can be summarized as follows:

"For deconserving cars, covered with layers of paraffin wax, and companies reconditioning engines more drastic measures (emulsion separator, flocculation-flotation unit and ultra- filtration unit) than installing a sludge trap and an oil separator are proposed.
Waste water coming from this form of deconserving and cleaning with rotary cleaners must not contain more than 20 mg/kg mineral oil.
Special attention should be paid to chlorinated hydrocarbons with companies that recondition engines.
It is recommended that either anti-corrosive treatments are preferably carried out 'dry', or waste water is treated drastically. A demand is laid down that the permissible oil concentration in waste water is not more than 20 mg/kg.
Discharges into surface water should be avoided as much as possible by connecting to the municipal sewerage.
In case of discharge into larger surface waters, for which no special water quality objectives or demands go, waste water must meet the following demand:

- mineral oil 20 mg/kg;

It is recommended to lay down a demand on chemical oxygen use. We are thinking of a concentration up to 200 mg 02/l.
Stricter demands can be laid down for smaller and more vulnerable surface waters in particular. This also goes for surface waters which have to meet certain quality objectives and function demands.
A sludge trap and oil separator may be sufficient -in case of discharge into the sewerage- for the remaining activities not yet mentioned (for instance cleaning engines and bodies of cars, and refuelling). Should the method of working and the choice of the cleaning agent -in case of cleaning- not be aimed at preventing emulsions, then further drastic measures should be taken.
With the application of a sludge trap and oil separator, a demand of 200 mg/kg should be laid down. Should any further measures have been taken, then a demand of 20 mg/kg should be laid down.
It is pronounced in the recommendations upon the desirability to indicate all companies involved in motor and allied trades as "WVO" institutions (Surface Water Pollution Act). With it, the possibility of laying down general rules should be beforehand. A possible elaboration of this is given in enclosure 1.
It appeared with the realization of this report that there are sufficient possibilities for the treatment of waste water. It also became clear that exclusively accentuating the treatment of waste water will lead to a less desired direction into the development in the field of measures to reduce pollution of waste water from companies involved in the motor and allied trades. It is recommended to pay more attention to preventive measures.

The water quality can be protected sufficiently against optimized social costs with a balanced set of measures consisting of preventive and curative methods.
Further attention concerning the waste water problematic of companies involved in the motor and allied trades should be aimed at the application of preservatives and depreservatives in particular.
Research into ecotoxic qualities of substances in those agents, and research into the application of substances less harmful to the environment is desired.
Carrying out activities by private individuals in the streets should be considered critically. More attention should be paid to irresponsibly removing used oil and cleaning products applied whenever cars are cleaned.
It is recommended to examine the composition of cleaning products that are being used in the branch. It should be considered to ban the use of (chlorinated) hydrocarbons, and to lay down demands with regard to the degree of acidity.

3.14.2 Conclusions branch study

1. The total branch consists of 11,000 companies.
   Eight groups are distinguished as far as water polluting activities are concerned. It is indicated with every activity how many companies are carrying out those activities.

Deconserving layers of paraffin wax	900
Deconserving (co)polymer layers	450
Reconditioning engines	70
Anti-corrosive treatments	1,600
Cleaning engines and such	7,000
Cleaning bodies of cars	10,500
Maintenance and repair	10,500
Refuelling	7,200

2. It is estimated that the total emission from this branch amounts to:

Oxidizing substances	300,000 p.e.
Mineral oil	4,000 t/y
Metals	1,250 k/y
Mono-aromatic hydrocarbons	40 t/y
Poly-aromatic hydrocarbons	100 k/y

3. The most important emissions are caused by the following activities:
   - Deconserving cars covered with layers of paraffin wax:
     Mineral oil 1,300 t/y
   - Reconditioning engines:
     Metals 1,000 k/y
     The following figure is related to an estimate of an emission to the total environment.
     Chlorinated hydrocarbons 9,000 k/y

Combatting water pollution is possible by:
1. Drastically treating waste water released during deconserving cars covered with layers of paraffin wax by means of an emulsion separator, a flocculation-flotation unit or an ultra-filtration unit.
2. Preventing or limiting the use of chlorinated hydrocarbons by cleaning differently in the companies, or handing in baths as laid down in the Chemical Waste Act (WCA), or recirculating and periodically handing in rinse water as laid down in the Chemical Waste Act.
3. Applying anti-corrosive layers by means of dry processes.
4. Handing in waste water from rotary cleaners as chemical waste according the Chemical Waste Act, or treating it with an emulsion separator, a flocculation-flotation unit or an ultra-filtration unit.
5. Chosing a method of working when cleaning which will enable the oil separator to function well.
   This will be possible whenever the following method of working is applied. The cleaning agent should not be applied with a high pressure pistol. It is preferable that the cleaning product has de-emulsifying qualities and does not contain hydrocarbons. The applied cleaning product should be able to be exposed to the dirt for some time. A high pressure pistol may be used when the cleaned object is washed down.
6. The costs of possible techniques to reduce pollution may vary from some guilders to Dfl.90 per kg oil removed.

3.14.3 Recommendations

The policy plan and aspects determining the contents of the recommendations as stated in paragraph 6.1.2.

1. Whenever possible, companies involved in the motor and allied trades should discharge their waste water onto the sewerage.
2. All companies discharging company waste water should install a sludge trap and oil separator.
3. Whenever cars covered with layers of paraffin wax are deconserved, waste water should be treated in an emulsion separator, flocculation unit or ultra filtration unit. An oil-demand should be laid down for waste water to be treated of 20 mg/kg waste water.
4. Companies reconditioning engines are not permitted to discharge baths containing chlorinated hydrocarbons. Rinse water polluted with chlorinated hydrocarbons is to be recirculated, and ,finally, be transported to a processing plant, as laid down in the Chemical Waste Act (WCA).
5. Waste water from rotary cleaners is to be handed in as chemical waste as laid down in the Chemical Waste Act (WCA), or to be treated with an emulsion separator, a flocculation-flotation unit or an ultra filtration unit. An oil-demand should be laid down for waste water to be treated of 20 mg/kg waste water.

6. The method of working and the choice of cleaning agents should be aimed at preventing oil-water emulsions when cleaning. Then it is sufficient to treat waste water in a sludge trap and oil separator. An oil-demand should be laid down for waste water to be treated in an oil separator of 200 mg/kg waste water.
7. Further treatment of waste water should take place, whenever the method of working and the choice of cleaning agents are not aimed at preventing oil-water emulsions when cleaning. An oil-demand should be laid down for waste water to be treated of 20 mg/kg waste water.
8. The recommendations mentioned above to reduce the pollution of waste water can be used as a test whenever it is checked whether the "usual measures to reduce pollution" are taken, as meant in coefficient nr 3B in enclosure II with the Implementation Order Pollution State Waters.
9. It is recommended that company waste water should meet a demand for mineral oil of 20 mg/kg waste water, whenever discharges take place into larger surface waters for which no special water quality objectives or function demands go.
   It is also recommended that a demand is laid down for the use of chemical oxygen (COD). One can consider a concentration up to 200 mg O_2 per liter.
10. Stricter standards are recommended whenever discharges take place into smaller surface waters for which special water quality objectives or function demands go.
11. The emission of cadmium through coolant will be limited by product measures. Within the framework of the Substances Harmful to the Environment Act, the preparation of a cadmium order is in an advanced stage.
12. The study group recommends to allow the discharge of coolants, should re-use turn out to be impossible and discharge take place onto the municipal sewerage.
13. The study group recommends to allow the discharge of fluids released with the cleaning of brakes, provided treatment in a sludge trap took place and discharge onto the municipal sewerage will take place.
14. It should not be permitted to discharge other fluids such as spent oil, brake fluid and battery acid. Those fluids are to be handed in as 'chemical waste', as laid down in the Chemical Waste Act. Handing in can take place at a licence-holder within the framework of the "Order collecting chemical waste" (14 December 1987).
15. Maintaining this order should actually be taken up, as a result of which companies are stimulated to work in a manner that is harmless to the aquatic environment, and to keep up equipment for waste water treatment well.

16. It is important that every company involved in the motor and allied trades indicates in an internal maintenance regulation what the maintenance procedure for the sludge trap and oil separator involves.
17. To effectuate measures to reduce pollution by the branch, it is desired that all companies involved in motor and allied trades are regarded as a "Water Surface Pollution Act institution". The possibility of laying down general rules should be beforehand.
18. Regarding the form of legislation with companies involved in the motor and allied trades, one can consider both permits and general rules for the following groups of companies:
    - Deconserving paraffin wax and/or
    - Reconditioning engines.

    As far as the following groups of companies are concerned, legislation may work out through general rules in the future:
    - Anti-corrosive treatments and/or
    - Maintenance activities and/or
    - Cleaning with water.

3.14.4 Recommendations for further research

1. Further attention to the waste water problematic of companies involved in the motor and allied trades should be aimed at the application of preservatives and depreservatives in particular.
   Research into ecotoxic qualities of substances in those agents, and into the application of agents less harmful to the environment is desired.
2. Carrying out activities by private individuals in the streets should be considered critically. Further attention should be paid to irresponsibly removing spent oil, and cleaning cars in the public streets.
3. It is recommended to further examine the composition of cleaning agents used in this branch. It should be considered banning the use of (chlorinated) hydrocarbons, and laying down demands as far as the degree of acidity is concerned.

3.15 Screen printers

Recommendations regarding measures to reduce pollution caused by waste water discharges from screen printing processes (December 1989)

3.15.1 Summary report

As from 22 June 1989, it is compulsory for screen printers discharging onto the municipal sewerage to have a permit as laid down in the Surface Water Pollution Act. This means that the water authority in whose surface water or sewage water purification plant the sewerage ends up, will grant a permit (and may lay down discharge demands, too). Toxic substances not belonging to the environment and hardly decomposable substances, among other things, are found in waste water from screen printers. It is indicated in this report how and at what costs the discharge of waste products from screen printers can be prevented or limited. A CUWVO VI report regarding the "Waste water problematic of the Graphic Industry" was already published before. However, specific waste water aspects of the screen printing process were not examined thoroughly in this report.

The sub-study group gathered information about screen printers by interviewing suppliers of base materials and additives, screen printers, branch organizations and water quality authorities.

The screen printing process is used in more branches than just the graphic. For instance: the textile industry, the printing-plates industry and enamel companies. The number of "independent screen printers" (companies that sell their capacities and expertise to a third party) is estimated on approx. 650.

All base materials and additives used during the screen printing process may be present in waste water, among which black-listed substances and heavy metals.

With regard to preventing water pollution, and treating waste water, the following is recommended.

First of all, due attention should be paid to "good housekeeping and choice of systems". The most important measures are:

- only using those detergents that are biologically decomposable;
- not using chromium (VI) salts as light sensitive components;
- cleaning silk screen frames in a simple "form plate washer" (open tank), during which waste products released during the removal of residual printing ink (mostly solvents and inks) are not to be discharged, but to be transported (WCA, the Chemical Waste Act).

For the treatment of residual waste water, it may be sufficient for the screen printer to hold back form plate remnants that arise during the removal of form plates from the silk screen frames that were used (the so-called stripping) by means of a simple permanent substance separator.

The set of measures indicated to accomplish this is considered to be a "basic approach".
With this basic approach, emissions of substances are limited according to effort principles based on national lines of policy (potentially black-listed substances may only be present as spores).
Investment costs of this basic approach amount to approx. Dfl.20,000, and do not depend on the size of the company. Those costs are considered to be acceptable. Furthermore, it is not expected that there will be insurmountable drawbacks for the branch or individual companies.
Should companies invest in a more expensive, closed form plate washer and equipment for recirculating rinse water, then investment costs may rise to approx. Dfl.100,000.
More extensive waste water treatment will turn out to be necessary in special cases, for instance in case of direct discharge into surface water, or the use of dichromate or whenever ink and solvents are present in waste water. Investment costs may then rise to more than Dfl.100,000.
Models included in this report for application and permit regulations fit in with the basic approach. We have chosen a combination of regulations for means and objectives, in which regulations for objectives have been laid down in such a manner that regulations will be exceeded amply whenever the basic approach is not observed.

