

# SCOPE NEWSLETTER

IN EUROPE

Number Fifteen

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## **The Impact Of Sodium Tripolyphosphate Substitution In Western Europe**

According to scientists at the Imperial College of Science, Technology and Medicine, the overall impact of STPP substitution on the natural environment is insignificant. Instead, the trend is better explained by political and marketing considerations.

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## **Publication Of The Swedish Phosphate Report**

Landbank Environmental Research and Consulting publishes the results of a second life cycle analysis of the two main detergent builders, Sodium Tripolyphosphate and zeolite/PCA. The report of the study confirms that under all modelled conditions, phosphate appears as a better environmental solution than Zeolite/PCA. To the authors, advanced wastewater treatment is the only effective method to prevent water pollution. A review of bans and restrictions on the use of detergent phosphate is recommended.

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## **Second Report Of The Technical Committee On Detergents And The Environment**

The United Kingdom Technical Committee on Detergents and the Environment assessed the relative importance of detergent phosphate on river nutrient enrichment, as compared to agricultural, domestic and industrial sources.

The committee concludes that the removal of STPP from detergents has been unsuccessful as a strategy for improving water quality. Only the use of a range of techniques such as nutrient stripping, modification of agricultural practices and removal of sediments can succeed in reversing the effect of nutrient enrichment in sensitive areas.

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## **Debate On The Relationship Between Phosphorus Concentration And Water Quality.**

*Water Resources* publishes a comment on an earlier article which suggested a direct link between the reduction of phosphorus concentration and improvement of water quality. For the authors of the comment, the relationship between the two phenomenon has not been scientifically demonstrated and should therefore not be made.

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## **Pesticides Might Ignite Blue-Green Algae Bloom**

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## **High Humus Concentration Might Control Algal Blooms**

SCOPE is a non-commercial, non-profit making European association based in Brussels.

Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

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SCOPE : Scientific Committee on Phosphates in Europe - Association Sans But Lucratif sise à Bruxelles et soumise à la Loi du 27 juin 1921

UNITED KINGDOM

**THE IMPACT OF SODIUM  
TRIPOLYPHOSPHATE SUBSTITUTION  
IN WESTERN EUROPE**

**According to scientists at the Imperial College of Science, Technology and Medicine, the overall impact of STPP substitution on the natural environment has been insignificant. Instead, the trend is better explained by political and marketing considerations.**

Scientists from the Environmental Engineering Laboratory at the Imperial College of Science, Technology and Medicine in London, reviewed the issue of phosphate limitation in western European countries, with special regard to its actual impact on the control of eutrophication. They have come to the conclusion that there is no example in Europe where STPP restrictions alone have been a solution to eutrophication.

A thorough study of European legislation and its impact show that the only improvements in this field were obtained in countries where phosphorus removal was implemented at sewage treatment works, with or without restrictions on the phosphate content of detergents.

This finding is explained by the limited contribution of

detergents to the total phosphorus discharge in rivers. Of all the anthropogenic sources of phosphorus, about 50 % originates from diffuse sources like agricultural run off and livestock waste. The remainder is supplied by industrial and domestic waste water, half of which comes from human waste.

In this context, the exclusion of STPP from laundry detergents is considered, at most, a secondary and mainly economic consideration. Instead, the authors recommend the implementation of waste water treatment.

However, despite a lack of any demonstrated effectiveness of STPP restrictions, many governments have used this measure to respond to public pressure at a low cost. This kind of measure indeed meets a popular demand without raising governments' expenditures, identified as an important factor in voting preferences.

The appearance of P-substitutes in detergents also responded to a marketing opportunity. The economic aspect of this question is developed by the authors who relate how the switch to phosphate free product was successfully instigated by a detergent manufacturer, as a way to increase its presence on the detergent market and to secure its position as a detergent builder supplier.

*The Impact of Sodium Tripolyphosphate Substitution in Western Europe, G. K. Morse, R. Perry and J. Lester, in Ambio, Royal Swedish Academy of Sciences, Sweden March 1995.*

# SCOPE NEWSLETTER

IN EUROPE

## SWEDEN

### PUBLICATION OF THE SWEDISH PHOSPHATE REPORT

Landbank Environmental Research and Consulting publishes the results of a second life cycle analysis of the two main detergent builders, Sodium Tripolyphosphate and zeolite/PCA. The report of the study confirms that under all modelled conditions, phosphate appears as a better environmental solution than zeolite/PCA. To the authors, advanced wastewater treatment is the only effective method to prevent water pollution. A review of bans and restrictions on the use of detergent phosphate is recommended.

The Swedish Phosphate Report completes the analysis of detergent builders which began with the publication in 1994 of "The Phosphate Report" The first document addressed the impact of builders on the aquatic environment specific to the United Kingdom. The Swedish reports assesses the fate in the environment of phosphate and zeolite/PCA, within the context of advanced wastewater treatment as widely practised in Norway, Finland, Denmark and Sweden.

As in the first study, a Delphi panel was set up to evaluate the impact of the two builders on a range of

receiving waters and for different sludge disposal practices (landfill, agriculture, incineration, sea). Seventeen European water scientists specialising in waste water treatment participated in the panel. The Delphi technique requires scientists to remain anonymous. Therefore, a scientific auditor was appointed, his task being to ensure that the scientists involved were genuinely independent and that their views were all fairly treated.

Each scientist had to evaluate the impact of builders according to three possible situations.

The "as-is" situation calculated the impact of the current mix of phosphate-based and phosphate-free detergents as used in each country. The "all-P" and "P-free" situations calculated what the impact would be if only phosphate-based, or phosphate-free detergents were used. The results of the consultation are summarised in table 1.

**Table 1: Index of Environmental damage for five countries**

	As-is	All-P	P-free
Sweden	78	55	80
Norway	87	59	87
Finland	117	82	113
Denmark	327	183	570
UK	536	164	848

The results obtained bring two conclusions:

- Under all conditions, phosphate-based products are less environmentally damaging than products made of zeolite/PCA.
- Advanced wastewater treatment as practised in the Nordic countries is highly effective in preventing pollution

Highlighting the position of Sweden as a role model, Landbank recommends the implementation of advanced wastewater treatment and the production of sludge with low metal contents for recycling to agriculture, as part of a truly sustainable policy of water resource management in Europe.

The report is available on request from Landbank Environmental Research and Consulting, UK tel. +44 171 372 7122, fax +44 171 328 5910.

*B. Wilson, B. Jones. The Swedish Phosphate Report, Landbank Environmental Research and Consulting, London, May 1995.*

<p style="text-align: center;"><b>UNITED KINGDOM</b></p> <p style="text-align: center;"><b>SECOND REPORT OF THE TECHNICAL COMMITTEE ON DETERGENTS AND THE ENVIRONMENT</b></p>
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**The United Kingdom Technical Committee on Detergents and the Environment assessed the relative importance of detergent phosphate on river nutrient enrichment, as compared to agricultural, domestic and industrial sources. The committee concludes that the removal of STPP from detergents has been unsuccessful as a strategy for improving water quality. Only the use of a range of techniques such as nutrient stripping, modification of agricultural practices and removal of sediments can succeed in reversing the effect of nutrient enrichment in sensitive areas.**

The second report of the Technical Committee on Detergents and the Environment, published in December 1994, covers the years 1992-1993. It includes position papers on detergents' ingredients likely to have an effect on the environment.

The position paper on sodium tripolyphosphate points out that this builder optimises washing conditions and, by so doing, minimises the overall chemical use per wash.

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As far as eutrophication of rivers by point sources is concerned, phosphate stripping from wastewater is considered more effective than reducing the phosphate content of detergents. Also, diffuse nutrient sources coming mainly from agriculture are likely to be responsible of most the eutrophication problems in the often remote sensitive areas. The sources of phosphate in surface waters are shown in table 2.

