## FEDERAL OFFICE FOR SCIENTIFIC, TECHNICAL AND CULTURAL AFFAIRS.

*Scientific Support Plan for a Sustainable Development Policy*

# Quality status and terrestrial inputs for the North Sea

## Summary of the research

**Coordination: Analytical and Environmental Chemistry Service (ANCH), VUB.**

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**2001**

## Quality status and terrestrial inputs for the North Sea

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## OBJECTIVES

### General objectives of the project:

The first and principal objective of this project is to write the 4th Chapter of the following "Quality Status Report-1999" (QSR). The history of the QSR´s goes back to the first International Conference on the Protection of the North Sea in 1984, where one recognised the need to arrive at a comprehensive overview of the extent of North Sea pollution caused by human activities. The QSR of 1987 which was drafted in response to this need identified a number of shortcomings in the scientific knowledge at that time. These shortcomings were dealt with at the second North Sea Conference in 1987. The Conference asked ICES and OSPARCOM to set up a special group known as the "North Sea Task Force" (NSTF), which was given the following mission : " To carry out work leading, within a reasonable timescale, to a dependable and comprehensive statement of circulation patterns, inputs and dispersion of contaminants, ecological conditions and effects of human activities in the North Sea".

The variability in physical characteristics and processes has a major impact on chemical and biological characteristics and processes and casts a haze of uncertainty over determinations of the impact of human influences on the natural characteristics and processes in the North Sea. Moreover, in the past the accuracy and reliability of analytical results were far from high. As a result of this, one became much more clearly aware of the need for a quality control of environmental analyses, as can be illustrated by the proliferation of "quality assurance" (QA) guidelines, standards and accreditation systems. Today, many databases accept only such "quality assured" data. The present research project, however, is also designed to seek out additional data produced in the various coastal states. This latter information will be subject to a QA evaluation, taking accuracy and precision into account. Attention will be focused on metals and organic contaminants (metals, organometals, persistent organic pollutants, polycyclic aromatic hydrocarbons), Petroleum hydrocarbons, Nutrients (inorganic and organic dissolved nitrogen and phosphorus as well as inorganic dissolved silicon) and eutrophication, as well as radioactivity. Spatial and temporal distributions of these chemical compounds in seawater, atmosphere, sediments and biota as well as their input fluxes to the marine environment will be addressed.

The 1993 "Quality Status Report" already mentioned a number of influences of human activities on concentrations and evolutions. We will attempt to refine the methods used and add new ones so as to better recognise anthropogenic influences.

Beyond this, terrestrial fluxes from Belgium and the 3 Regions will be established for most of the 36 priority substances which are persistent, toxic and bioaccumulable and which were included in annex 1A of the Final Declaration of the 3rd North Sea Conference (The Hague, 1990). This agreement provides for emission reductions of the priority substances. For practical reasons, the Belgian North Sea Technical Working Group decided to determine the substance fluxes to the North Sea on the basis of the primary emissions into the water and the air, and not on the basis of calculated advective fluxes in these two compartments.

Current substance flows from Belgium to the North Sea will thus be drawn up on the basis of more recent emission data to water and atmosphere from the 3 Regions in Belgium. These will be compared with data obtained from experimental concentration and flow measurements in the Scheldt estuary and the North Sea.

This project fully corresponds to the complementary subjects A6 “Evaluation of the chemical contamination of the North Sea” and A8 “Assessment of the contamination of the marine environment from land-based sources”.

## Objectives of each of the Subprojects:

The objectives of each of the subprojects are the same as those of the general project. The tasks to be performed were evenly divided among the three promoters.

Distribution of tasks:

A. The Quality Status Report: Chapter 4 “Marine Chemistry”.
  - Introduction (VUB)
  - Input (ULB)
  - Background and reference values (UIA)
  - Heavy metals (ULB, except for the VUB for Hg)
  - Persistent organic pollutants (UIA, except for the VUB for TBT)
  - Multiple chemical inputs (ULB)
  - Oil (ULB)
  - Radionuclides (UIA)
  - Nutrients and oxygen (VUB)
  - Input trends (UIA)

B. Substance flows.
  - PAH´s, PCB´s, dichlorvos, trichlorobenzene, pentachlorophenol (UIA)
  - Cadmium, copper, lead, carbon tetrachloride, chloroform, tri- and tetrachloroethylene, 1,2-dichloroethane and trichloroethane (ULB)
  - Mercury, tributyl- and triphenyltin compounds, dioxins and nutrients N/P (VUB)

## CONCLUSION: QUALITY STATUS REPORT-2000

In 1999 the troika composed of the participating laboratories of the VUB, ULB and UIA wrote a draft text for chapter 4, Chemistry, of the Quality Status Report-2000, Region II – Greater North Sea. In preparing the draft text, primary use was made of official OSPARCOM reports (OSPARCOM = Oslo and Paris Commissions) which already form a synthesis of the information and the data which were submitted by the individual Member States to the Commission.