3.15.2 Conclusions branch study

Due to the combination of materials used, and many different wide-spread methods of working, black-listed substances and other than environmental substances end up in waste water from screen printers.
Among those substances are solvents (including toluene), inks (including inks with heavy metals) and light sensitive emulsions (including chromium VI salts). Waste water pollution especially arises after printing, when the frames are stripped off ink remnants and the light sensitive emulsion used.
It is possible that the emission of black-listed substances through waste water can be prevented entirely, by a combination of a proper choice of system and "good housekeeping".
A better choice of system is considered to be a change in the method of working (such as separating the removal of ink and stripping off the form plate) and/or avoiding the use of certain base materials and additives (such as switching over to chromium-free photopolymers).
The major part of the black-listed substances ends up in waste water during the removal of ink from the silk screen frames. Therefore, the method of working with regard to this cleaning step has to be changed in many screen printing companies.Removing inks has to be done thoroughly in a separate form plate washer. During the process, it should be impossible that there is any contact between ink and waste water. After this cleaning step, the silk screen frames should have the opportunity to

dry, so that all solvents used can evaporate. Afterwards, the form plate can be removed with water and agents such as periodate. With it, it can be prevented that inks and solvents will pollute waste water. Even whenever water thinnable inks are used, and the first cleaning step is not done with organic solvents, it should be carried out in such a manner that it is impossible that there is any contact between ink and waste water. Those water thinnable inks may contain substances harmful to the environment as well.
The use of the proper base materials and additives should consist of the facts that no light sensitive emulsions containing chromium salt, except when ink is removed, and no degreasants and cleaning agents containing organic solvents are used.
"Good housekeeping" should consist of the fact that during other processes in the company as well, cleaning takes place in such a manner that no ink or solvents shall end up in waste water.
The solid substance (form plate remnants) should be removed with a simple permanent substance separator in the appropriate waste water stream.
The final result is a waste water stream containing pollutants that are reasonably to well biologically decomposable, in which the degree of ink remnants and solvents is reduced to spores. With it, the emission of ink remnants and solvents with waste water has almost been ended completely.
The basic approach mentioned above is simple, requires a small investment, and, therefore, is also suitable for the smaller companies.
Advanced form plate wash installations, which (are going) to be applied for working-hygienic and efficiency reasons or to reclaim solvents, will yield the same results as the basic approach with regard to waste water aspects.
With the basic approach is prevented that black-listed substances end up in waste water. With it, one will meet the obligation to reduce pollution in force for these substances by using the best technique existing.
For the remaining harmful substances goes that one meets the obligation to reduce pollution by using the best technique performable.
It is expected that the basic approach will not lead to insurmountable financial problems for the branch or individual companies. An investment of approx. Dfl.20,000 is sufficient for the smallest company.
As far as screen printers have their own form plate preparation departments, and handle photographic processes there, conclusions and recommendations from the CUWVO report "Photographic industry" are adopted.
The basic approach is sufficient for companies which are connected to a sewage water purification plant (rwzi) through the municipal sewerage.
Laying down additional demands in case of discharges into surface water might be necessary, depending on the surface water in question. Then, it

may be possible that financial problems will arise for individual companies.

3.15.3 Recommendations

It is recommended to attune permits to be granted to screen printers to the conclusions mentioned above. This actually means that:
- Using emulsions without chromium salts. In case of using other diazo compounds as mentioned in this report (p-diazodiphenylamino-sulphate), the water quality authority will be able to judge whether discharge is permissible, based on the information provided by the applicant for the permit.
- When cleaning silk screen frames and gauzes, the form plate and ink should be removed separately. Sufficient time should elapse between both stages to allow for drying.
- No thinners, other solvents or biologically non-decomposable detergents should be used during other cleaning steps.
- The solid substance should be removed with simple equipment (such as screening sieves) from the appropriate waste stream.
- As far as the preparation departments are concerned, recommendations from the report "Photographic Processes" (i.e. not discharging fixer and developer, in the rinse water from developing machines a maximum concentration of silver of 1 mg/l) should be adopted.

It is recommended to include in the permits a combination of regulations for means and objectives. The regulations for means should guarantee the proper choice of system and "good housekeeping". The function of regulations for objectives is to make it possible to control whether regulations for means are observed.

The regulations for objectives should be formulated in such a way, that whenever a screen printer observes the regulations for means, automatically no exceeding of the regulations for objectives will take place. This is possible, because every defect of the basic approach will lead to considerable, clearly measurable concentrations of harmful substances in waste water. It is recommended to use a discharge norm for organic solvents of 1 mg/l. In specific situations, whenever the use of chromium in photographic emulsions is unavoidable, measures should be taken to detoxify Cr^{6+} and compliance sought with a 1 mg/l discharge norm for the total Cr content.

It is recommended to prescribe with the permits that simple facilities are installed to measure and control pollution.

3.16 Dental care

Recommended pollution control measures dealing with waste water discharges from dental practices, dental faculties and dental laboratories (February 1990)

3.16.1 Summary report

Institutions for dental care include dental practices, specialists and dental hygienists, dental faculties and dental laboratories.
The waste water problematic mainly concentrates on dental practices, in particular as a result of the discharge of mercury and some other heavy metals in the form of amalgam remnants. It relates to a very large number of small discharges into the sewerage. We are talking about approximately 6,000 dentists.
Research has shown that the use of amalgam in the dental care may lead to a potential discharge of mercury of approximately 3,300 kilos per year. For the metals silver, tin and copper together, this approximately amounts to the same quantity. The waste water in dental practices shows a highly varying and sometimes very high percentage of those heavy metals.
As a result of the gathering of amalgam remnants in the exhaust installation of instruments for dental treatment and the cleaning of these instruments, part of the mercury also ends up in the household refuse and in the refuse from the practice, while part of the pollution still ends up in the sewerage. After discharging into the municipal sewerage system, the relatively heavy amalgam remnants (approximately 2,300 kilos per year) will form a deposit here, too. It is estimated that approximately 300 kilos of mercury from dental practices will finally be discharged into the surface water via sewage water transfers and sewage water purification plants. The gathering of mercury (approximately 600 kilos per year) in sewage sludge also results in not being able to use sewage sludge in agriculture anymore.
Mercury and other heavy metals in a bound form will spread -directly or indirectly very diffusely- over the various environmental compartments (water, soil and air), both as a result of discharging into the sewerage and of dumping and burning of waste.
With it, a change from the bound amalgam form of mercury into a free, more harmful form cannot be ruled out.
Holding back amalgam remnants from waste water in dental practices, as close to the source as possible, will therefore not only contribute to a reduced direct burden on surface water and sewage sludge with mercury, but will also accomplish a reduced burden on soil and air through all kinds of direct and less direct routes.
In the dental trade there are simple separation techniques available, mostly developed in Sweden and West Germany, to limit the discharge

of amalgam remnants by at least 95 % through suction installations on instruments for dental treatment. In this report developments with regard to research and regulation for discharges from dental practices in Sweden and West Germany are described, too. The measures to reduce pollution recommended for the Netherlands correspond to the measures desired in those countries.
Combined with measures in the sphere of 'good-housekeeping', the discharge of mercury by approximately 6,000 dentists may be diminished to less than 150 kilos per year, and amalgam remnants may be kept out of household and industrial waste. In this way a controllable stream of amalgam waste of more than 3,600 kilos of mercury per year (at the moment approximately 1,000 kilos) should be available for collecting, processing and possibly reuse (mostly thanks to the precious silver present in amalgam).
Solutions for the transport of amalgam remnants that are held back combined with the rest of the waste from the dental practice (used baths of X-ray processes, lead-foil, pulled out teeth, hypodermic needles etc.) are also offered by the dental trade. As a result of this a hygienic and integral solution to the waste water and 'small chemical waste problematic' in dental practices is possible.
The costs of the measures to take are not very high for the dentists (approximately Dfl.600 - Dfl.1,000 per year), and do not exceed the costs in other trades of industry for holding back mercury and other heavy metals or substances that are just as harmful. The annual costs also include transporting and processing all chemical waste released in the dental practice (a contract on a rental system in connection with the amalgam separator which has to be changed twice a year).
Discharges from dental faculties are also shown. The discharge of mercury and other heavy metals is estimated on some dozens of kilos per metal per year. The measures to reduce pollution will have to lead to the same result as is the case with dental practices. Thanks to the presence of central suction installations for many dental treatment installations, solutions can be chosen which are suitable for the local situation. As a result of this, those solutions can turn out to be relatively cheaper per kilo metal removed.
In dental laboratories, of which there are more than 250, the waste water problematic limits itself especially to the discharges of plaster as a result of the making of prosthesises and a slight quantity of heavy metals owing to the polishing and etching of prosthesises. In many cases, for reasons of management, plaster settling tanks have been installed to protect the sewerage. Yet, it is often impossible to meet the demand to discharge less than 300 milligrams of sulphate per litre, in order to protect the sewerage. Percentages in waste water can amount to 1,000 - 2,000 mg/l. It is not necessary to limit the discharges of sulphate in view of the quality of the surface water. It is recommended to see whether dis-

charges by major dental laboratories may lead to problems as far as the sewerage is concerned.
Waste acids containing metals are limited in size, as a result of which hardly any costs are involved when this waste is handed in at depots to prevent discharging into the sewerage.
The legal instruments available at the moment, to regulate discharges of dental practices and laboratories is made up by municipal regulations concerning discharges into the sewerage. It is necessary for dental faculties to be granted a Surface Water Pollution Act-permit within the framework of Royal Decree institutions second phase, being part of an university hospital or a complex with major integrated laboratories.
After discussions in parliament on the Bill 'Chapter permits and general rules' (WABM/WVO; i.e. Environmental Protection (General Provisions) Act/Surface Water Pollution Act), it will be possible for dental practices and laboratories to regulate discharges through general rules (not before 1992). It is especially important to dental practices, because they are confronted, at the same time and uniformly, with measures they have to take to reduce pollution.
Anticipating those general regulations, it is recommended that agreement is reached between the government (Ministry of Transport and Public Works, being firstly responsible) and the organization which dedicates itself to the dental care and the social-economic interests of dentists (Dutch Society for the Promotion of Dentistry). It can be laid down to promote that dentists voluntarily take necessary measures. The professional association could stimulate this through specific information to its members, in particular as far as the choice of the technical and hygienical solutions most desired are concerned. Being able to pass on costs in tariffs for dental care also plays a role in this. Solutions which deal with both the waste water problematic and the problematic of removing 'small chemical waste' from dental practices simultaneously and efficiently should be stimulated. We could ask a reserved position from the government with regard to issuing rules concerning regulations for discharges (permits c.q. further regulations), should the dental profession -anticipating the general rules coming into effect- proceed in agreement with the recommendations formulated in this report. Considering the relation with the Chemical Waste Act and the Discharge Regulation Sewerage, it is recommended to co-sign the agreement by the Minister for Housing, Regional Development and the Environment and the Association of Dutch Municipalities.

3.16.2 Conclusions branch study

1. The 'branch of industry' dental care consists of approximately 6,000 practising general dentists, approximately 400 specialists and approximately 850 dental hygienists. In addition, there are 3 faculties for dentistry and approximately 300 dental laboratories.