Table 2: Phosphate sources for the UK

Source	%
Human sewage	24
Detergents and cleaners	19
Livestock	29
Arable land run-off	14
Industry	8
Background sources	6

The authors note that the experience throughout Europe has shown that the removal of phosphate from detergents has been unsuccessful as a strategy for improving water quality. They suggest that in some countries, the act of removing phosphate from detergents has served only to delay the investment in appropriate solutions to eutrophication problems.

The objectives of the committee are to monitor trends in the use of chemicals in detergents and cleaning products and to keep their impact under review. The Committee comprises representatives of various government departments concerned with the environment and industry, water authorities, environmental associations and industry.

*UK Department of the Environment, Second Report of the Technical Committee on Detergents and the Environment, December 1994.*

## USA

### DEBATE ON THE RELATIONSHIP BETWEEN PHOSPHORUS CONCENTRATION AND WATER QUALITY.

***Water Resources* publishes a comment on an earlier article which suggested a direct link between the reduction of phosphorus concentration and improvement of water quality. For the authors of the comment, the relationship between the two phenomenon has not been scientifically demonstrated and should therefore not be made.**

The controversial article, by F. A.. Hoffman and J. W.. Bishop <sup>(1)</sup> concluded by saying that there is "evidence that implementation of the ban reduced loading of phosphorus to the James River and improved Water Quality of the River".

According to G. Fred Lee and Anne Jones Lee, "a decrease in phosphorus concentration does not, per se, demonstrate an improvement in water quality". The relationship between the two phenomenon can be

made only if the decrease has indeed led to an observed reduction of algal-related water quality problems. Planktonic algal biomass, algal related water quality or hypolemnetic oxygen depletion are among the indicators of such problems.

Lee and Lee mention one unusual situation where a detergent phosphate ban in the USA may have resulted in improvement of one waterbody's water quality in the 70's.

At the present time, it is technically impossible to evaluate the actual effect of a detergent ban since the phosphate content of most laundry detergent products in the USA was reduced in the 70's. The authors estimate that a minimum 25% reduction of the total phosphorus load would be necessary in order for it to have any influence on water quality.

"The mistake of trying to equate reduction in phosphorus load to improvement in eutrophication-related water quality is commonly made" state the authors. Even the US EPA recently confused water quality with changes in chemical concentration throughout the National Water Quality Inventory 1992 Report to Congress.

(1) F. A.. Hoffman and J. W.. Bishop, Impacts of a phosphate detergent ban on concentrations of phosphorus in the James River, Virginia, *Wat. Res.* 28, 1239-1240 (1994)

*G. Fred Lee and Anne Jones-Lee, Comment on Impacts of a phosphate detergent ban on concentrations of*

*phosphorus in the James River, Virginia, Water Resources, Vol. 29, N°5, PP 1425-1426*

## SHORT NEWS

### AUSTRALIA

#### PESTICIDES MIGHT IGNITE BLUE-GREEN ALGAE BLOOM

The impact of farm pesticides run-off in rivers was studied by a team of the Australian Water Resources department. They conclude that pesticides from irrigated farms are entering the nation's inland waterways, inflicting significant damage on water life and ecosystems.

According to Dr Wolfgang Korth who led the study, large amounts of poisons are reaching the natural waterways and swamps. In many cases, the detected levels were far above those considered safe for drinking water.

One of the conclusion is that the presence of agrochemicals may trigger blue-green algae blooms by killing the microscopic waterfleas that normally feed on algae and control their growth, a phenomenon commonly attributed to the presence in excess of nutrients.

Says Dr Korth, "there is evidence that toxicity kills aquatic life over several days". The toxicity of water entering natural waterbodies is often high enough to kill more than half the water fleas.

*Julian Cribb, Science and technology writer, The Australian, March 21, 1995*

**AUSTRALIA**

**HIGH HUMUS CONCENTRATION MIGHT  
CONTROL ALGAL BLOOMS**

Many of the wetlands of the Swan Coastal Plain, Western Australia are nutrient rich and subject to blooms of green algae. Some of these wetlands are dystrophic and less likely to experience algal blooms, possibly because of high humus concentration.

Yellow colour by absorbency at 440 nm (Gilvin level) and the octanol/water partition coefficient, normally expressed as  $\log P_{o/w}$  for humic stained water from eleven of these wetlands were determined.

Some of the wetlands show high levels of humus content and low phytoplankton biomass in spite of high total phosphorus concentrations. The same wetlands also showed an ecologically significant  $\log P_{o/w}$  value similar to many organic chemicals presently in use (algicides, herbicides).

It is suggested that inhibition of algal growth and production will occur in the humic stained water. A probable source of this humus rich material is decomposing eucalyptus leaves of the wetland catchment area. This may provide a valuable management tool to control blue-green algae bloom in these particular ecosystems.

*T. J. Wrigley and M. Cowan, Octanol Partition Coefficient for Wetland Humus, Water Res., Vol. 29, N°1, Page 11-15, 1995.*

The SCOPE Newsletter is produced by the SCIENTIFIC COMMITTEE ON PHOSPHATES IN EUROPE, a non commercial, non profit-making association (Association Sans But Lucratif) based in Brussels.

The association includes international groups headquartered in Belgium, France, Spain, Sweden and the UK, producers of a wide variety of detergent ingredients including phosphates. Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

The SCOPE Newsletter is open to input from its readers across Europe and we welcome all comments or information. Contributions from readers are invited on all subjects concerning phosphates, detergents, sewage treatment and the environment.

You are invited to submit scientific papers for résumé, to send comments on the studies mentioned in this Newsletter or other scientific or technical news.

For each study or paper mentioned in the SCOPE Newsletter, the full document can be obtained directly from :

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Number Fourteen,

March 1995

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**THE NETHERLANDS** p. 2

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### Reactions to the publication of "Ecological Control of Algal Densities"

Following the publication of the report entitled "Ecological control of algal densities" (see SCOPE Newsletter n°13), the UBA (German Federal Ministry of the Environment), reacted by the publication of a Press release.

We reproduce here this Press release and the reply from Dr. Martin Scholten, of the TNO Institute for Environmental Sciences, co-author of the report.

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**ITALY** p. 6

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### Phosphate deficiency in the Adriatic Sea is considered the cause of mucilage problems

Recent investigations on the origins of mucus formation in the Adriatic Sea - a phenomenon which has tremendously damaged tourism along the Italian Adriatic Coast since 1989 - show that the high Nitrogen : Phosphorus ratio and the very low P concentrations in the Adriatic Sea, during spring and summer, cause mucus excretion by phytoplankton. An article from Dr. Ulrich Horstmann.

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**FRANCE & SWITZERLAND** p. 7

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### Phosphorus reduction and algal biomass in Lake Geneva

Despite a regular decrease in total P concentration in Lake Geneva, the phytoplankton biomass (average and maximum) have increased for the last 3 years, reaching, in 1993, the highest level observed since 1987

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**UNITED KINGDOM** p. 9

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### Lake restoration: the role of biomanipulation

A seminar on the role of biomanipulation on lake restoration was organised by the National Rivers Authority and the Broads Authority in the UK. It appears that biomanipulation will be effective only once the internal concentration of nutrients is lowered; the reduction of the external phosphorus load alone having shown no result.

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**AUSTRALIA** p. 10

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### Nutrients cleared of coral killing charges

Pristine micro-atolls fertilized with 20 times the normal amount of nutrients did not respond, as expected, with enhanced algal growth. These findings are part of a research programme conducted on the southern edge of the Great Barrier Reef, 80 kilometres off Gladstone, Australia. They exonerate nutrients and algae from the charge of killing coral reefs

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**SWITZERLAND, CANADA, USA** p. 11

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### Phosphate reduction vs fisheries

Several reports mention the increasing problems caused to fisheries by phosphorus reduction programmes.