The draft text was then presented to the Regional Task Team (RTT) of the Greater North Sea which, with the Netherlands as pilot country and Frank van der Valk as chairman, coordinated all of the report's chapters. During the various RTT working meetings in 1999 and 2000, all of the chapters were discussed and improvements and adaptations were requested by all Member States, both as to form and content. These adaptations were made with regard to chapter 4 by the troika until one finally reached an agreement with the Task Team and the editor about the final version of the end report.

OSPAR then published all of the reports in 2000. The reference of the report relevant for our mission is: Quality Status Report 2000, Region II – Greater North Sea and is published by the OSPAR Commission, London 2000, ISBN 0 946956 48 0 (website: http://www.ospar.org). Chapter 4, Chemistry, is to be found on pages 51 to 85.

## CONCLUSION: SUBSTANCE FLOWS

The methodology followed for determining the substance flows is twofold: Firstly, the emissions to the compartments air and water were determined on the basis of measurement data which were collected by the Regions. In addition there are also estimates of substance flows on the basis of the consumption of the substance involved in a specific activities sector. The degree of uncertainty on the estimates rises as the diffuse character of the discharges increases.

The conclusions of each substance flow file are summarised below. The individual substance flow files are annexed.

### 1. Carbon tetrachloride:

In the past, the atmospheric emissions were by far the most important source of pollution and the PVC industry was the primary polluter. Since the introduction of a gas-washing system in 1997, the emissions by this sector have fallen so sharply that they are now situated below the detection limit. With regard to the other sectors, it appears that either there are no more emissions (petrochemicals) or they have been sharply reduced (laboratories) as a result of legal provisions concerning the use of the product. Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

99.8% for the compartment air (from 310 to 0.55 tonnes/year)
94.5% for the compartment water (from 2.19 to 0.12 tonnes/year)

**The overall reduction percentage amounts to 99.8%**

### 2. Chloroform

The atmospheric emissions are by far the most important source of pollution. The introduction of new, high-performance purification technologies in the dichloroethane industry is the primary cause of a sharp fall in atmospheric emissions. Moreover, earlier estimates assessed the contributions of workplaces and laboratories to be higher than they were in reality. Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

92% for the compartment air (from 694 to 54 tonnes/year)
60% for the compartment water (from 61 to 25 tonnes/year)

**The overall reduction percentage amounts to 90%**

## 3. 1,1,1 - trichloroethane

A reduction of 100% was attained in the year 2000 as a result of totally ceasing to use the product as a solvent for degreasing metal, as well as for several less important applications.

**The overall reduction percentage amounts to 100%**

## 4. Tetrachloroethylene (PER), trichloroethylene (TRI), dichloroethane (EDC)

The atmospheric emissions are by far the most important source of pollution. In general one observes a decrease in atmospheric emissions on an order of magnitude of 15 to 25% since 1995. In absolute figures, the most important sectors for the year 2000 are: (1) dry cleaning (1740 tonnes PER), but the sector shows a decrease of 25% and (2) the degreasing of metals (1960 tonnes TRI and 563 tonnes PER), whereby, compared with 1995, one found a shift in use from TRI (-373 tonnes) to PER (+353 tonnes). The use of EDC, for which in 1995 the vinyl chloride industry was responsible for one-half, fell from 98 to <14.5 tonnes.

The aquatic discharges of these solvents are marginal.

As a result of the stricter regulations and technological progress, the use and the emission of these solvents will decline even further.

**The overall reduction percentage between 1995 and 2000 amounts to 15 to 25%**

## 5. Dichlorvos

There is absolutely no question of attaining the 50% reduction target, proposed by the North Sea Conference, neither for non-agricultural nor for agricultural use. The application of dichlorvos in agriculture, by contrast, has risen spectacularly since 1985 (increase of 3 000%). Outside of agriculture, the use of dichlorvos has increased only slightly (increase of 20%). High residues are not found, however, because the product breaks down rapidly.

**The overall increase percentage between 1985 and 2000 amounts to 200%**

## 6. Trichlorobenzene

Trichlorobenzene only recently began to be monitored. That is because this substance is only stored for further transit. A 1985-2000 evolution is thus irrelevant.

**The overall reduction percentage between 1985 and 2000 is not known.**

## 7. Polycyclic Aromatic Hydrocarbons (PAH´s)

The atmospheric emissions are by far the most important source of pollution (more than 99% of the total). The two greatest sources are wood protection (655 tonnes in 2000) and traffic (97.5 tonnes in 2000).

The treatment of wood with creosote and carbolineum, both by the wood preservation industry and by private individuals, remains far and away the most important source for the emission of PAH´s, even despite a 57% reduction. For 2000, this sector´s share of the total emissions to air is estimated at 84%.

Traffic represents around 12% of the PAH emissions. A decrease of 55% since 1985 was found, which is primarily ascribable to the introduction of new technologies to eliminate both gaseous and particulate emissions. Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

61% for the compartment air (from 1980 to 780 tonnes/year)
94% for the compartment water (from 53 to 3 tonnes/year)

**The overall reduction percentage amounts to 62%**

## 8. Pentachlorophenol (PCP)

In Belgium, PCP and derivatives may no longer be used. One can state that the emissions of PCP and derivatives are thus virtually extinct. The only new source of emissions is the importation of wood treated with PCP. Furthermore, only the emissions resulting from treated wood in the waste phase are significant.