2. The pollution of waste water caused by this branch is mainly determined by the discharge of mercury, silver, tin and copper of amalgam remnants, and to a lesser extent by silver coming from used photographic baths. In addition, sulphate and to a less extent heavy metals are discharged by the dental laboratories.
3. It is estimated that for filling approximately 2,000 teeth per dentist in the Netherlands approximately 12 tons of amalgam are yearly used, half of which consists of mercury. A result of this is that approximately 3.3 tons of mercury are yearly released through waste water from the suction installations of dental treatment, while approximately 2.3 tons of it is discharged into the municipal sewerage. Due to the discharge of waste water from dental faculties, this quantity will yearly increase by some dozens of kilos.
4. After treatment with dental amalgam, waste water in the suction installations of the dental practices may contain a percentage of mercury of 1 - 2 grams per litre (other metals Ag, Sn, Cu 0.2 - 1.3 g/l). After dilution with the remaining waste water in the dental practice, the percentage of mercury in waste water that is to be discharged into the sewerage amounts to an average of some milligrams per litre. The sludge deposited in the drains of the dental practices and the municipal sewerage near the junctions of dental practices may have been polluted by those metals sharply.
5. Although the harmfulness of mercury and other heavy metals in the bound amalgam form (as for acute toxicity) is limited, it should be prevented that amalgam remnants get into the environment through waste water and solid waste from dental practices and would spread diffusely. It cannot be ruled out, due to the way in which refuse from the practice, sewage sludge and purification sludge is processed, that while losing the binding of those metals, particularly in the amalgam alloy, mercury gets available in a form more harmful to the environment.
6. It is estimated that when approximately 5.5 million dental X-rays are yearly taken by practising general dentists and specialists, approximately 300 kilos of silver are yearly released with used fixing-baths, more than half of which is discharged into the sewerage.
7. It is estimated that yearly 300 tons of plaster is used in dental laboratories, 10 % of which gets into the waste water during processing. Most of the plaster is stopped by settling tanks through which the waste water runs, in order to prevent stoppage in the drains. The percentage of sulphate in waste water that is discharged into the sewerage may amount to 1,000 - 2,000 mg/l. As a result of this, the demand to discharge no more than 300 mg/l (for the protection of the sewerage) cannot be met in many cases. This need not lead to problems with a slight quantity of waste water from small dental laboratories in particular, considering the thin-

ning effect with the remaining water in the municipal sewerage. Of the some hundreds of kilos of precious metals that are yearly used in the dental production, some dozens of kilos will be released in waste acid; those acids are generally not discharged.

8. The emission of mercury and other heavy metals coming from amalgam remnants can be reduced by at least 95 % with the installation of amalgam separators available in the dental trade. The amalgam remnants can easily be removed from waste water through physical techniques, because mostly solid particles are released when drilling and filling. To achieve the best effect, those separators are to be installed at the outlet of the air-water separator of the suction installation (combatting at the source). Describing regulations to achieve goals for waste water from dental practices is hardly feasible; formulating regulations how to act, just as is done in other European countries, is a good alternative. Separators available on the market differ from a hygienical point of view, in the way in which can be dealt with those separators in dental practices. Physical separation technics can also be applied to waste water that is released from central suction systems in dental faculties. However, the way in which it is implemented needs to be further studied on the spot.
9. The development with regard to the use of composite as an alternative filling material to amalgam is such that a decreasing tendency is visible in the number of amalgam fillings and an increase in the number of composite fillings. Considering the requirements on the restoration of teeth in the dental care (strength, life span), composite cannot replace amalgam in all cases at the moment. Should this be the case in the near future, then the installation of amalgam separators on dental treatment installations cannot be missed in view of the after-effect in the emission of mercury and suchlike, resulting from the replacement of existing amalgam fillings.
10. It is expected that the use of amalgam separators in dental practices will lead to a decrease in the use of disinfectants out of hygienic reasons. They mostly contain chlorine phenols.
11. Photographic liquids released when taking dental X-rays can be collected separately and transported to depots, to be handed in, and processing plants.
12. A set of measures and facilities is offered by the dental market, which makes an integrated approach possible in the dental practice to remove amalgam remnants from the waste water of dental treatment installations, including the transport of the remnants separated, combined with the transport of other chemical waste products. Such an approach offers advantages both to the dentist and to the possibility to control the transport and processing of waste products from dental practices.

13. Taking measures to reduce pollution may decrease the pollution of waste from practices, sewage water, sewage sludge and surface water with mercury and other heavy metals from 3,300 and 3,700 kilos per year respectively to 150 and 200 kilos per year respectively. The quantities removed will be available in a form that is controllable for processing.
14. The yearly costs of the measures to reduce pollution through the installation of amalgam separators and such in dental practices will totally involve approximately 5 million guilders. The yearly costs for each dentist will amount from Dfl.600 to Dfl.1,000. The yearly costs for the so-called integrated set are Dfl.850. Investment costs for amalgam separators vary from some hundreds of guilders to some thousands of guilders. However, the integrated set is offered as a contract of hire, so that a dentist does not need to invest, apart from the installation costs.
    It is estimated that the measures for a dental faculty will amount to some thousands of guilders per year.
    Yearly, no extra costs are involved in the measures for a dental laboratory. From a managerial point of view, settling tanks for plaster have already been installed, and can be counted as running costs. Gathering and transporting relatively small quantities of waste acids hardly demands financial effort.
    The costs for each kilo of mercury and other heavy metals that are not used do not differ from the costs which are considered acceptable on the basis of the policy to pursue with regard to water-management. Subsequently, in this, we will join the policy pursued in other European countries by taking measures available to us to reduce pollution.
15. The Surface Water Pollution Act offers the possibility of effectuating measures to reduce pollution from dental faculties directly and from dental practices indirectly through (passing on regulations) granting permits and further regulations (municipal discharge regulation sewerage). It is considered desirable by the dental care that those who discharge, are confronted with further demands at the same time and in an uniform manner. There is no certainty whether this wish can be fulfilled completely by passing on regulations. The possibility of laying down general rules will be available to us within a few years through the Bill WABM/WVO (chapter 'Permits and general rules') which could indeed offer certainty to dentists.

3.16.3 Recommendations

It is recommended that the granting of a permit or the issuing of general regulations by the government is attuned to the conclusions described. This means in concrete terms:

1. Demanding the installation of amalgam separators in dental practices with an efficiency of at least 95 %.
2. Whenever such an separator is installed by the supplier, a Swedish or West German test report is to be handed in, which proves that the demand with regard to efficiency is met in case of a certain water supply given by the supplier. This supply is not to be exceeded when in use in the dental practice concerned.
3. In order to maintain this demand, checks on the presence of amalgam separators, as well as the correct operation and maintenance of the machine (registration of the removal and transport of substances as chemical waste).
4. Following the same technical approach to dental faculties, provided that wherever more extensive technical provisions on central suction installations are required, which can be judged separately with regard to granting a permit. If necessary, regulations for checks can be formulated. Measures to reduce pollution can be demanded before a permit is to be granted in accordance with the Surface Water Pollution Act (AMvB-institutions, second phase).
5. Not permitting the discharge of used photographic liquids released through taking X-rays, and thus accomplishing a separate collection and transport as chemical waste.
6. Regulating the use of disinfectants/cleansing agents in dental practices by means of a policy aimed at products within the framework of the Pesticide Act (effectuating the admission of other means than those used in agriculture).
7. Following, with regard to the possible discharge of used waste acids in dental laboratories, the same course of action as with regard to photographic liquids, and discharges of waste water containing plaster are only permitted if the water runs through a settling tank with a sufficient capacity.
8. Anticipating the realization of the WABM/WVO-change, promoting the formulation of general rules which lead to the effectuation of measures to reduce pollution in an uniform manner, and a simultaneous introduction of those measures for dental practices in particular. It is advisable to have general regulations for dental laboratories. The problematic of municipalities of not being able to meet the demand for discharging sulphate (for the protection of the sewerage) needs further attention.
   Municipalities should be attentive that the deposited sludge in their sewerage systems near dental practices can be polluted with mercury and other heavy metals.

It is recommended that from the side of the professional group developments desired on the basis of the conclusions mentioned above will be promoted. This means in concrete terms:

1. Choosing those systems, in case of installation of amalgam separators, which involve the slightest possible danger of contagion for the dentist and his assistant when operating and maintaining the apparatus.
2. Besides, striving for the possibility of the combined transport of amalgam remnants separated from other (chemical) waste products that are to be removed from the dental practice, so that a total solution is offered to the dental practice. Registration of the substances transported can also contribute to the check on the functioning of the amalgam separator.
3. In case of installation of amalgam separators; promoting the removal of sediments containing amalgam from the draines of dental practices and these sediments are to be treated as chemical waste.
4. Actively following developments on the field of quality improvement of composite as an alternative filling material for amalgam, and, if necessary, stimulating in order to end the application of amalgam containing mercury in the long run (policy aimed at the product). Now, the use of corrosion resistant amalgam alloys should be preferred.

It is finally recommended, anticipating the general rules on the discharge of waste water from dental practices, that from the side of the government and the representatives of the professional group the instrument of agreement, in which the above-mentioned recommendations have been laid down, will be used. The agreement would also stimulate dental practices to take measures to reduce pollution voluntarily, and guarantee the installation of amalgam separators not being enforced by the government by means of granting permits or issuing regulations on the basis of the legal instruments available at the moment.

It is recommended that the agreement is co-signed not only by the Minister of Transport and Public Works and the Dutch Society for the Promotion of Dentistry -being the parties to reach agreement-, but also by the Minister for Housing, Regional Development and the Environment and the Association of Dutch Municipalities.

3.17 Agriculture and pesticides

An exploratory study into the emission to surface water of pesticides used in agriculture and horticulture (April 1990)

3.17.1 Summary report

This report is about the problems caused by emissions of agricultural pesticides into surface water, and was commissioned because of the increasing relevance of diffuse sources of pollution affecting such waters. Improved analysis techniques, and stricter quality objectives, among other things, mean that water quality authorities and drinking-water companies are discovering more and more that quality objectives and standards for surface water, as far as pesticides are concerned, are being exceeded. In a number of cases, the ecological functions of the water system involved are clearly damaged as well.
Agriculture and horticulture are important in the Netherlands, both in economic terms and in terms of the surface area (approx. 65%). Roughly estimated, 17,000 - 21,000 tons of pesticides (active substances) are yearly used. Half of this is accounted for by soil disinfectants. By far most pesticides are used at arable farms, a large proportion in the cultivation of eating and seed potatoes. Glasshouses and bulb cultivation account for the highest average use per hectare (approx. 99 kg/ha and 121 kg/ha per year respectively). This is primarily caused by the cultivation of cut flowers, such as chrysanthemums and roses.
Pesticides can be emitted into surface water in a number of ways. It is roughly estimated that approx. 2% - 3% of the amount used (approx. 350 - 600 tons of active substance per year) ends up in surface water. The amount of individual substances varies enormously, depending on the characteristics of the substances and the methods of application. The most sizeable emissions from arable farming result from leaching, the cleaning of spray tanks, runoff, wind dispersal and atmospheric deposition. In glasshouses, condensation and water which escapes during cleaning and disinfecting cause emissions as well.
At present, activities to measure concentrations of pesticides in surface water are largely limited to those substances for which quality objectives have been formulated within the framework of basic water quality as laid down in the 1985-1989 Indicative Multi-Year Programme for Water. Those objectives are hardly representative of current uses of pesticides, as many substances are now being used only rarely as pesticides in agriculture and horticulture, if at all. Those objectives and standards are regularly exceeded, which is a cause for concern.
An attempt is made to obtain a picture of water quality throughout the country in respect of pesticides which are currently being used. The first step was to propose 23 substances of which it was believed that they should be included in the routine measuring programmes of water

authorities on account of water quality criteria, the extent to which they were used, their toxicity and the damage they caused to the environment. The Third National Policy Document on Water Management provides a number of numeric values for those substances against which the quality of surface water and water bed can be assessed.
A number of policy intentions have recently been presented in documents such as the National Environmental Policy Plan and the Agriculture Structure Policy Document which are bound to have a positive effect on the pollution of surface water with pesticides. The aim is to reduce the use of agricultural pesticides by 50% before the year 2000; the emission of pesticides has to be reduced considerably, too. Both objectives are discussed in great detail in the Multi-Year Plan for Crop Protection. The agricultural branch itself has drawn up an environmental action plan with the aim to ensure that pesticides have no negative environmental effects, and to clean-up any that do occur.
With regard to the instruments available to ensure that emissions are limited, the current possibilities offered, among other things, by the Pesticides Act, the Nuisance Act and the Surface Water Pollution Act have been examined.
The instruments available to the various levels of authority must be harmonized and used in coordination, if the policy objectives regarding the use of pesticides and their emissions are to be achieved. At present, water quality authorities can help the process best by regulating certain activities through permits issued under the provisions of the Surface Water Pollution Act, reaching agreement on emission reductions in covenants, promoting appropriate use by, for example, introducing levies and by actively cooperating in projects to process wastes such as spray residues. By monitoring the situation and providing information, water authorities can play an important role in raising the awareness of farmers and horticulturalists, and encouraging them to introduce measures and changes in their working methods. Measures within the framework of the Pesticides Act are being prepared for monitoring illegal discharges and the judicious uses of pesticides.
A number of measures to reduce emission is catalogued, which may help considerably to reduce the emission of pesticides into surface water in particular.