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**SWEDEN** p. 11

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### Phosphate containing detergents easier to treat in waste water plants

From a technical point of view, P-based product are considered the best solution in regards to waste water treatment, says Stockholm Water.

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**THE NETHERLANDS**

**REACTIONS TO THE PUBLICATION OF  
"ECOLOGICAL CONTROL OF ALGAL  
DENSITIES"**

Following the publication of the report entitled "Ecological control of algal densities" (see SCOPE Newsletter n°13), the TNO Institute for Environmental Sciences (co-author of the study with the University of Alicante, Spain and the University of Savoie, France) received many diverse comments. Among them, an opinion was expressed by UBA (the German Federal Ministry of the Environment), which entered the debate through the publication of a Press release.

We reproduce here the text of the UBA Press release and the reply from Dr. Martin Scholten, of the TNO Institute for Environmental Sciences.

**UMWELTBUNDESAMT**

**Press Release - December 22, 1994**

(German version available on request from SCOPE)

**The German Federal Environmental Agency UBA (Umweltbundesamt) refutes claims made by the Dutch Research Institute TNO.**

The German Federal Environmental Agency UBA (Umweltbundesamt) is designating statements as incorrect, which had been made by the Dutch Research Institute TNO, which says that phosphate-free detergents result in a higher environmental burden than phosphate-containing detergents. The study claimed that phosphate-containing detergents should be preferred under ecological aspects.

Feeding phosphate into surface water leads to an increase in algae growth. This has been said correctly in the study. However, it is incorrect to state that, on the other hand, a simultaneous increase in the volume of zoo plankton is occurring, which live on these algae. In contrast to this, reality is that the spectrum of algae species changes - mass developments of species occur, which in part cannot be used as food by those types of zoo plankton that have a higher position in the food chain.

This excessive algae growth can also result in the occurrence of foam, an impairment of taste of the drinking water caused by the contents of the algae, shortage of oxygen in the surface water and to allergic reactions of bathers. These are negative effects caused by eutrophication (overfeeding) of surface water with nutrients like phosphate.

These adverse effects on surface water of using phosphate in detergents and cleaning agents can be avoided by precipitating phosphate in sewage

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purification plants. However, not yet all water treatment plants are adequately equipped .

The statement made in the TNO study that a fresh water lake can handle ten times the normal phosphate quantity without having its biological balance being destroyed, is entirely unfounded. An increase by a factor of three of the phosphate concentration will transfer the lake into a new "trophic level" which will cause a change of the ecological system.

The far-reaching replacement of phosphate in detergents is an example of successful environmental politics. The phosphate quantity in detergents and cleaning agents in Germany has been reduced from 270,000 tons per year in the middle of the seventies to less than 10,000 tons per year. The replacement of phosphate has resulted in provable relief of surface water. The frequently heard argument that the phosphate-replacing substances (mainly, polycarboxylate and soda) have toxic effects on the zoo plankton (statement made in the TNO study) is incorrect.

The TNO study should also be assessed against the background that it has been a research assignment funded by the phosphate-producing industry. Therefore, the German UBA Agency has no reason to undo the development of limiting the phosphate quantity in detergents, which has been initiated early in the eighties through the Maximum Phosphate Quantity Regulation ("Phosphathöchstmengen-Verordnung").

**Reply to UBA's Press release**

**by Dr. Martin Scholten,**

**TNO Environmental Sciences**

Dear Sir,

Herewith I send you a few reports regarding one of our studies on the relation between surface water pollution and algal problems, which received a lot of publicity in the German media in response to an UBA Press release.

The report concerns only one small project out of a series of research projects regarding this subject, which have been executed at my laboratory since 1987. The results are mainly presented in technical reports, but some scientific publications on the subject have been submitted and accepted by international journals. To clarify TNO's position, which is based on the results of the entire research programme, I herewith present you our statements:

1. Eutrophication problems are related to prolific algal biomass, not by enhanced algal production (eutrophication *sensu stricto*) alone.
2. Prolific algal biomass is the net result of algal production and algal consumption by herbivores.

3. Zoo plankton plays an important role in controlling algal biomass. This is already accounted for in biomanipulation projects executed to turn eutrophied water bodies in a pristine state by improving the ecological structure (elimination of roach and bream, reintroduction of pike and perch, re transplantation of rooted macrophytes). Under optimal conditions, cladocerans can control phytoplankton at a level of  $3-5 \mu\text{g l}^{-1}$ .

4. One of the factors causing a sub-optimal functioning of zooplankton is the presence of toxicants besides changed hydrodynamics (re-suspension of sediments) and heavy predation (deterioration of macrophytes and dominance of planktivorous fish).

4a. It appeared that toxicants induces a shift in the competitive relation between zooplankton species, favouring opportunistic species with a high algal threshold concentration (and thus a low algal control capacity) to the detriment of specialized competitors with a low algal threshold.

4b. The algal control capacity (grazing efficiency) of zooplankton is reduced when exposed to toxicants at a level of  $0.5 \cdot \text{NOEC}$  obtained from toxicity tests.

5. Sub-optimal zooplankton functioning is more obvious in nutrient enriched systems,

due to the induction of algal blooms as a result of un-grazed algal production.

6. Elevated concentrations of nutrients generally coincide with elevated concentrations of toxicants. The observed decrease in algal concentration in several case studies correlate both with a reduced nutrient and toxicant load. Specific nutrient restrictions alone do not guarantee a decrease of algal problems.

7. Large scale outdoor experiments with various nutrient and toxicant concentrations reveal that the critical nutrient concentration strongly depends on the toxicant concentration. The critical P-concentration is  $> 500 \mu\text{g l}^{-1}$  in unpolluted water, but decreases down to  $< 100 \mu\text{g l}^{-1}$  in surface waters with toxicants at the NOEC-level.

8. The current water quality standards are sufficient for moderately polluted conditions, but could be higher in case of an effective reduction of toxicants or other measures optimising the conditions for zooplankton. The need for nutrient reduction is due to the deteriorated state of water bodies with sub-optimal conditions for herbivores. The effectiveness of nutrient reduction is larger under optimal conditions for cladocerans.

9. An exception is made for natural oligotrophic water bodies (i.e. small alpine lakes and meres), in which nutrient availability

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should limit algal densities below the lowest threshold levels for herbivores ( $< 3 \mu\text{g chl} a \text{ l}^{-1}$ ). In these cases, the critical phosphate load should be  $< 10 \mu\text{g P l}^{-1}$ .

10. The induction of bluegreen algae blooms is primarily related to water turbidity, due to the competitive advantage of bluegreens over regular green algae under restricted light condition, and not to an excess of phosphate. When zooplankton can not effectively respond to the algal spring bloom, that algal density can reach levels favouring bluegreens ( $> 40 \mu\text{g chl} a \text{ l}^{-1}$ ). Bluegreens are hardly consumed, and thus not controlled by the main cladoceran species.

11. Based on points 1-9 it is concluded that the use of phosphate free laundry detergents is not the most effective and sufficient measure to solve water quality problems related to prolific algal growth.

12. In a series of experiments, an inhibitory effect of household effluents containing phosphate free laundry detergents has been observed. However, the environmental load of surface waters with detergents is negligible compared to other toxicants, and will not contribute to algal problems in the field situation. Moreover, laundry detergents are effectively degraded in waste water treatment plants.

13. The difference in environmental impact of phosphate free and phosphate based

laundry detergents is thus negligible, and the use of modern laundry detergent is not an important factor in surface water problems.

Based on these results. TNO recommends:

a) To reconsider the concept of the environmental hazard of phosphates for aquatic ecosystems in environmental policies, and bring it in perspective of ecosystem health related to chemical, physical and biological disturbances and imbalances in the ecological food chain.

b) To optimise the health (structure and functioning) of aquatic ecosystems in favour of herbivorous, in order to realise a sustainable balance between algal growth and algal consumption.