**The overall reduction percentage amounts to > 50%**

## 9. Polychlorinated biphenyls (PCB´s)

The closed applications of PCB´s account for 81% of the estimated total emissions in 2000. Moreover, in the future the share of these emissions will increase further, due firstly to the later date on which this application was prohibited, and secondly to the character thereof (closed vs. open).

The emissions from large condensers and transformers (4500 kg in 2000) are difficult to estimate, since the holders of such equipment only indicate capacities, and a good conversion factor does not exist. A realistic estimate of the emissions for 2000 lie around 4500 kg, which corresponds to 52% of the total emissions. This is a decrease of around 18% vis-à-vis 1985.

Small condensers contribute by far the most to the emissions of all uncontrolled applications (29%). Their total emissions fell from 11.5 tonnes in 1985 to 2.5 tonnes in 2000. This constitutes a decrease of 78%.

The various open applications are responsible for an emission of 1600 kg in 2000 (reduction of 97% since 1985).

**The overall reduction percentage amounts to 88%**

## 10. Dioxins

The atmospheric emissions are by far the most important source of pollution. The emission amounted to 854 g-TEQ in 1985 and fell by 81.3% to 153 g-TEQ in 2000. The 2 most important sectors in 2000 (they represent more than 90% of the total emission) are the iron and steel industry and building heating systems. Although the aquatic emissions of dioxins are marginal, relatively high contents are observed in sewage sludge. The origin of this is still unknown.

For the entirety of the sectors in Belgium, therefore, the proposed reduction percentage of 70% has been attained for the period 1985-2000.

**The overall reduction percentage amounts to 81%**

## 11. Organotin compounds

The use of tributyl compounds in Belgium as antifouling agent, the primary application, displays no observable trend over the period 1985-2000.

Triphenyl compounds are used only in agriculture and, in the absence of alternatives, no reduction can be observed here.

**The overall reduction percentage is zero**

## 12. Cadmium

The most important reductions in the period 1995-2000 are situated in the compartment air, as a result of flue gas treatment in the most polluting sectors.

Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

95% for the compartment air (from 14.2 to 0.69 tonnes/year)
64% for the compartment water (from 16.9 to 6.1 tonnes/year)

**The overall reduction percentage amounts to 78%**

## 13. Copper

The most important polluting sector for the compartment air is the transport sector, more specifically the wear and tear of brakes and transport fuel and, for the compartment water, domestic waste water. As a result of the multiple applications and pollution sources of copper, the proposed reduction percentage of 50% has not been attained.

Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

38% for the compartment air (from 154 to 95 tonnes/year)
47% for the compartment water (from 148 to 78 tonnes/year)

**The overall reduction percentage amounts to 43%**

## 14. Lead

At 75% of the total, atmospheric emissions remain the primary pollution path in 2000 as well. Yet for this compartment the reduction target (50%) has been amply met (86%), while this is not the case for the compartment water (42%, short of the target 50%). The most important reason for the big decrease in atmospheric emissions is the switch to unleaded petrol.

Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

86% for the compartment air (from 1743 to 243 tonnes/year)
42% for the compartment water (from 126 to 73 tonnes/year)

**The overall reduction percentage amounts to 73%**

## 15. Mercury

At 75% of the total, atmospheric emissions are the primary pollution path. The strict discharge standards and the adaptation of production processes (e.g. in the chlorine-alkali industry) or waste recovery (e.g. the installation of amalgam separators) have led to a sharp reduction in emissions. The proposed overall reduction target of 70% has been attained.

Vis-à-vis the reference values in 1985, the reduction in 2000 amounts to:

88% for the compartment air (from 13 325 to 1 583 kg/year)
78% for the compartment water (from 2 350 to 515 kg/year)

**The overall reduction percentage amounts to 86%**

## GENERAL CONCLUSION: SUBSTANCE FLOWS

The reduction targets proposed by the Ministerial North Sea Conferences were met for the following substances: carbon tetrachloride, chloroform, trichloroethane, PAH´s, Pentachlorophenol, PCB´s, dioxins, cadmium, lead and mercury.

These targets were not met for dichlorvos (the only substance whose use even increased sharply), tributyl- and triphenyltin and copper. The status quo situation for the tin derivatives is especially alarming, due to their high toxicity and persistence.

For the period 1985-2000, the reduction percentages could not be calculated for trichlorobenzene (this substance is only stored in our country with a view to further transit) and for tri- and tetrachloroethylene and 1,2-dichloroethane. For these last three substances together, the overall reduction percentage in the period 1995-2000 lies between 15 and 25%.

### ACKNOWLEDGEMENTS:

The authors-promoters wish firstly to thank the Office for Scientific, Technical and Cultural Affairs for their financial support and their interest in this policy-supporting work. For the "Quality Status Report" section, our deepest appreciation goes to the members of the "Regional Task Team" and its Belgian representative, the MUMM. For the Substance Flows section, we wish to express our gratitude to everyone who provided information and data, and in particular the representatives of the three Regions and the MUMM.