3.17.2 Conclusions branch study

1. Agriculture and horticulture are important factors in Dutch society, as far as the use of land and economic significance are concerned. Highly specialized culture sectors can be distinguished in agriculture and horticulture. This specialization, and the necessity to maintain a high level of production and quality have led to the enormous application of fertilizers and pesticides.

2. The application of pesticides in agriculture and horticulture is globally approx. 17,000 - 21,000 tons per year, on the basis of active substance. Half of this application is made up by soil disinfectants. It is calculated that the average annual use of active substance in the total area of arable land in the Netherlands is approx. 10 kg/ha.
3. However, there are big differences between the culture sectors which can be distinguished, even per crop. It appears that the application of pesticides is relatively high in the bulb-growing culture and cultivation under glass. The cultivation of chrysanthemums and roses in particular has a very high application of pesticides per ha. The total annual application is highest in arable farming. The culture of eating and seed potatoes and onions has a relatively large part in this. The next table briefly represents this.

culture sector	average application (kg/ha/y)	spreading application (kg/ha/y)	total application (ton/y)
arable farming	18.9	3*- 31*	14,207
vegetable culture	28.4	3 - 201	1,284
fruit culture	9.9	4 - 17	466
bulb-growing culture	121.0	78 - 360	2,037
cultivation under glass	98.9	4*- 223	1,092
bulb culture	101.5	?	107
tree culture	76.5	31 - 75	503
cattle farms	0.6	not applicable	705
public parks/gardens	?	?	140
edible mushrooms	112.6	?	10

* excluding soil disinfectants

4. The emission of pesticides to surface water takes place along a number of ways. Rinsing, leaching, wind dispersal, atmospheric deposition and cleaning spray tanks are the most important emission routes with arable farming. In case of cultivation under glass, condensation water, the outlets of irrigation systems and water released during the cleaning and disinfecting of greenhouses are explicitly important routes as well. The most important emission percentages are represented in the next table, based on information limited available and well-reasoned estimates. They are conveyed as percentages of the quantities used.

culture sector/ emission route	arable farming	fruit culture	cultivation under glass
- runoff	0.04-1.5	0.1	0.004
- atm. deposition	0.01	0.004	0.002
- rinsing	0.3 -0.4	0.3-0.4	--
- draining	0-2	0-2	0-3
- spray residues	1	1	1
- condensation gutters	--	--	0.18
- irrigation pipes	--	--	0.1
- cleaning greenhouse	--	--	0.02-1

5. The total emission of pesticides into surface water is globally estimated at approx. 2%/3% of the pesticides applied. This is an active substance of approx. 350 - 600 tons.
6. Usually, water authorities have limited measuring techniques for pesticides. The substances examined are based on objectives and standards for the basic quality according to the IMP-Water 1985-1989 (Indicative Multi-Year Programme for Water) in particular. However, this does not join in with the current application of pesticides. It is often established that standards are exceeded.
7. The parameters formulated within the framework of the Third National Policy Document on Water Management and Water Beds fit in better with the current application of pesticides than the basic quality. Numerical values are based on chronic exposure to substances.
8. It was established that a number of pesticides gives cause to exceeding the standards that were laid down for drinking-water, after researching at collection points of manufacturers of drinking-water. At the moment, standards for surface water destined for the preparation of drinking-water, and standards for the product of drinking-water do not join in with one another. In order to provide this, a change of the Royal Decree 'quality objectives and measuring surface water' is in an advanced stage of preparation.
9. Different pesticides are found in a number of areas after thematic research. In a parallel hydrobiological research in the Westland, it was established that there was a seriously disrupted ecological community poor in species, probably resulting from high concentrations of pesticides.
10. In a number of policy plans recently published, such as the National Environmental Policy Plan and the Agriculture Structure Policy Document, objectives have been added which should lead to a reduction of the application and emission of pesticides. Most obvious are the 50% objectives to reduce application in the year

2000, and measures to reduce pollution caused by agents most sensitive to rinsing before 1994.

11. The Agricultural Board itself drew up an Environmental Action Plan, too. Point of departure for pesticides in this programme is that unwanted side-effects should be reduced, and, should it turn out to be insufficient, that one should come to a phased reduction of the application while alternatives are being offered simultaneously.
12. An important elaboration of those objectives in the field of crop protection will have to take place by means of the Multi-Year Plan for Crop Protection (MJP-G). It is expected that this report will be published before the end of 1990.
13. An inquiry was made into the legal possibilities of preventing or limiting emissions to surface water. Globally, the distinction can be made that the Pesticides Act has a preventative effect on the basis of admittance policy and carefully applying pesticides. The Surface Water Pollution Act can just regulate a thing or two, whenever discharges take place by a so-called site or plant. An important development is the possibility of determining general (legal) rules for uniform discharge situations.
14. It is possible that a reduction is realized under the Pesticides Act by designating a protected area within the framework of the Soil Protection Act. The Nuisance Act is applied to prevent damage and nuisance outside the institution in general, and prevention of calamities within working accommodation(s) and the farm yard. A possible temporary alternative to legal regulations is laying down binding arrangements according to private law between authorities and agricultural companies in a so-called covenant.
15. Consultation takes place in many frameworks about the application of pesticides in agriculture and horticulture and the environmental problematic resulting from that application. This consultation takes place from various points of view and interests. There is a wide participation of the authorities and target groups concerned, but a clear central framework for mutually attuning objectives, priorities and actual measures is lacking.
16. Also under pressure of social developments and new insights, more goal-oriented research takes place into, among other things, agricultural systems with a much lower pesticides consumption, the so-called integrated systems, into improved efficiency of application techniques, into facilities on spray devices which limit emission, and into possibilities to process certain residual streams. Stimulation and swift introduction of those systems may lead to a considerable reduction of undesired emissions from agriculture and horticulture in the near future.
17. In addition to a reduction of emission, which can be realized by reducing the application of pesticides, it is possible to take a

number of measures aimed at emission. Beside fundamental changes in culture systems (for instance substrate culture), a number of possibilities are mentioned in the report in the field of facilities on spray devices, organizing parcels and further limiting, for instance, the use of cropspraying aircraft. A ban on directly collecting surface water to prepare spray solvents, may improve the possibilities of enforcing considerably.

18. Cooperation between various authorities and trade and industry is absolutely necessary to reduce emissions from agriculture and horticulture. To do so, various regulating, methodical, stimulating and communicative instruments are available.

3.17.3 Recommendations

1. It is recommended that water authorities should intensify routine research into the presence of pesticides in surface water. To obtain an uniform national picture, a series consisting of 23 substances (see table 17, p. 62) is proposed as a first initiative. In addition to this, it is desirable that this list will be extended which will depend on the application in specific cultures in certain regions. The Third Water Management Policy Document offers a number of numerical values against which the quality of surface water and water bed can be tested.
2. Furthermore, it is recommended to quantify emission routes to surface water which can be distinguished. In principle, this could be done in the same way for each culture sector in a CUWVO follow-up study. Considering the relatively high application of pesticides, the strong regional concentrations and water quality problematic resulting from this, priority should be given to cultivation under glass, bulb-growing culture and the culture of eating and seed potatoes.
3. Considering the costs and complexity of such research into each separate culture sector, it is necessary to come to cooperation between various water quality authorities, agricultural companies, regional and national authorities or research institutes. One should also try to join in with activities that are already taking place. It would be recommended to provide a permanent central emergency and coordinating centre for research activities. This could be started, for instance, by the Union of District Water Boards or the Institute for Inland Water Management and Waste Water Treatment (DBW/RIZA). Research should also be aimed at indicating measures and/or regulations in permits to reduce emissions, either in general rules or in a covenant.
4. The water quality objectives formulated in the Third Water Management Policy Document can play an important part in addition to the total prevention of emission of pesticides. Achieving those

objectives will certainly cause problems as far as ditches and water levels in an agrarian region are concerned. It can be promoted through the CUWVO that research into size, frequency and effects of exceeding standards is carried out in practice. The LAC (Agriculture Advisory Board) could also be an initiating and point of support within this framework.

5. On the other hand, it could be promoted through the CUWVO that, in the short term, a vision is energetically worked at how the desired water quality can be achieved in local water levels as well. This relates to the requirements laid down in the Third Water Management Policy Document regarding " not being able to meet the numerical values in local water levels bordering on agrarian parcels, right after the application of the means concerned".
6. At the moment, an assignment to water quality authorities is under preparation consisting of a limited detection authority within the framework of the Pesticides Act. It is recommended to take up supervision on discharges and careless actions intensively.
7. It is necessary that water quality and quantity authorities themselves, wherever possible, should actively contribute to measures to reduce emissions of pesticides (in agriculture). This is possible, on the one hand, by not using chemical pesticides for maintaining water levels anymore or adjusting dates when surveys take place, as a result of which the possibilities of mechanically cleaning water levels will increase. On the other hand, emission limiting measures and/or facilities can now be prescribed based on the Surface Water Pollution Act (WVO), through whether or not standardized permits or general rules in the future.
8. Should it turn out to be impossible to apply the Surface Water Pollution Act at the moment, then it is recommended to examine -within the framework of the Pesticides Act- whether measures to reduce emission can or, possibly, will be prescribed, or whether the Surface Water Pollution Act can be changed in such a manner that diffuse emissions of pesticides can be regulated as well. The latter actually means that the implementing order of section 1, paragraph 3 of the Surface Water Pollution Act will have to be adjusted. Anticipating this, certain agreements will have to be reached in a covenant -in consultation with the other authorities involved- with organizations of agriculture and horticulture to reduce emissions. Attention should particularly be paid to the facts how participation and enforcement can be guaranteed.
9. Policy intentions regarding the use and application of pesticides in agriculture and horticulture include many good elements and measures, also as far as quality aspects of surface water are concerned. Yet, elaboration, implementation and realization of this policy are only to a very limited extent within the spheres of participation and influence of the water authority directly involved.

One should attune and adjust this framework, in which the water quality authority plays a part as well. It is possible that the Multi-Year Plan for Crop Protection (MJP-G) provides this.

10. The measures which the water quality authority would like the branch to take, can be divided into more structural measures, which mostly require backing research and a longer implementation period, and measures which could be realized from a technical point of view in a very short period of time. The measures from this last category are:
    - observing great(er) care whenever spray solvents are prepared, the necessity of cleaning spray tanks is determined and residues are removed. With it, limiting the possibility of using surface water for preparing spray solvents may be a means;
    - taking measures to limit wind dispersal of pesticides to surface water; such as limiting cropspraying by aircraft, laying out wind-breaks of trees along, among other things, orchards, and introducing zones along water levels where it is not permitted to spray;
    - limiting chemical maintenance of banks and water levels;
    - diverting condensation water and gutters from surface water;
    - limiting the application of pesticides through overhead irrigation in view of limiting the chance of rinsing and draining of the residues to surface water.

Those measures should also be considered within the framework of the Multi-Year Plan for Crop Protection (MJP-G).