I seize this opportunity to additionally respond to some statements in the UBA Press release and additional comments by UBA employees in the German media :

1. TNO does not proclaim phosphate free detergents to be environmental hazardous, but pointed out that strictly speaking phosphate based detergents are somewhat "greener" because of having a natural (instead of xenobiotic) builder and a generally lower need of surfactants. However, both points are in practice no environmental problem, especially not when waste water is treated.

2. The change in algal composition seems to be primarily due to sub-optimal zooplankton grazing, resulting in changed competition at higher algal densities. Of course, fertilization promotes the shift towards undesired species (viz. bluegreen), when the cladocerans functioning is sub-optimal.

3. The critical phosphate level depends on the general condition of the water body.

4. TNO does not state that zeolite, soda or polycarboxylate determines the toxic properties of laundry detergents.

5. TNO is, by law, an independent research organization with an undisputed reputation. Insinuations that TNO's statements are adapted to its contractors are therefore disregarded by us. The results presented are related to the key research topic of TNO's field ecology laboratory, executed since 1987 in a series of projects commissioned by various bodies.

TNO is aware that the result of its research regarding algal problems in surface waters may be counterproductive for the current environmental policy of water authorities regarding phosphates, and for the economical interest of the NW European detergent industry. However, we are looking forward to an open, scientific discussion. I hope this letter may contribute to a discussion between UBA and TNO. I am therefore asking you kindly, to disseminate this letter to all interested persons within the UBA.

Martin Scholten  
TNO Environmental Sciences

## ITALY

### **PHOSPHATE DEFICIENCY IN THE ADRIATIC SEA IS CONSIDERED THE CAUSE OF MUCILAGE PROBLEMS**

by Dr. Ulrich Horstmann\*

Recent investigations on the origins of mucus formation in the Adriatic Sea - a phenomenon which has tremendously damaged tourism along the Italian Adriatic Coast since 1989 - show that the high Nitrogen : Phosphorus ratio and the very low P concentrations in the Adriatic Sea, during spring and summer, cause mucus excretion by phytoplankton.

Kaltenbäck and Herndl had previously found, in 1992, that "deficiency in phosphate availability might be one of the triggering factors for excessive production of mucoïd material by phytoplankton"; a hypothesis which was also established by Fogg, 1983. Furthermore, they show evidence that mucilage production appears when simultaneously, photosynthesis is possible but nutrient limitation retards growth of cell material. Kaltenbäck and Herndl obtained, under phosphorus limited conditions, a photo-synthetically extra cellular release (mucus) of 80 % for the phytoplankton in the northern Adriatic Sea (E. Kaltenbäck and G.J Herndl 1992)<sup>1</sup>.

Horstmann & al (unpublished data) found, in 1994, a significant correlation of low dissolved P values and

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<sup>1</sup> Kaltenbäck and G.J Herndl, *Ecology of amorphous aggregations in the northern Adriatic Sea* IV. in *Marine Ecology Prog. Ser.* Vol 87 : 147 - 159

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high values of particulate organic carbon in the northern Adriatic Sea, off the Po-river delta. They found very high alkaline phosphatase activity in the northern Adriatic Sea during spring and summer 1993/94, indicating strong P limitation. Obernosterer and Herndel (1994) showed in culture experiments that P-limitation of phytoplankton leads to 30-100 % higher rates of photosynthetic extra cellular release, which, after coagulation, can form mucilage.

New findings also indicate that very low P concentration in the Adriatic Sea water during Summer is also considered to be the main reason for limited and slow propagation of marine bacteria, and consequently of the degradation of mucus.

Phosphorus-limitation in the marine environment is not common. In the Adriatic Sea, it is apparently due to the high N/P-ratios (between 50 and 100) of the Po-river water. For algae growth a N/P ratio of 16 (Redfield ratio) is required. There are also hypotheses that P may be removed from the Adriatic Sea water by the high amounts of iron due to "terra rossa" erosion which, under occasional anaerobic conditions at the sea bottom, may be converted into insoluble Fe PO<sub>4</sub> and deposited in the sediment.

*\* Dr Ulrich Horstmann, from the Institute of Oceanography of Kiel University, Germany, is a contributor to the European environment project "MARE"*

## FRANCE & SWITZERLAND

### PHOSPHORUS REDUCTION AND ALGAL BIOMASS IN LAKE GENEVA

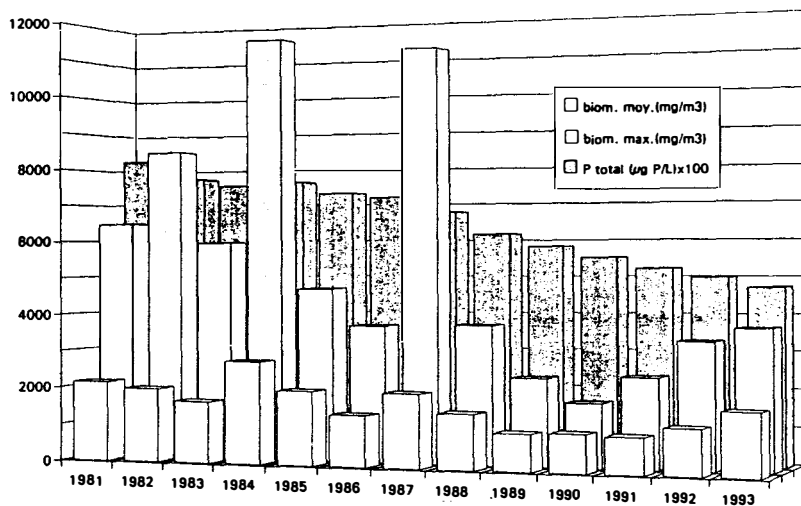
**Despite a regular decrease in total P concentration in Lake Geneva, the phytoplankton biomass (average and maximum) have increased for the last 3 years, reaching, in 1993, the highest level observed since 1987.**

The results are detailed in the 1993 edition of the report on the studies and research conducted of the Lemman Basin, published during the autumn of 1994.

The measurements show that 1993 was characterised by a high average biomass (1650 mg/m<sup>3</sup>), 36 % higher than the one observed in 1992 already considered high with respect to phytoplankton biomass concentration.

During the 1987-1993 period, total phosphorus regularly decreased with a drop from 61.7 µg P/L to 47.3 µg P/L (fig.1 and 1a).

Meanwhile, the value for average phytomass concentration raised from 1 463 mg/m<sup>3</sup> in 1988 to 1 646 mg/m<sup>3</sup> in 1993. The most marked increase has occurred during the last three years with a low of 963 mg/m<sup>3</sup> in 1991 to a high of 1 646 mg/m<sup>3</sup> in 1993.



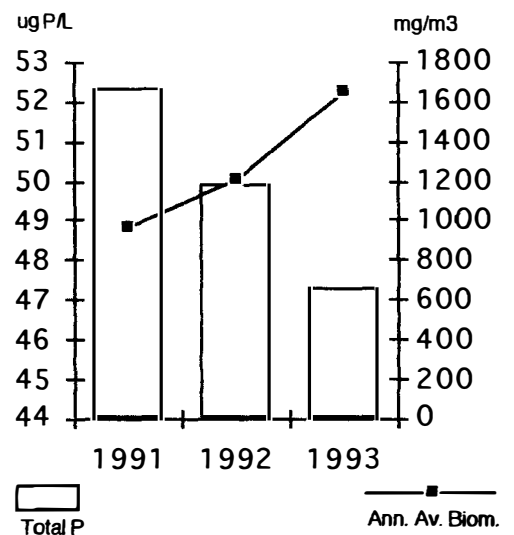
**Fig.1: Evolution of average (biom. moy.), maximum (bio. max.) annual biomass and total phosphorus average concentration in the water column (Léman, SHL2, 1981-1993). (Source: CIPEL 93)**

The diversity of phytoplanktonic species has also been modified, with a strong but temporary presence, in 1992, of *Oscillatoria rubescens*, a species considered typical of eutrophic ecosystems.