11. It should be examined to what extent the total of the measures within the MJP-G sufficiently guarantees that the quality desired for surface water will be achieved and/or maintained. Through the CUWVO VI, a request to attune to the MJP-G has already been addressed. It is recommended to elaborate this at the beginning of 1990.
12. Apart from possible legal instruments and agreements which have to be reached, it is advisable to come to a regular exchange of information between the authorities involved in this problematic and agricultural organizations on a regional level.
    Water quality authorities can play an important part in this, by awakening the agricultural and horticultural industry to emission aspects into surface water by monitoring. By participating with the agricultural industry in regional study groups, a number of necessary changes in methods and/or adjustments of companies can be stimulated.
    In principle, this also goes for reaching working agreements between various detection authorities, as a result of which more attention can be paid to discharges and careless use.

Synopsis: for easy reference, recommendations are summarized in the scheme below.

Nr.	To whom addressed	Description
1.	water authorities	extending water quality monitoring as far as pesticides are concerned (+23)
2.	CUWVO	research into the branch and formulating recommendations with regard to reducing emissions (indicating means and target objectives for: - cultivation under glass - bulb-growing culture - culture of seed and eating potatoes)
3.	Union for District Water Boards/ DBW/RIZA	central emergency centre for coordinating research
4.	CUWVO/ water authorities	insight into quality ditches in agrarian regions
5.	CUWVO	promoting vision feasibility environmental quality values in ditches in agrarian regions
6.	water authorities	intensifying supervision illegal discharges
7.	water authorities	- limiting chemical maintenance - preparing permits to be granted
8.	CUWVO	- advising application covenant or possibly, should it not be feasible, - advising reconsideration implementation s. 1, p. 3 of the WVO regarding pesticides ending up in surface water
9.	CUWVO	giving feedback as far as elaboration and adjustment MJP-G are concerned
10.	agriculture	short-term measures in view of limiting direct discharges of spray residues and wind dispersal of pesticides
11.	CUWVO	advice MJP-G
12.	water authorities	regional adjustments, and consultation with agricultural industries and other authorities

3.18 Spraying of recreational vessels (April 1991)

Waterpollution problematic caused by spraying of recreational vessels (April 1991)

3.18.1 Summary report

Preserving ships entails pollution of surface water and sediment. The latter pollution may become so serious that the spoil which is dredged up has to be stored in a specially constructed depot. That is why the Coordination Committee Implementation Surface Water Pollution Act (CUWVO VI) established the sub-study group "Cleaning and preserving mobile objects". One of its tasks is to formulate proposals for measures to reduce pollution, which have been described in two reports. The present report is one of them, and deals with hosing-down recreational vessels. The second report discusses shipyards for commercial shipping and large shipyards for yachts.
Every year, a large number of recreational vessels are stripped of fouling. When fouling is cleaned off, traces of paint will come away as well. The cleaning is done by commercial businesses, such as boatyards and non-commercial bodies, such as yacht-clubs and municipal institutions. They are equipped with facilities such as slipways and/or small docks, yacht-basins and winter storage accommodation.
There are approx. 900 yacht-building companies, and 1,000 yacht-basins in the Netherlands. 90% of them is equipped with facilities to hose-down pleasure boats. Every year, approx. 170,000 pleasure boats are treated in approx. 1,600 hosing-down installations in the Netherlands. This spraying under high pressure is mainly done in spring, from the beginning of April to the middle of the month of May, and in autumn, from the beginning of October to the beginning of the month of November.
That part of the ship which is below the waterline is equipped with a paint system consisting of a number of preserving layers. As far as the hull is concerned, tar may be used instead of paint. Among the preservatives, anti-fouling paints are the most harmful, since they contain biocides. According to an estimate based on information from 1989, each year approx. 75,000 litres of anti-fouling paint and 40,000 litres of tar products are used in the Netherlands.
As far as recreational vessels are concerned, both hard and self-polishing anti-fouling paints are applied. Hard paints are generally used for vessels sailing in fresh water, whereas the self-polishing paints are mostly used for ships which sail in salt water. The reason is that considerably less fouling takes place in fresh compared to salt water. Besides, self-polishing paints are more effective, but also more expensive.
Usually, the biocide used is copper(I)oxide, often in combination with tributyl tin compounds or other biocides. Anti-fouling paints containing organotin have average copper and organotin percentages of 25% and

6% respectively (weight percentage of the wet product). The cupric anti-fouling paints, which do not contain organotin as a biocide, have average copper percentages of 25% as well.

Anticipating EC regulations, the Dutch government revoked the permission to use organotin for yachts with lengths less than 25 meters as from 1 January 1990. This will result into a growing use of cupric anti-fouling paints. However, as the copper contents in both types of paint are equal, it is not expected that this change-over will have any influence on the copper load on surface water caused by recreational vessels.

Waste water from hosing-down recreational vessels only contains a fraction of the initial quantity of biocides applied. This means that the greater part of the biocides will leach out, and will be emitted diffusely into surface water. As recreational vessels will spend relatively much time lying still, the yacht-basins will suffer most from this diffuse emission.

Leaching out accounts for the following estimated amounts of pollutants emitted into Dutch surface water:

- 200 kg of polycyclic aromatic hydrocarbons (PAHs),
- 18,500 kg of copper and
- 2,000 kg of organotin.

As a diffuse source, recreational vessels cause approx. 3% of the total diffuse PAH emission, 17% of the total diffuse copper emission and 49% of the total diffuse organotin emission. The above-mentioned ban on organotin, however, will lead to a strong decrease in the emission of this biocide.

Whenever recreational vessels are hosed-down under high pressure, approx. 60-90 litres of water are emitted per hour. Yearly, approx. 10,200 to 15,300 m^3 of water will be used in the whole country. Waste water resulting from this is polluted with fouling (algae, water plants and shellfish), particles of paint,and in some cases oil and fat solvents.

Hosing-down pleasure boats causes the following annual emissions:

- per site	- nation-wide
- 200 gr of copper	- 160 kg of copper
- 80 gr of organotin	- 65 kg of organotin
- 18,900 gr of suspended matter	- 15 tons of suspended matter

In addition to this, oil may be emitted as well.

Consequently, as far as recreational vessels are concerned, diffuse emissions are much more important than emissions from shipyards. So, whenever we talk about cleaning-up, it seems obvious that much effort should be put in developing paint systems which are less harmful to the environment. However, according to the present views held by the paint industry, a breakthrough in this field (towards a general use of non-toxic, solvent-free coatings) is not to be expected before the year 2000. For reasons already mentioned, emissions from hosing-down sites will probably not decrease considerably in the years to come. However, the latter does not alter the fact that the current product policy should be pursued unrelentlessly.

The emission of pollutants to surface water from hosing-down facilities is concentrated near the facilities, which, on account of the settling of suspended matter (particles of paint), causes a direct local pollution of the sediments. This justifies the principle that a cleaning-up effort is currently demanded from the businesses and institutions concerned. Waste water purification should include collecting and treating waste water in a settling tank -possibly connected with an oil filter- because of possible oil pollution (even when measuring turns out negative, oil may still be present). Wherever possible, the effluent should be discharged into the sewerage. 90 to 99% of the pollution can be removed by sedimentation. This means that after treatment the following loads will be discharged yearly:

- per site	- nation-wide
- 14 g of copper	- 11 kg of copper
- 6 g of organotin	- 5 kg of organotin
- 1,300 g of suspended matter	- 1 ton of suspended matter

As was mentioned before, organotin will gradually disappear from waste water. Often, the remaining sludge in settling tanks will have to be removed as chemical waste. Measures taken at the site itself keep the pollution of waste water limited to the facility. This means that possible oil discharges can be restricted to a minimum by installing collecting tanks. The application of fat solvents on hosing-down sites should be banned as well, and other activities such as sandblasting, sanding and paint application -as far as they are harmful to the quality of the water- should not take place there. Finally, sludge and oil filters should be cleaned regularly.

Especially at sites where private owners can hose-down their pleasure boats as well, it is desirable to make a connection between the spraying device and settling tank, so that it sets into action automatically when spraying is started. HISWA (the Dutch organization for the water sport trade) is developing a mobile spraying installation in cooperation with a constructor. It may turn out to be lucrative for certain businesses to work with such an installation. However, this installation may not be used and the effluent may not be discharged without a permit of the water quality or sewerage authority.

The estimated costs for a business of an average size amount to approx. Dfl.20,000 (soil protection not included). Assuming the installation is written-off in ten years, the annual costs are approx. Dfl.3,700. The annual extra charges per mooring are estimated at 10 to 20 guilders.

Whenever an emission approach is chosen, the following effluent requirements are recommended:

A random sample of treated waste water should meet the standard of 100 mg/l of suspended matter, and 20 mg/l of oil before it is permitted to

be discharged into surface water. Whenever it is discharged into the sewerage, the standard for oil may be adjusted to 200 mg/l. It is necessary to carry out further research in order to establish practicable lower values.
These regulations can be enforced by means of inspection to determine whether waste water runs through a settling tank, and whether this installation is installed and operated properly. The adequacy of measures taken within the business concerned (good housekeeping) can be examined as well, paying special attention to possible oil and other emissions at the site which may influence the quality of the water. Whenever doubts have arisen after an inspection, a sample can be taken to determine whether requirements are met.
In the near future, it will be possible to regulate discharges of waste water from hosing-down recreational vessels by means of general rules based on the Surface Water Pollution Act (WVO), which is to be amended. The heart of the matter is that this is one of a large group of similar discharges to which comparable measures to reduce pollution apply. The preparation of such administrative measures should already be started now, but they can only come into effect after the WVO has been amended (it is expected that this will take place at the beginning of 1992).
In case of emissions to surface water, it is desirable that the obligatory permit is maintained next to general regulations. It may be necessary to make the requirements more stringent, in connection with vulnerable surface water and to protect sediments against pollution. So, a WVO permit is always obligatory in case of direct emission to surface water. Facilities which cannot be connected to the sewerage, and, therefore, will continue to discharge into surface water can be equipped with waste water treatment installations before 1 October 1991. This process has already been started at a number of sites.
In view of the large number of sites, delivery periods for equipment and adjustments necessary for connection to the sewerage, a transition period of one year is considered to be indispensable. 1 January 1993 is therefore recommended as a final date for the improvement of all sites.

3.18.2 Conclusions branch study

In general

1. Hosing-down recreational vessels is carried out at the following sites: shipyards with slipways and/or small docks for inland navigation, fishing and recreation, yacht-basins, winter storage accommodation and yachting-marinas.
2. There are 900 companies building yachts, and 1,000 yacht-basins in the Netherlands. There are approx. 165,000 moorings.

3. 90% of the yacht-building companies and yachting marinas have the possibility of hosing-down recreational vessels. Which makes a total number of approx. 1,600 hosing-down institutions.
4. The following activities can be performed at hosing-down sites of yacht-basins: high pressure cleaning, maintenance of engines and screw propellers as well as steam purging.
   The following activities can be performed at hosing-down sites of shipyards: high pressure cleaning, maintenance of engines and screw propellers and other repairs.
5. 70 to 80% of all recreational vessels is put ashore in autumn. Half of the yachts remaining in the water during the winter is still hosed-down in spring. Every year approx. 170,000 pleasure boats are hosed-down in the Netherlands.
6. The peaks of hosing-down will take place in the periods from early April to the middle of May, and from early October to early November.

Preservatives

7. Of all preservatives used, the anti-fouling paints are the most harmful to the environment due to the presence of biocides.
8. Less fouling takes place in fresh water compared to salt water.
9. Hard anti-fouling paints are mostly applied in fresh water, because they are relatively cheap and still sufficiently effective to fouling.
10. Self-polishing anti-fouling paints are mostly applied on ships in salt water.
11. Copper(I)oxide is usually used as a biocide, mostly in combination with tributyl tin compounds or other biocides.
12. Copper is added to anti-fouling paints containing organotin to accomplish an anti-fouling effect for boats lying still.
13. Anti-fouling paints containing organotin have average copper and organotin percentages of 25% and 6% respectively. Cupric anti-fouling paints have an average copper percentage of 25%.
14. As from 1 January 1990 the Netherlands revoked the permission to use organotin for yachts with lengths less than 25 meters. As a result of this, the application of cupric anti-fouling paints will increase. A further development of a product policy is necessary, particularly in connection with the diffuse load on surface water with, among other things, copper.
15. As the average copper percentages of both types of paint are equal, it is expected that this change-over will not affect the copper load to surface water coming from recreational vessels.
16. It is estimated that (in 1989) 75,000 litres of anti-fouling paints and 40,000 litres of tar were applied in the Netherlands.

Leaching out

17. In the water from cleaning recreational vessels is only a fraction found of the amount in biocides applied originally. This means that the major part of biocides leaches out and is emitted into the water diffusely.
18. As people with recreational vessels sail relatively little, the emission caused by leaching out will be a load in yacht-basins.
19. Due to leaching out, 200 kg of PAHs, 18,500 kg of copper and 2,000 kg of organotin from recreational vessels ends up in surface water.
20. As a diffuse source, recreational vessels cause approx. 3% of the total diffuse PAH emission, 17% of the total diffuse copper emission and 49% of the total organotin emission.
21. Together with agriculture, recreational vessels are responsible for the diffuse organotin load. As a result of the ban on organotin for recreational vessels, the diffuse load will decrease by approx. 50% after some years' time.

Waste water

22. Each hour, approx. 60 to 90 litres of water is released. Nation-wide, approx. 10,200 to 15,300 m^3 of water is used.
23. Waste water is polluted with fouling (algae and seaweed), particles of paint and possibly oil.
24. Due to hosing-down recreational vessels, an emission takes yearly place of 200 g of copper, 80 g of organotin and 18,900 g of suspended matter per hosing-down institution (210 vessels hosed-down).
25. Nation-wide, due to hosing-down recreational vessels (170,000 vessels hosed-down), 160 kg of copper, 65 kg of organotin and 15 tons of suspended matter is released.
26. The emission of PAHs resulting from hosing-down recreational vessels can be neglected.
27. The diffuse load from recreational vessels plays a much larger part compared to the emission from shipyards.

Measures to reduce pollution

28. Pollution reduction measures for waste water consist of collecting and treating waste water by means of a settling tank, because of possible oil pollution, connected to an oil separator.
29. It is expected that 90 -99% of the pollutants can be removed through sedimentation. This means that yearly 14 g of copper, 6 g of organotin and 1,300 g suspended matter is still discharged per average company after measures have been taken to reduce pollution.

    It is estimated that -after measures to reduce pollution have been taken- the annual loads of PAHs, copper, organotin and suspended matter will still amount to 11 kg, 5 kg and 1,000 kg respectively. After some time, organotin will disappear from the waste water entirely.

30. A mobile spraying installation is being built by HISWA in cooperation with a constructor. Financially, it might be very interesting for certain companies to work with such an installation.
31. In general, sludge from the settling tank of a spraying installation will have to be transported as chemical waste.
32. Before 1 October 1991, pollution control measures must be possible for companies which cannot be connected to the sewerage, and, therefore, continue to discharge into surface water.

Costs

33. It is estimated that the costs per average-sized company amount to approx. Dfl.20,000 (excluding soil protection). Should the installation be written-off in ten years' time, then the annual costs amount to approx. Dfl.3,700. The extra annual costs per mooring are estimated at Dfl.10/20.

3.18.3 Recommendations

1. It is recommended to stimulate a product policy, especially in view of the diffuse load on surface water caused by those substances.
2. In connection with the oxidizing substances still present in waste water, waste water from hosing-down recreational vessels (together with for instance domestic waste) should, if possible, be discharged into the sewerage, should there be a sewerage in the vicinity. In all other cases, direct discharge into surface water is possible.
3. Waste water should pass through a sludge separator as well as an oil separator -in case of possible oil pollution- before it is discharged.
4. Based on the emission approach, a demand for a random sample of suspended matter of 100 mg/l and for oil of 20 mg/l (in case of discharge into surface water), or an demand for oil of 200 mg/l (in case of discharge into the sewerage) should as yet be laid down for waste water already treated. Further research will have to be carried out to gain insight into the values that are feasible in practice. Based on the results of this research, permits already granted can then be adjusted officially to the actual situation.
5. Possible oil discharges should be avoided as much as possible by installing settling tanks.
6. A necessary condition for an oil separator to function well is that the application of fat solvents, as a result of which emulsions arise, should be avoided.
7. Particularly companies and institutions where also private owners can hose-down their recreational vessels are recommended to

connect their settling tanks to spraying installations, so that the former will operate automatically whenever someone hoses-down his/her vessel.

8. Other preserving activities, such as sandblasting and paint spraying, which may place an unnecessary load on surface water, should not be permitted at spraying institutions. This kind of activities should take place at such a distance from the waterside that no pollution of surface water can take place.
9. Whenever (rented) mobile spraying installations are applied, first a permit (WVO or municipal discharge regulation) should be granted by the water or sewerage authority in case of discharge into surface water c.q. sewerage.
10. Supervision may consist of inspection, to see whether discharge through a settling tank takes place or whether this tank is properly installed and operated (no hydraulic overload). Furthermore, attention should be paid to possible oil discharges, and whether the measures taken are sufficient (remember the application of fat solvents).
    Whenever there are any doubts during inspection about the installation operating well, a random sample of the effluent may be taken, so that it can be determined whether the temporary demands mentioned before of 100 mg/l of suspended matter and 20 mg/l of oil (200 mg/l in case of discharge into the sewerage) are met.
11. Discharges of waste water from hosing-down recreational vessels can be regulated by means of a generally issuing of rules based on the (to be amended) WVO and WABM (Environmental Protection (General Provisions) Act), considering the fact that a large group of comparable discharges with comparable pollution reduction measures are concerned. Such a Royal decree has yet to be prepared, but can come into effect after the WVO/WABM are amended (which is expected to happen early 1992).
    In case of discharge into the sewerage, it is sufficient to use general rules without an issuing of rules. In case of discharge into surface water, it is desirable that the obligation to have a permit is maintained. In connection with vulnerable surface water and to protect the water bed against pollution, it may be necessary to lay down further demands. (In case of direct discharge into surface water, a WVO permit should always be obligatory.)
12. Considering the large number of companies, the delivery times of equipment and adjustments necessary for connecting to the sewerage, a transition period of one year is thought to be necessary. Therefore, as a final date before which all companies must have taken measures to reduce pollution caused by them is recommended 1 January 1993.

3.19 Blasting and preserving at shipyards

Water pollution problematic caused by blasting and preserving at shipyards for commercial shipping and large yachts (April 1991)

3.19.1 Summary report

In general
The preservation of ships entails pollution of surface water and sediment. Preservation or maintenance work is understood to mean cleaning by means of spraying, blasting and applying paint. The last mentioned form of pollution can become so serious, that the spoil dredged up has to be stored in a specially constructed depot. Therefore, the Coordination Committee Implementation Surface Water Pollution Act (CUWVO VI) established a sub-study group "Cleaning and preserving mobile objects". One of its tasks was to formulate proposals for measures to reduce pollution, which have been described in two reports. The present preliminary report deals with shipyards for commercial shipping and large yachts. The second report deals with hosing-down recreational vessels.
Shipyards for commercial shipping can be divided, as far as their activities are concerned, into shipyards for seagoing and inland craft. In the Netherlands, approx. 140 shipyards are mainly engaged in building and repairing ships for inland navigation, and approx. 50 shipyards are equipped for building and repairing seagoing vessels.

Pollution
Pollution is caused by the paint systems applied. Tar products are mainly used for inland craft. Those tar products almost entirely consist of coal tar pitch, the polycyclic aromatic hydrocarbons (PAHs) of which cause problems. This report is based on 6 Borneff PAHs. In addition to the regular tar products, binary epoxy tars (approx. 30% coal tar pitch) are sporadically used. Approx. 700 tons of coal tar or coal tar products are yearly used in inland navigation.
Anti-fouling paints are used for seagoing vessels. The application of anti-fouling paints, of which the paints containing organotin and copper compounds are the most striking examples, is regarded as a serious hygienic environmental problem. The quantity of paint used for seagoing vessels cannot be estimated. Regularly, ships bring the paint from abroad to apply in the Netherlands. On the other hand, it sometimes happens that part of the paint supplied by a distribution outlet in the Netherlands is taken on board when a ship sails.

Emissions
The maintenance of inland craft consists of blasting the hull below the water line with water under high pressure, and then applying a tar coat with a brush or roller.
Emissions resulting from this consist of diffuse emissions by evaporation of the fresh tar layer, wear by scraping the water bed and leaching of the ship's skin. At the shipyard, emission takes place as a point source in case of water-blasting.
Approx. 9 m^3 of water is used for spraying an inland craft. Approx. 130 g of PAHs flows away as a result of water-blasting, whenever an average inland craft is undergoing maintenance. The annual PAH emission of an average inland shipyard (100 dry docks) is estimated at 13 kg.
Due to the application of tar for inland craft, approx. 14 tons of PAHs are yearly released into the atmosphere, nation-wide. Approx. 10 tons of PAHs are directly diffused into surface water yearly, as a result of leaching and scraping by touching the water bed. Nation-wide, approx. 23,000 m^3 of water is released as a result of spraying. Thus, approx. 200 kg of PAHs is released into surface water near the shipyards. The emission of PAH into surface water directly from inland shipyards amounts to 2% of the total PAH load on surface water by inland craft.
The estimates of PAH, copper and organotin emissions into surface water in the Netherlands are represented below.

SOURCES	PAH kg	Copper kg	Organotin kg
Point sources			
- industry	630	47,580	1,640
- recreational vessels	-	160	64
- shipyards, seagoing	-	*1	*1
- shipyards, inland	200	-	-
total	830	47,740	1,704
Diffuse sources			
- bank protection	1,350	-	-
- households	180	36,600	-
- road traffic	180	3,600	-
- dumping	-	10,980	-
- agriculture	-	7,320	2,100
- atmos. deposition	5,590	31,110	-
- recreational vessels	200	18,500	2,000
- seagoing vessels	-	*2	*2
- inland navigation	10,000	-	-
total	17,500	108,170	4,100
TOTAL	**18,330**	**155,910**	**5,804**

*1) National emissions of copper and organotin from shipyards are estimated at approx. 1,000 kg.
*2) Yearly, several tons of copper and organotin are diffused into surface water in the Netherlands.

Nation-wide, the total PAH load in surface water (all emissions included) is approx. 18 tons. With approx. 10 tons, inland navigation accounts for the greatest part by far.
As far as seagoing vessels are concerned, maintenance work consists of spraying the hull below the waterline, possibly removing oil by means of detergents, scouring or completely removing paint layers by grit-blasting, and re-applying the paint system, usually by means of airless spraying. Therefore, emissions are diffused: evaporation from fresh paint systems and leaching from the hull, and, particularly at shipyards, caused by emissions from point sources, high pressure water jets and wind dispersal of grit and paint particles.
The quantitative data available on leaching of copper and organotin from seagoing vessels are inadequate; practically no research has been carried out.
The working of anti-fouling paints is based on the emission of toxic substances (copper and organotin). It is therefore expected that the total load from leaching is higher compared to the load from shipyards. As seagoing vessels are in a harbour for a relatively short period of time, biocides will mainly enter the water at sea. Whenever the ship's hull is grit-blasted, minuscule grit and paint particles will be blown away at open docks or slipways. Emissions will be blown away as well, whenever paint is sprayed on, which may amount to several dozens of per cents. This depends on the wind speed, and the method used. As far as airless spraying is concerned, spray mist losses may amount to 45%. Emission to the soil or surface water is minimal, whenever paint is brushed or rolled on.
The following waste water streams are discharged at shipyards: sprayed water from maintenance operations, ballast, cooling and bilge water from the ship. At excavated docks, leakage and soil water seepages are added. Furthermore, rain-water may be polluted at uncovered facilities. Leakage water at dock gates and ballast water from the ship can often be removed from waste water separately.
The quantities will differ for each ship, day and shipyard. Nation-wide, the quantities of waste water discharged, therefore, cannot even be estimated for shipyards of this type.
An indicative study into possible waste water pollution was carried out at one shipyard. It appeared that the polluting components were present in waste water as hard or suspended matter. The average waste water emissions from seagoing vessels are 1,000 g of oil and 20 kg of suspended matter, which include 270 g of copper and 40 g of organotin. Other metals were found as well, but copper and organotin were the most important.
The level of pollution will highly depend on the methods used. Certainly, oil pollution is not always found in waste water. At one shipyard (with an yearly average of 150 dockings), the following weights that are yearly

released were estimated: 3.5 tons of suspended matter, 40 kg of copper, 10 kg of organotin and 150 kg of oil.
As it is unknown how much paint is applied, it is difficult to make a nation-wide estimate of the emissions of copper and organotin with any degree of accuracy.