In 1993, the increase in phytoplankton biomass seems attributable mainly to an important growth of nanoplankton during the spring and microplankton during the summer period, with 3 particular species (*Ceratium hirundella*, *Dinobryon sociale*, and *Mougeotia gracillima*).

No clear mention is made in the article about the possible cause of this biomass increase. The results go, indeed, against commonly accepted beliefs about the relationship between phosphorus concentration and algae growth.

In the summary of the general report, however, the authors suggest that the phenomenon may be due



**Fig.1 a: Evolution of average annual total phosphorus (µg P/L) and biomass (mg/m³) from 1991 to 1993.**

to the persistence of high winter temperatures for the last 7 years.

Despite the observed results, the authors conclude that, "since algal production is still too high, efforts must be continued to further diminish phosphorus input from all sources, in order to reach the objective of lake concentration of 20 to 30 µg P/L".

These observation campaigns are part of a 5 year programme (1991-1995) aimed at re-establishing water quality in Lake Geneva and conducted by the Scientific Council of the International Commission for the Protection of Lemman Waters.

*Pelletier J.R., Druart J.C. and Revaclier R., Evolution du phytoplankton du Léman, Rapport de la Commission Internationale de Protection des Eaux du Léman contre la Pollution, Campagne 1993, 1994, 83-96.*



UNITED KINGDOM

**LAKE RESTORATION:  
THE ROLE OF BIOMANIPULATION**

**A seminar on the role of biomanipulation on lake restoration was organised by the National Rivers Authority and the Broads Authority in the UK. It appears that biomanipulation will be effective only once the internal concentration of nutrients is lowered; the reduction of the external phosphorus load alone having shown no result.**

Restoration of a diverse aquatic life is considered a priority in the Broads region. The final objective is to re-establish a stable state in lakes and the edges of the river channels, where aquatic plants are traditionally dominant.

Restoration efforts appear to be far more complex than at first thought. The participants in the seminar took stock of the research situation and agreed to summarise the best strategy for restoration as follows:

- Initial lowering of nutrient concentrations, with a target evaluated in the range of 50-100  $\mu\text{gP l}^{-1}$ ,
- subsequent biomanipulation<sup>1</sup> as a

<sup>1</sup> Biomanipulation includes a wide range of corrective measures based mainly on the re-introduction of species in

restoration tool, with the landowners' permission and public support,

- development of the knowledge necessary to re-establish aquatic vegetation and stabilise the new lake community.

The results of 6 research programmes were presented, including a study by Geoff Philipps of the National Rivers Authority on the link between phosphorus and algal production. His report, entitled "*Why do we need to use bio-manipulation ?*", addresses, notably, the relationship between algal biomass and phosphorus. The author notes that, despite a 90 % reduction of the external phosphorus load in the Barton Broad over the last 12 years, no substantial reduction in algal biomass has been achieved. The phenomenon is attributed to the continued availability of phosphorus from the sediments and the absence of long term fixing of nutrients in macrophytes. In that case, biomanipulation will only be effective after reduction of the internal nutrient load.

The other presentations were:

- A 5 year field study of food competition between fish and wildfowl,
- Restoration by fish stock reduction in the Netherlands,
- The use of biomanipulation in Danish lakes,
- Biomanipulation, how to make sure that it is appropriate,
- The role of biomanipulation in lake management, an overview.

order to restore affected ecosystems.

*Lake Restoration: The Role of Biomanipulation, National Rivers Authority and Broads Authority, 1994. Copies available from the National Rivers Authority, Peterborough, (0733) 371811 and the Broads Authority, Norwich, (0603) 610734.*

**AUSTRALIA**

**NUTRIENTS CLEARED OF CORAL KILLING CHARGES**

**Pristine micro-atolls fertilized with 20 times the normal amount of nutrients did not respond, as expected, with enhanced algal growth. These findings are part of a research programme conducted on the southern edge of the Great Barrier Reef, 80 kilometres off Gladstone, Australia. They exonerate nutrients and algae from the charge of killing coral reefs.**

It has been a common belief that excessive algal growth, induced by the increased presence of nutrients in water, was responsible for the death of coral reefs. This assumption had been made after massive destruction of coral reefs was correlated with a 30 year long release of sewage in the Kaneohe Bay, in Oahu island, Hawaii.

The findings of a thorough series of tests conducted by 30 scientists from Australia and abroad at One Tree Island, off the Australian coast, contradict this assumption. It was demonstrated that the addition of 20 times the natural concentration of nitrogen and phosphorus in non polluted micro-atolls did not result in enhanced algal growth.

These tests were conducted during a 17 month period in twelve of the many micro-atolls surrounding One Tree Island. At low tide, unpolluted water is captured in these atolls about the size of an Olympic swimming pool. Radio controlled robots added three times the natural levels of phosphorus and nitrogen to 9 atolls, over five hours, at low tide. Three atolls were kept as controls.

The scientists of the ENCORE (Enrichment of Nutrients in a Coral Reef Experiment) team were expecting an increase rate of algal growth, followed by the death of corals. Instead, they found no enhanced production of algae, even when water was enriched at 20 times the normal level.

Grazing fish, which are thought to control algal growth, were not affected either and primary productivity of algae, measured by the output of oxygen from photosynthesis, was similar in fertilized micro-atolls and controls. According to Professor Larkum, who led the study on One Tree Island, the experiment conclusively established that "small increases in nutrients have no effect on the algae", and that "the algae are not the indirect culprits in the death of corals".

The ENCORE team will study other effects and causes for the destruction of corals which is considered of great concern. The following topics should be studied:

- the lack of capacity of coral larvae to settle and develop new colonies,
- the stunted growth of reef animals,
- the poisoning of coralline algae which "glue" the reef together,

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- the effect of excess nutrients on the competition between algal species.

*"Pollution not coral culprit", Peter Pockley, The Age, Sydney, Australia, March 14, 1995.*

## SHORT NEWS

### SWITZERLAND, CANADA, USA PHOSPHATE REDUCTION VS FISHERIES

Several reports mention the increasing problems caused to fisheries by phosphorus reduction programmes.

In Lake Lucern, Switzerland, measures to restore water quality led to a 75% reduction in phosphorus inflow, from 1977 to 1989, with P concentration dropping to 2-3 ppb. The lake is now considered low in nutrients, and fish growth has been reduced. Despite fears of professional fishermen about their future, the proposal to increase fish nutrients was rejected, considered incompatible with clean water regulations. Instead, fisheries were allowed to use finer nets in order to catch smaller fish.

This particular consequence of P reduction has been observed in other lakes including Lake Erie and Lake Ontario at the USA/Canada border<sup>1</sup>.

*Cleaning agent Newsletter, E. A. Matzner, 1995/1*

<sup>1</sup> See SCOPE Newsletter n°9 and n°13

### SWEDEN PHOSPHATE CONTAINING DETERGENTS EASIER TO TREAT IN WASTEWATER PLANTS

Tests performed in 1994 by the Stockholm water authority show that almost all detergents are adequately degraded in municipal waste water treatment plants.

Cajsa Wahlberg, environment chemist of Stockholm Water, considers that, with respect to their possible effect on living species, P-based detergents are a better solution than P-free detergents. However, the overall impact of powder detergents on the environment, regardless of whether they contain phosphate or not, must be considered of minor importance.

From a technical point of view, P-based products are considered the best solution in regards to waste water treatment. P-free products contain more tensides, organic carbon and non degradable acrylates, which cause problems in the waste water treatment facilities.