Pollution approach at source
As it is applied to inland craft, tar is the largest PAH source in the Netherlands. Since diffuse loads are many times higher compared to point loads from shipyards, a direct emission approach is urgently required, i.e. a pollution approach at source, which is the paint system used.
Research into the possible application of substitutes (bitumen, binary epoxy paints) is therefore desirable in the short term. This is also stated in the "Derde Nota Waterhuishouding" (National Policy Document on Water Management). Should an acceptable substitute for tar be available, then a prohibition should be considered against the application of tar or tar products on ships or other mobile objects.
Germany and Belgium are particularly important with regard to transferring to other maintenance products. Shipyards in the Netherlands will come under competitive pressure from those two countries, should maintenance costs be raised unilaterally in the Netherlands. Therefore, it is important that those two countries are going to be involved as well.
From an environmental hygienic point of view, (aluminium) bitumen is preferable as a substitute to tar for inland craft. It is unclear whether those products are feasible in paint technology. Should those products be used, then maintenance costs for an average inland craft will yearly increase by approx. Dfl.350.
Transferring to another paint system will take time. In contrast, the load from the shipyard will be concentrated at the fitting location, where the soil is directly loaded in connection with settling particles of suspended matter (tar particles). This justifies the assumption that shipyards should be imposed to rationalize their maintenance activities.
An approach at source would also be preferable for seagoing vessels. However, because of its international and global nature and lack of acceptable substitutes, it is not expected that a technological breakthrough will be made in this field in the years to come. Here, too, the assumption of rationalizing maintenance work is justified.

Maintenance efforts by shipyards
Waste water that is to be discharged will have to be collected and treated. As far as collecting waste water is concerned, shop floors will have to be adapted by taking measures to protect the soil, and by laying a drainage system.
With regard to maintenance activities, facilities to protect the soil are particularly important at the slipways. Because of the extreme loads, it is

often difficult to keep a sloping surface liquid proof at shipyards at the moment. Paving with clinkers, concrete or asphalt will provide sufficient protection to pollution of the soil with paint particles. The risk of soil pollution by fluids (mainly oil) may be avoided by taking measures linked with the company. Measures may consist of placing collecting tanks.
The treatment of waste water from shipyards for inland navigation and seagoing vessels shall almost be the same. It is to be expected that jet water released whenever inland craft are sprayed can be treated properly by sedimentation. Laboratory tests showed that 80% to 90% of the suspended matter has settled after one hour. It remains to be seen whether those results can be achieved in practice. Substances that rise upwards (oil) can be removed by means of an oil-water separator. This may be combined with, for instance, a sediment separator. Because of the large surfaces of shop floors, rain-water may play an important role within the dimensions of a purification unit. It is proposed that -to calculate the basic dimensions of the waste water treatment unit- account is taken of a rain intensity of 1 mm/h. As guidelines for discharge requirements are proposed 100 mg/l for suspended matter and 20 mg/l for oil.
The present practice for waste water from shipyards is flowing away via the slipway or dock floor (sometimes through a sedimentation unit) into surface water. The policy of the District Water Boards is directed towards ending current discharges into surface water by connecting to drainage systems.
Because of their location, it will often be impossible to take waste water from shipyards into a drain. Many shipyards are situated seaward of the dykes. Complete connection is only possible in a limited number of cases, particularly as far as shipyards are concerned which mainly deal with seagoing vessels. Each company will have to be examined to see whether connection is desirable in view of the nature and size of the waste water flow.
Overspray (when paint is sprayed) should be restricted, in the first place, by good working discipline on the part of the painters: applying the correct means, and getting as close as possible to the surface under treatment. Both are part of good dock and slipway discipline. Out of economical and technical reasons (unreliability), it is not yet possible that alternative techniques are applied.
Measures against wind (protection/influence) should be taken as far as grit blasting and paint spraying in the open air are concerned. Practical tests are being carried out with fine-mesh nets in combination with a water spray.
To a large extent, the set of measures mentioned above will give substance to the rationalization efforts which shipyards -being spear-head companies- will have to make to satisfy the arrangements made at the Rhine and North Sea ministerial conferences.

Costs
The costs of implementing the rationalization measures will vary considerably per shipyard. To give some indication, two examples are given of the fixed costs.
The costs of purifying the waste water flow from a slipway consist of:
1. Preparatory work on the ground.
2. Construction of one or more open drains (where water levels change): drill horizontally through the slipway track.
3. One or two (for larger cross-slipways) pumping wells.
4. One or two (for larger cross-slipways) settling tanks.
5. Modification (under internal management) of slipway trolleys and chain wells.
6. Floating oil barriers in case of calamities.

Taking into account depreciation over ten years, and an interest rate of 13%, the annual fixed costs for purifying waste water at a shipyard with a paved cross-slipway amount to approx Dfl.40,000 (excluding the costs of sealing the slipway floor and any decontamination of the soil).
The costs of purifying the waste water flow from a dock consist of the purchase, engineering and installation of a separator and sludge pit. As far as shipyards with two uncovered excavated docks are concerned, the annual fixed costs amount to approx. Dfl.80,000. Particularly the costs of installing the equipment may rise considerably. The average costs of floating docks will be on the same level compared to the costs of excavated docks. Depending on the construction, however, the costs of floating docks may vary considerably. Particularly the costs of a pontoon, the floor of which consists of a number of separate segments, may increase considerably.
Against the high costs which have to be invested for environmental facilities, there will clearly be savings for dredging and dumping spoil in the long term.

Supervision
Supervision at shipyards may generally consist of an inspection to see whether the discharge runs through a settling tank (or some other approved purifier), and whether this unit has been installed and is operated properly (no hydraulic overload). The specific company measures ("good housekeeping") can be inspected for their adequacy, by checking any discharges of oil or other substances at the site which have an adverse effect to the quality of the water.
Whenever doubts arise during inspection -as to the unit not being operated properly- a sample of the effluent can be taken to determine whether the requirements as laid down in the permit have been met.
To decide whether the working floor is properly cleaned, it will be necessary that the District Water Board is notified with regard to the water supply at certain facilities.

Other recommendations
It is recommended that a method is selected for grit blasting, so that the grit is left on the floor, and is only cleared up after the paint has been sprayed (sawdust function). Shipyards will have to promote that spraying of the dock must later take place in a rationalized situation, in which waste water is treated after the grit and paint have been cleared up dry. At the moment, work at many shipyards in the Netherlands is being carried out according to dock and slipway floor discipline (MDH). Good implementation of this is vitally important as far as manageable emissions are concerned.
It is recommended that clear agreements are reached regarding measures to be taken when ships extend beyond the confines of the docks. The following arrangements can be made with the docks:
- The ship must always be treated above an enclosed sealed surface, so that waste water, paint and grit particles can be collected properly.
- If possible, the ship must be treated within the side walls of the dock. Should this be impossible, the dock will have to be provided with the necessary protective measures against wind ("extending" the dock walls).
- Should it be impossible to work inside the dock walls and to take the measures mentioned above, only the vacuum blasting method (plus wind speed reduction) will be used on the projecting part and paint may be applied with a brush or roller (above the paved surface).

Work on floating objects may only be carried out if it does not affect surface water.
Underwater brushing of the submerged surfaces of seagoing vessels, applying the current paint systems, still gives rise to uncontrollable and unmanageable emissions into surface water. This is not to be permitted by the District Water Boards.

Rationalization dates
Shipyards should submit a rationalization plan before August 1992. This plan should indicate how the purification of emissions will be realized. It should also state what the residual emissions will be after purification. Based on the rationalization plan, the licensing authorities will lay down requirements for waste water flows to be discharged. Purification may be divided into the rationalization of water polluting operations and the cleaning of the work floor.
It is recommended that August 1992 is the final rationalization date, before which all companies must have rationalized their water polluting operations. It is important that the companies will be informed about the date.
Cleaning work floors (whenever they fall under the Surface Water Pollution Act, WVO), such as slipways which are regularly submerged, for instance at high tide and in tidal waters, may be included in the rationalization of water polluting operations. However, it is also possible

that -in consultation with the (water pollution) licensing authorities- the rationalization will be phased. There will have to be an agreement on clear time limits. It is proposed that measures to clean work floors are to be taken before August 1994 (a year extra). The cleaning of work floors (such as slipways) will mainly be controlled by the licensing authority applying the Nuisance Act (HW).

3.19.2 Conclusions branch study

In general

1. Preservation activities are carried out at the following sites:
   - large shipyards with docks/slipways for seagoing vessels,
   - shipyards with slipways and/or small docks for inland craft, fishing and recreation,
   - specialized maintenance companies (water-blasting companies) at a permanent site, along a wharf, (covered) dock or work floor.
2. In the Netherlands, there are approx. 50 shipyards disposing of facilities for building or repairing seagoing vessels, and approx. 140 shipyards for building and repairing mainly inland craft. There are approx. 15 larger shipyards for yachts. More than half of these companies is situated in the provinces of North and South Holland.
3. Cutbacks in capacity and jobs have led to some improvement as far as productivity and continuance in certain sectors are concerned.
4. The following facilities, (un)covered, are used at shipbuilding and ship-repair yards: slipways, docks, ship canal lifts and screw propeller docks.
5. At the time when those facilities were designed and built, no account was taken of the current environmental demands. Therefore, it will be difficult to implement the necessary environmental measures in the old facilities without high costs, because no adjustments have been made through the years.

Activities

6. There are approx. 7,850 inland craft in the Netherlands, which enter a yard every two to four years.
7. Inland craft are put in dry-docks or on slipways in shipyards. The part of the ship below the water line is sprayed with water under high pressure, subsequently, two new layers of tar are usually applied after possible repairs.
8. Seagoing vessels are put in docks for maintenance every two to four years. The procedure pursued is as follows:
   - enter dock, take up position and moore the ship;
   - cleaning the hull of the ship below the water line by means of a jet of water (removing fouling, paint and rust that is coming off);
   - in case of an oil surround on the ship's skin, a detergent is sometimes sprayed;

- if necessary, layers of paint are roughened or completely or partially removed by means of grit blasting;
- subsequently, a paint system containing anti-fouling agents is applied;
- the grit used is cleared up from the dock floor, usually after the layer of paint has been applied.

9. Whenever there is a slipway, the ship is brought to land by means of winches. No grit blasting is applied on slipways, apart from some exceptions, in connection with wear of the winches. Furthermore, the procedure equals the one mentioned under 8.
10. In case of shipbuilding, high pressure spraying is not applied. Grit blasting activities only occur sporadically, and paint spraying periodically.
11. High pressure water spraying is mostly carried out with pressures up to 250 bar.
12. The best known form of dry blasting is the so-called grit blasting. A considerable emission of dust will arise when grit blasting is applied.
13. No spreading of dust will take place in case of the vacuum blasting method. However, both for economic and technical reasons (unreliability), it has not yet been applied for the treatment of larger surfaces.
14. Brushes or rollers are mostly used for inland craft, recreational vessels and partly fishing boats as well, whenever paint is applied.
15. Airless paint spraying is almost exclusively applied whenever large ships are built or maintained. Due to wind dispersal of paint sprays, considerable spray losses (5% - 45%) may occur whenever this method is applied.
16. Research into industrial application of electrostatically spraying in the open is going on.