*Svenska Dagbladet, Stockholm daily newspaper, November 26, 1994.*

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The association includes international groups headquartered in Belgium, France, Spain, Sweden and the UK, producers of a wide variety of detergent ingredients including phosphates. Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

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For each study or paper mentioned in the SCOPE Newsletter, the full document can be obtained directly from :

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December 1994

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**THE NETHERLANDS** p. 2

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**The Role of Toxicants in Surface Water Quality Problems**

A group of leading European specialists in water quality problems met in January 1994 at TNO, Institute of Environmental Sciences in the Netherlands to discuss the topic of eutrophication. The meeting was organized by SCOPE (Scientific Committee on Phosphates in Europe). A summary of the discussions is now available in a report entitled "Eutrophication Problems and Remedial Measures : the P factor".

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**THE NETHERLANDS** p. 4

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**Links between toxic substances and algal density problems**

The results of an experimental programme conducted in three European countries show that surface water algal problems, commonly attributed to phosphates, are caused, to a large extent, by the presence of toxic substances. As a result of this collaborative research, a new model has been developed, based on the principle that algal density depends on both algal production and the natural ability of ecosystems to control algal crops. Aimed at better assessing the causes of water quality problems, this model will enable better water quality management in the future.

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**UNITED KINGDOM** p. 5

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**Report by the World Wide Fund for Nature on nutrient enrichment of water bodies**

The report states that the replacement of detergent phosphate by substitutes would not have any significant impact on nutrient levels in sensitive areas. Only a wide range of measures including nutrient stripping of waste water and better agricultural practices may achieve this objective. The report also raises questions about the environmental impact of phosphate substitutes.

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**CANADA** p. 7

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**Phosphorus Management in Lake Ontario**

The results of an empirical study measuring water quality trends in Lake Ontario from 1969 to 1992 have been published. They indicate that the phosphate concentration in the lake has decreased to a point where the food chain might be endangered. Dr. Dobson, author of the report, suggests that releasing more phosphorus from municipal sewage could be a solution to the problem, but he stresses that caution is needed before implementing such measures.

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**SWEDEN** p. 8

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**Nutrient imbalance in the Baltic Sea.**

The policy of complete reduction of phosphorus discharges from sewage treatment plants into the Baltic sea is being questioned. According to Dr. Ulf Larson, system ecologist at the University of Stockholm, obtaining the right balance between nitrogen and phosphorus should be the objective.

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**UNITED KINGDOM** p. 8

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**Environmental and economic impact of key detergent builder systems**

A second life cycle analysis study of detergent builder systems published this year confirms that measures against phosphate products will not bring any improvement to the environment.

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**SWEDEN** p. 9

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**New technology in sludge recycling**

A new project for the recycling of elements present in wastewater treatment sludge will start this autumn in Helsingborg, Sweden.

SCOPE is a non-commercial, non-profit making European association based in Brussels.

Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

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## **THE NETHERLANDS**

### **The Role of Toxicants in Surface Water Quality Problems**

**A group of leading European specialists in water quality problems met in January 1994 at TNO, Institute of Environmental Sciences in the Netherlands to discuss the topic of eutrophication. The meeting was organized by SCOPE (Scientific Committee on Phosphates in Europe). A summary of the discussions is now available in a report entitled "Eutrophication Problems and Remedial Measures : the P factor".**

The scientists discussed a number of topics and reached the following conclusions :

**It is not necessarily meaningful or helpful to attempt to set universal quality standards for water bodies.** The scientists agreed that it is not possible or necessarily desirable to return the majority of lakes to their truly pristine condition. They also concluded that restoration objectives should be set on an individual basis, taking into account the desired final use of each water body as well as cost benefit considerations.

**It is important to distinguish clearly between the process of eutrophication and actual water quality problems.** The scientific term

eutrophication applies to the process of progressive fertilisation of water bodies by nutrients (phosphorus and nitrogen). Problems of excessive algal density most normally associated with eutrophication, can be caused by a range of factors other than nutrients including the presence of toxic material, micro-pollutants and organic discharge.

**Fertilisation of a water body does not necessarily lead to the problems associated with eutrophication.** In fact, experiments show increasing evidence that although relatively high phosphate levels may increase algal productivity, this does not necessarily lead the ecosystem to becoming overwhelmed by planktonic algae, so long as there is a healthy and active zoo-plankton community (e.g. daphnia). The zoo-plankton graze on algae and ,by so doing, contribute to maintaining a well balanced ecosystem.

**Experimental data indicate that besides nutrients, the presence of toxic substances in water bodies can result in excessive algal density.** Experiments have shown that reduction in zoo-plankton numbers, brought about by the presence in the ecosystem of heavy metals, pesticides or other toxic chemicals, leads to a significant increase in algal biomass and can result in permanent changes in the flora and fauna of the water bodies, unrelated to phosphorus supply.

Preliminary microcosm research also indicates that the addition of phosphate free detergents leads to a greater increase in algal growth in comparison to that

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caused by a conventional phosphate detergent, when the doses are proportional to those recommended by the manufacturers. This impact is thought to be due to the presence of higher concentrations of substances such as surfactants, which are relatively toxic to zooplankton, in the phosphate free products.

A 16 year long survey of Zurich lake, Switzerland, shows that, **despite enormous efforts and investments made in phosphate removal from waste water, the very low level at which phosphorus becomes the limiting nutrient has not been reached.** On the other hand, the appearance of the lake has been good for the past several years, due to the implementation of waste water treatment, and there is no clear justification, from a drinking water point of view, for further reduction in phosphate load. These findings have also led the Zurich Water Supply Company to recommend a return to the use of detergents formulated with phosphate (with well known and controllable effects) rather than the use of substitute chemicals with unknown effects, in particular on drinking water quality.

**Remedial measures introduced so far have not always led to the expected reduction in algal biomass because they are often based on an incorrect application of the scientific models developed to describe algal production phenomena.** To date, the model developed in 1968 by R.A. Vollenweider has been the most widely used. This model assumes an almost linear relationship between chlorophyll

concentration (an indicator of algal density) and concentration of phosphorus in water. The model is based on average statistical data from many lakes and therefore does not take into account the specific conditions of individual water bodies.

A recent study conducted in the Norfolk Broads region of the United Kingdom shows, indeed, that chlorophyll and phosphorus concentrations observed in specific water bodies do not correlate as predicted by the Vollenweider model (fig. 1).

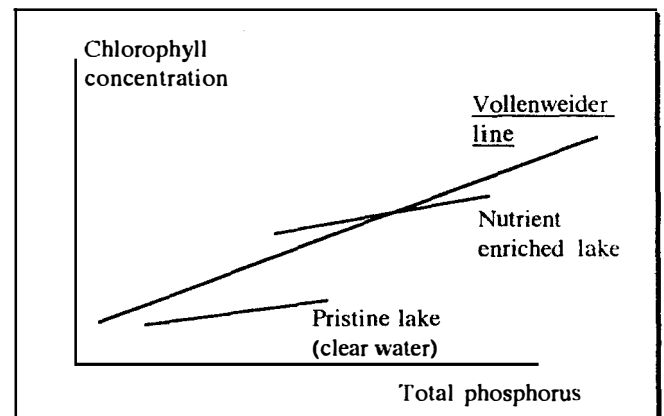


Fig. 1: Correlation between phosphorus and chlorophyll concentration: disparity between the Vollenweider model and results from on site experiments

In the course of the discussions, scientists agreed that it is necessary to take into account the characteristics specific to individual water bodies. To assist in this, a model is currently being developed by the Institute of Environmental Sciences (TNO) in the Netherlands (see article "Links between toxic substances and algal density problems").

*Eutrophication Problems and Remedial measures: the P Factor, E. Johnston. Published by TNO, Den Helder, 1994, full report available on request from ECU.*

## **THE NETHERLANDS**

### **Links between toxic substances and algal density problems**

**The results of an experimental programme conducted in three European countries show that surface water algal problems, commonly attributed to phosphates, are caused, to a large extent, by the presence of toxic substances. As a result of this collaborative research, a new model has been developed, based on the principle that algal density depends on both algal production and the natural ability of ecosystems to control algal crops. Aimed at better assessing the causes of water quality problems, this model will enable better water quality management in the future.**

An experimental programme to study the effects of domestic waste water on aquatic ecosystems was conducted by the TNO Institute of Environmental Sciences, The Netherlands. It included studies by The University of Alicante, Spain, and the University of Savoie, France. This programme, commissioned by the Centre Européen d'Etudes des Polyphosphates

(CEEP), is summarized in a report entitled "Ecological control of algal density: towards a better comprehension of eutrophication related problems in aquatic ecosystems".

Different waste water effluents were introduced to microcosms to evaluate the impact of nutrients and toxic substances on the aquatic communities. The effluents included residues of phosphate-free and phosphate-containing laundry detergents to measure their relative impact on algal density.

Results show that, under experimental conditions:

- the final algal density is less with effluents containing phosphate-based detergent than with phosphate-free detergents, both at manufacturers' recommended doses
- the difference in algal density seems to be due to the toxic effects on zoo-plankton (e.g. daphnia or water fleas) of some of the detergents' components other than phosphate. Zoo-plankton graze on algae and therefore help to maintain a proper algal density. When exposed to stress by ecotoxic ingredients, zoo-plankton lose this ability and algal density increases, leading to algal problems.
- algal density in these experiments is also influenced by the amount of detergent used. In this respect, phosphate-containing detergents are a better option since the recommended dosage is lower than for phosphate-free detergents.



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Results of the experiments in the three countries show that, at recommended doses, phosphate-containing products produce a much lower algal density than phosphate-free formulations. They also confirm that algal problems are the result of a combination of excessive algal production and a lack of algal density control due to zoo plankton inhibition by toxic substances.

Until now, public and political perception of algal problems focused on the phosphate load as a predictor of algal production, disregarding other factors. These experiments show that healthy aquatic ecosystems can cope with increased nutrient load, so long as the zoo-plankton capacity to graze on this increased food supply is not inhibited by toxic stress.

Concluding that the concept of environmental hazards of phosphates for aquatic ecosystems needs to be reconsidered, TNO has developed a model to assess the balance between algal production and algal removal processes as a measure of the health condition of water bodies.

$$\text{Algal Control Index (ACI)} = \frac{\text{rate of algal production}}{\text{rate of algal removal}}$$

An ACI superior to 1 results in prolific algal density indicating a potential for algal problems. The authors also propose a structured experimental programme to determine, for various types and conditions of water body, which factors including nutrient loads, lead to algal density problems. The information generated could be used as the basis for a major revision of

environmental policy regarding phosphate and water quality management.

*Ecological control of algal densities: Towards a better comprehension of eutrophication problems in aquatic ecosystems, M. C. Th. Scholten (TNO), G. Blake (University of Savoie), D. Prats (University of Alicante), TNO Institute of Environmental Sciences, Nov. 1994. Full report available on request from ECU.*

## UNITED KINGDOM

### Report by the World Wide Fund for Nature on nutrient enrichment of water bodies

**The report states that the replacement of detergent phosphate by substitutes would not have any significant impact on nutrient levels in sensitive areas. Only a wide range of measures including nutrient stripping of waste water and better agricultural practices may achieve this objective. The report also raises questions about the environmental impact of phosphate substitutes.**

"No one measure will solve the UK's problems of eutrophication. A package will need to be adopted and

implemented in a creative manner to enhance nature conservation benefits". This is the main recommendation of a report published by the World Wide Fund for Nature called "Too much of a good thing ; Nutrient enrichment in the UK's inland and coastal waters".

The report addresses the issue of eutrophication ; a process defined as the artificial enrichment of water bodies as a result of human activities. As far as nutrients are concerned, phosphates are considered as the limiting factor in freshwater while nitrogen controls the growth of plants in the marine environment. In some cases, it is increasingly becoming apparent that several factors other than just nutrient enrichment may be influential in causing eutrophication related problems.

In order to limit the phosphorus input to freshwater bodies, several measures are recommended including the installation of phosphorus stripping in sewage treatment works. With such equipment, the amount of phosphorus released into the environment with waste water could be lowered by 90 %. It has been estimated that 45% of the total phosphorus loading to freshwater comes from STWs.

According to the author, the compulsory use of phosphate free detergents would not be enough to reduce phosphate concentrations to ecologically acceptable levels for most receiving waters. Besides, the environmental effects of phosphate substitutes still have to be fully evaluated. Therefore, decisions on the banning of phosphate detergents should wait until

it is proven that the chemicals used as substitutes are not causing harm to the environment.

Despite its evident advantages, nutrient stripping should not be seen as the only solution to river enrichment problems. In fact, diffuse sources, largely from agriculture, may be responsible for most of the nutrient loading in water bodies even though more difficult to quantify. Nutrients can be lost from the soil through leaching (primarily of nitrate), or through run-off (primarily of phosphate).

In order to reduce these inputs, agricultural practices such as the excessive use of fertilisers and ploughing up of permanent grass-land should be restricted. Techniques like the use of cultivated strips of land alongside water bodies (buffer strips), or the presence of undrained wetlands adjacent to open water areas can also help restore habitats by significantly reducing nutrient loading. Management of livestock units is also an important factor in some areas.

The report concludes by saying that whatever measures are envisaged, strong caution is needed. A great deal of research is still required, particularly in the marine environment, in order to understand the complex processes of nutrient cycling and flux patterns.

*Too Much of a Good Thing: Nutrient Enrichment in the UK's Inland and Coastal Waters, R. Irving, published by the World Wide Fund for Nature, October 1993.*

*Copy of the full report is available (price £5.00) from UK Conservation Unit, WWK UK, Panda House, Weyside Park, Godalming, Surrey, GU7 1XR, UK.*

**CANADA  
Phosphorus Management  
in Lake Ontario**

**The results of an empirical study measuring water quality trends in Lake Ontario from 1969 to 1992 have been published. They indicate that the phosphate concentration in the lake has decreased to a point where the food chain might be endangered. Dr. Dobson, author of the report, suggests that releasing more phosphorus from municipal sewage could be a solution to the problem, but he stresses that caution is needed before implementing such measures.**

Actions were taken in order to lower the abundance of planktonic algae in Lake Ontario, including a reduction of the phosphate content in detergents (starting in 1970) and precipitation of phosphorus at municipal sewage plants (from 1976). These measures have led to a drastic decrease in spring phosphorus concentration in the upper layer of the lake, dropping from about 22 µg P/L in 1975 to 9.2 µg P/L in 1992 (P

expressed in soluble reactive phosphorus, not yet depleted by zoo plankton).

The phosphorus concentration has now reached a point low enough to raise the question over whether or not phosphorus discharge from municipal waste water should be increased again in order to prevent a shortage. The author notes that if the present trend lingers, the food chain of the lake may be in jeopardy.

Before implementing such measures, however, great caution is recommended. Increasing the phosphate load would help the food web population but might also generate undesirable counter effects linked to the present abundance of nitrate in Lake Ontario waters.

The study points out the importance of understanding of the multiple interactions of the basic nutrients nitrogen and phosphorus with the complex food web of the lake. It also underlines the need for better models to predict the effects on algal biomass of physical and chemical factors, including nutrient concentration.

Dr Dobson concludes by saying that "for any design of a new P-loading target, we must be careful and knowledgeable".

*Lake Ontario Water Quality Trends, 1969 to 1992: Some observational Nutrient-science for Protecting a Major and Vulnerable Source of Drinking Water, Hugh F.H. Dobson, National Water Research Institute. Ontario, Canada, 1994*

**SWEDEN**  
**Nutrient imbalance in the Baltic Sea.**

**The policy of complete reduction of phosphorus discharges from sewage treatment plants into the Baltic sea is being questioned. According to Dr. Ulf Larson, system ecologist at the University of Stockholm, obtaining the right balance between nitrogen and phosphorus should be the objective.**

Dr Larson has reported an experiment involving adjustment of nutrient discharge from the Himmerfjärd sewage treatment plant in Grödinge. This plant treats the waste water from 250 000 residents of the S.W. Stockholm area. It was designed for maximum removal of phosphorus.