Preservants

17. Preservation is composed of more layers, such as anti-corrosive primers, intermediate layers and a top layer.
18. The current consumption of anti-fouling paints, paints of which the ones containing organotin and copper compounds are the most striking examples, is considered to be a serious environmental problem.
19. Anti-fouling paints containing organotin have average percentages of copper and organotin of 25% and 6% respectively. The anti-fouling paints containing copper have an average percentage of copper of 25%, too.
20. Anti-fouling paints can be divided into two types: leaching and self-polishing anti-fouling paints. Leaching anti-fouling paints can also be divided into soft and hard anti-fouling paints.

21. The major disadvantage of leaching anti-fouling paints lies in the fact that biocides are used inefficiently. Self-polishing anti-fouling paints equally emit biocides to the environment, and do not have this problem. A weak point of those paints is the protection when boats lie still for a long time. Therefore, copper compounds are added to self-polishing anti-fouling paints.
22. Approx. 20% of the seagoing vessels that are treated at Dutch ship-repair yards has a self-polishing coating, 30% of the ships has a hard anti-fouling coating.
23. Tar products are mostly applied in inland navigation.
24. Those tar products almost completely consist of coal tar pitch, in which the polycyclic aromatic hydrocarbons (PAHs) cause problems.
25. In addition to the regular tar products, binary epoxy tars are applied as well (approx. 30% coal tar pitch). Those products are used as bottom layers at seagoing vessels.
26. Approx. 700 tons of tar are yearly applied in inland navigation. It is impossible to make an estimate of the quantities of paint used.

Emissions

27. Emissions resulting from the preservation of inland craft consist of diffuse emissions due to evaporation, wear and leaching, and of an emission at the yard as a point source caused by water-blasting.
28. As far as seagoing vessels are concerned, emissions consist of diffuse sources such as evaporation and leaching, at the shipyard also of emissions due to high pressure water water- blasting, wind dispersal of grit and paint particles.
29. 50% of the PAHs present in tar applied at inland craft disappears due to evaporation during the process of drying.
30. In inland navigation, 0% to 38% of the PAHs ends up in water diffusely due to wear. Due to leaching, 6% to 25% ends up in water diffusely.
31. Due to inland navigation, 25% to 45% of the PAHs that was originally applied with the paint will disappear in surface water diffusely. Which is a yearly load of 7 to 13 tons of PAHs.
32. Particularly as far as anti-fouling paints are concerned, it is expected that the total load due to leaching is higher than the load at shipyards. As seagoing vessels only enter port for a relatively short period of time, biocides will mostly end up in water at sea.
33. It can be expected that leaching of copper will especially take place at ships that are just treated, but that leaching of organotin from self-polishing anti-fouling paints will be relatively low locally, in ports.
34. No quantitative data are available on the leaching of copper and organotin from seagoing vessels.

35. Whenever grit blasting of the ship's skin takes place, minuscule particles of paint and grit will be blown away at an open dock or slipway. Also whenever paint is sprayed, emissions will take place due to wind dispersal, which may run to some dozens of percents. This depends on the wind speed and method applied. Emission to the soil or surface water is minimal in case of applying paint with a brush or a roller.

Waste water

36. Whenever an inland craft is hosed-down, approx. 9 m^3 of water is used. Nation-wide, approx. 23,000 m^3 of water is released due to hosing-down.
37. An average of approx. 130 g of PAH is released by each inland craft. The annual PAH emission of an average inland shipyard is estimated at approx. 13 kg.
38. The following waste water streams are released at ship-repair yards for seagoing vessels: sprayed water from preservation activities, ballast, cooling and bilge water from the ship. At excavated docks, leakage water and groundwater seepage are added. At uncovered facilities, rain-water might be polluted as well.
39. Leakage water at the dock gates and the ballast water from the ship can often be removed from the waste water stream separately.
40. The quantities will differ for each ship, day and shipyard. Therefore, the quantities of waste water discharged nation-wide cannot even be estimated for shipyards of this type.
41. It appears that the polluting components are present in waste water as solid substances or suspended matter.
42. The average emission from seagoing vessels is 1,000 g of oil and 20 kg of suspended matter containing 270 g of copper, 40 g of organotin. The degree of pollution strongly depends on the methods pursued.
43. Oil pollution is certainly not always present in waste water. (Possible sources: removal of oil surround and fat/oil from the ship's screw propeller.)
44. Waste water from high pressure spraying appears to be less polluted than waste water released after hosing-down the dock after grit blasting or paint spraying.
45. At an average ship-repair yard for seagoing vessels (150 dockings a year), it is estimated that the following loads are yearly released: 3.5 tons of suspended matter, 40 kg of copper, 10 kg of organotin and 150 kg of oil.
46. Nation-wide, 14 tons of PAH (6 Borneff) yearly evaporates into the air due to the application of tar on inland craft. 7 to 13 tons of PAH ends up in surface water diffusely, and 50 to 200 kg of PAH is yearly emitted to surface water due to high pressure spraying at shipyards.

47. It is hardly possible to make an estimate of the national emissions of copper and organotin.
48. The PAH emission to surface water directly from shipyards for inland craft amounts to approx. 2% of the diffuse load due to leaching and wear.
49. The total national emission of PAH amounts to approx. 18 tons. Inland navigation contributes most to this with approx. 10 tons.

Measures

50. A direct emission approach, that is an approach at source -the paint system- to reduce pollution, is urgently desired for the method of preservation which is momentarily applied for inland craft. Adjusting slipways and docks will only lead to a slight decrease of the total soil pollution caused by tar preservation.
51. An approach at source for paint systems on seagoing vessels is impossible due to the international (global) character.
52. From an environmental point of view, (aluminium) bitumen are preferable to tar as a substitute in inland navigation.
53. With it, the costs for maintenance of an average inland craft are yearly increased with approx. Dfl.350.
54. At the moment, good dock and slipway floor discipline (MDH) is pursued at many Dutch shipyards. A good implementation of it is of the utmost interest to keep emissions controllable.
55. It is to be expected that jet water released during hosing-down inland craft can be treated well by means of sedimentation.
56. Also waste water from ship-repair yards for seagoing vessels can be settled well. After one hour, 80% to 90% of the suspended matter has settled.
57. Rising substances (oil) can be removed by means of an oil/water separator. Which can be combined with, for instance, a sediment separator.
58. Due to the location of many shipyards, it will often be impossible to transfer all waste water to the sewerage.
59. As far as preservation activities are concerned, facilities to protect the soil are particularly important to slipways.
60. Because of the extreme loads, it is often difficult to keep a sloping surface at the shipyards in question waterproof. Paving with clinkers, concrete or asphalt will provide sufficient protection against pollution of the soil with paint particles. The risk of soil pollution by fluids (mainly oil) can be avoided by taking measures linked with the company. The measures may consist of placing collecting vessels.
61. Activities to floating objects should only be carried out whenever they do not affect the surface water.

Costs

62. The costs of implementing measures to reduce pollution will strongly differ for each shipyard. As an indication: in case of a depreciation over ten years and an annual interest rate of 13%, the annual fixed costs for purifying waste water at a shipyard with a paved cross-slipway amount to approx. Dfl. 40,000. (Which is exclusive of sealing the slipway floor and any decontamination of the soil.) For a shipyard with two uncovered excavated docks, the annual fixed costs amount to approx. Dfl.80,000.
    The costs for floating docks will, on average, be on the same level as those for excavated docks. Depending on the construction, however, the costs for floating docks may vary considerably. Particularly for a pontoon dock, in which the floor consists of a number of separate segments, costs may increase considerably.
63. Against the high costs which have to be incurred for environmental provisions, there will clearly be savings in the long term as far as dredging and dumping dredging spoil are concerned.

3.19.3 Recommendations

1. It is recommended that for grit blasting a method is selected so that the grit is left lying and is only cleared up after the paint has been sprayed (sawdust function).
2. It is recommended to lay down in the permit, that in a rationalized situation (treatment waste water) the dock is sprayed after the grit and paint has been cleared up dry.
3. Overspray should firstly be limited by a good floor discipline of those who apply the paint: using the proper equipment and working as close as possible to the surface that is to be treated. Both are part of a good dock and slipway floor discipline.
   In case of grit blasting and paint spraying in the open air, protective measures against the wind should be taken to avoid wind dispersal. (Practical tests are being carried out with fine-mesh nets in combination with a water spray.) It is recommended that such measures are laid down in the permit.
4. It is recommended that clear agreements are reached regarding the measures to be taken when ships extend beyond the confines of the docks. The following arrangements can be made with the docks:
   - The ship must always be treated above an enclosed surface, so that waste water and paint and grit particles can be collected properly.
   - If possible, the ship must be treated within the side walls of the dock. Should this be impossible, then the dock will have to be provided with the necessary protective measures against wind ("extending" the dock walls).

- If work cannot be done inside the dock walls and the supplementary measures mentioned above cannot be taken, only the vacuum blasting method (plus wind speed reduction) will be used on the projecting part and the paint may be applied by brush or roller (above the paved surface).

5. As indicative discharge demands in the permits for suspended matter and oil are recommended 100 mg/l and 20 mg/l respectively.
6. It is proposed that for calculating the basic dimensions of the waste water treatment unit, account is taken of a rain intensity of 1 mm/h.
7. Companies with docks, ship canal lifts and slipways with dock gates should report in writing launchings, after preserving activities have been carried out, to the water quality authority not later than 24 hours before they are to happen. Whenever a launching takes place after other activities are carried out, the above-mentioned reporting is to be done not later than four hours before.
   Should it appear -after a reporting as meant above- that preservation activities will be ended sooner as reported to the water quality authority, the license holder may request the water quality authority to allow a launching to take place at an earlier stage.
   The water authority is to respond to such a request immediately. It is recommended to include this in the permit.
8. The shipyards are to submit a rationalization plan before August 1992. Based on this plan, the licensing authority will have to formulate demands regarding the waste water streams to be discharged. Measures to reduce pollution are to be divided between activities that pollute water, and pollution control measures at work floors. August 1993 is recommended as the final date with regard to rationalization, by which all companies must have rationalized their water polluting activities. It is important that the companies are notified of this date.
9. Cleaning the work floors (when they fall under the WVO, Surface Water Pollution Act, such as slipways which are regularly submerged, for instance at high tide and in tidal waters) may be included in the rationalization of water polluting operations. However, it is also possible that -in consultation with the (water pollution) licensing authorities- the rationalization will be phased. Clear time limits will have to be agreed. It is proposed that August 1994 be regarded as the time for cleaning the work floor (a year extra). Especially the cleaning of work floors (slipways) will be controlled by the licensing authority by applying the Nuisance Act (HW).

With regard to checks

10. Checks at shipyards may generally consist of an inspection to see whether the discharge flows through a settling tank (or another approved purifier), and whether this unit has been installed and is being operated properly (no hydraulic overload). The specific

company measures ("good housekeeping") can be inspected for their adequacy, with a check for any discharges of oil or other substances on the site which may have an adverse effect on the quality of the water.
If the inspection raises doubts, as to the proper operation of the unit, a sample of the effluent can be taken to determine whether the requirements laid down in the permit have been met.

11. Underwater brushing of the submerged surfaces of seagoing vessels, applying the current paint systems, still gives rise to uncheckable and unmanageable emissions into surface water. Therefore, this should not be permitted by the water authorities.
Subsequently, the following recommendations can be brought to the notice of the Ministry for Housing, Regional Development and the Environment.
12. It is recommended that a research is to take place into acceptable substitutes for tar and tar products for application on ships.
13. Should an acceptable substitute for tar be available, then consideration should be given to a prohibition on the use of tar or tar products on ships or other mobile objects. Replacing coal tar is the only permanent solution to pollution of the soil with PAHs from preservation of ships.
Germany and Belgium are particularly important with regard to transferring to other maintenance products. Shipyards in the Netherlands will come under competitive pressure from these two countries should maintenance costs be raised unilaterally in the Netherlands. Therefore, it is important for these two countries to be involved.