According to Dr Larson, the absence of phosphorus in sufficient concentration creates an imbalance between nitrogen and phosphorus in the receiving waters, leading to a situation where coastal ecosystems lose their ability to use these nutrients (algae can utilise nitrogen most effectively when the ratio between P and N is about 1:7). In this situation, nitrogen reaches the deeper part of the Baltic Sea.

During the one year experiment, the Himmerfjärd sewage treatment plant was allowed to discharge 4 times the amount of phosphorus usually released in

order to reach the 1:7 P/N ratio. The results showed that the increased input of P led to a decrease in the export of nitrogen to the open sea, while no significant changes were noticed in the quality of coastal water.

Dr. Larson also stresses the importance of nitrogen discharge reduction in order to restore nutrient balance in the in the Baltic.

*Phosphorus discharge can also be positive, artic. published in Svenska Dagbladet, Oct. 11, 1994.*

**UNITED KINGDOM**  
**Environmental and economic impact of key detergent builder systems**

**A second life cycle analysis study of detergent builder systems published this year confirms that measures against phosphate products will not bring any improvement to the environment.**

A newly published report from the Imperial College of Science, Technology and Medicine, London, entitled The Environmental Impact of Key Detergent Builder Systems in the European Union<sup>1</sup>, gives the results of an extended Life Cycle Analysis (LCA) of these products.

The main conclusion is that builder systems have a very small impact on the environment. In this context,

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improvements could only be achieved by reducing the use of all detergents' components, regardless of whether the products contain phosphate or not.

Detergent builders are key components which contribute to the cleaning action of detergents by removing the calcium and magnesium ions present in water and soil and by preventing their deposition on textiles and washing machines. The most widely used builders are STPP (sodium tripolyphosphate) and zeolite. This latter builder needs to be augmented by chemical compounds such as PCA or, to a limited extent, NTA, in order to achieve an acceptable level of performance. Zeolite is the most commonly used product in phosphate free detergents.

The LCA methodology used for the assessment of the impact of detergent builders took into account the stages of production, use and disposal. The disposal stage was evaluated according to different types of situations including direct release in the aquatic environment, waste water treatment, and sludge removal and recycling. In this last case, STPP builders represent the best alternative since they can be reused in agriculture.

The authors conclude that with the exception of restrictive action on the use of NTA, where health issues remain, any changes to builder systems may be expected to have only minor effects on the environment.

The most significant improvements in environmental impacts can be achieved by focusing on a strategy

aimed at a minimum use of all detergent components and by full implementation of waste water treatment as recommended by the European Urban Waste Water Directive.

Minimizing the use of detergent components, energy and water can also be achieved by improving washing machine efficiency, which is already advanced with the development of the European ecolabel scheme.

This report reaches similar conclusions as *The Phosphate Report*<sup>1</sup>, LCA published by Landbank Environmental Research in the UK, and a study conducted by the Austrian consumer association VKI comparing detergents with and without phosphate. Both these studies published earlier this year (See SCOPE Newsletter n° 10 & n°11) concluded that there is no real difference in terms of environmental impact between the two main builder systems.

*The environmental and economic impact of key detergent builders in the European Union, G. Morse, J.N. Lester & R. Perry, London, 1994. Full report available on request from ECU.*

## SWEDEN

### New technology in sludge recycling

A new project for the recycling of elements present in wastewater treatment sludge will start this autumn in

Helsingborg, Sweden. The objective is the separation of sludge into three reusable components:

- an energy-rich hydrolised organic fraction useable as a carbon source to enhance nitrogen removal or to produce bio-gas,
- a dried organic sludge useable for soil improvement or energy production,
- an inorganic sludge useable for the recirculation of coagulant and phosphorus recovery.

Sludge hydrolysis, separation and nitrogen removal will be carried out at the Helsingborg wastewater treatment plant and recovery of phosphorus and precipitation of chemicals will be done at the nearby Kemira Kemi plant. The project, supported by the Swedish National Environment Protection Board, will be completed by the beginning of 1997.

*Source: Kemira Kemi AB, The City of Helsingborg, Kemwaters and Alpha Laval Separation AB's, Helsingborg, Sweden.*

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# SCOPE NEWSLETTER

IN EUROPE

Number Twelve, October 1994

**SPECIAL ISSUE**  
**SUMMARY OF PREVIOUS NEWSLETTERS**

*Dear readers,*

*Four years have passed since we published the first issue of the SCOPE Newsletter. During this time, scientists world-wide have studied a number of water-related processes such as eutrophication, mucilage and the production of algal toxins, gaining a clearer insight into the causes and effects of these natural phenomena. What has emerged, above all, is the appreciation that environment problems are often highly complex and seldom respond to simplistic solutions.*

*Water quality remains one of the most pressing environmental problems faced by mankind and SCOPE, through its newsletter, has taken an active part in the debate by providing a platform for scientists from all over the world to present their results.*

*In our previous newsletters we have brought to the attention of our readers, studies, research and experiments exploring the effects of detergent components on water bodies, on sewage treatment and on product performance. We have not flinched from presenting work which is controversial and which questions commonly-held beliefs. We have demonstrated that water quality problems are complex, that there is no "quick fix" and that only effective water treatment measures can result in the quality of water which we all desire.*

*This edition marks an important step in our efforts to share scientific knowledge with ever wider audiences. It summarises all of the information published in the last four years of the newsletter and, in doing so, we believe we have taken another small step towards increasing knowledge and awareness of water quality issues. Finally, this edition gives us the opportunity to acknowledge all those scientists and experts who have contributed to the newsletter in the past and to remind everyone that additional contributions are always welcome.*

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SCOPE is a non-commercial, non-profit making European association based in Brussels.

Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

SCOPE NEWSLETTER

produced by European Communications Unit - 81, rue François Mermet - 69160 TASSIN - FRANCE - Tél. (33) 78 34 23 39

## **EUTROPHICATION AND WATER POLLUTION**

THE NETHERLANDS, SN n°11

### **THE DEVELOPMENT OF AN EUTROPHICATION INDEX FOR ECOSYSTEMS**

Preliminary results of a study conducted by TNO, the Netherlands research institute, shows that rather than the impact of nutrients, the effect of toxicants on zooplankton and macrophytes which compete with algae can be largely responsible for eutrophication phenomena

CANADA, SN n°11

### **THE RELATIVE IMPORTANCE OF BIOLOGICAL AND CHEMICAL PROCESSES IN THE RELEASE OF PHOSPHORUS FROM A HIGHLY ORGANIC SEDIMENT**

A study was conducted on sediments extracted from a Canadian shield lake in order to measure the role of bacteria on phosphorus and iron release from sediments. It appears that, as opposed to the prediction of the Eisenle/Mortimer model, P and Fe movements are independent. Most of P-release occurs following bacterial cell destruction after sterilization, implying the importance of bacteria as a reservoir of P

USA, SN n°11

### **INTERACTION OF TOXICANTS AND COMMUNITIES: THE ROLE OF NUTRIENTS**

The interaction between community nutrient status and toxicity was studied. Results reveal that communities living in a microcosm with a high nutrient value show better resistance to toxicants and faster recovery. It also shows that once it reaches a certain level qualified as eutrophic, the increase in concentration of nutrients does not affect the nutrient consumption by periphyton nor its productivity

ITALY, SN n°11

### **CONTRIBUTION OF DRAINAGE WATERS FROM AGRICULTURAL SOURCES TO THE CONCENTRATION OF PHOSPHATE AND NITROGEN IN COASTAL WATERS**

A study was conducted in order to assess the contribution of nitrogen and phosphate originating from agriculture in the Po Valley to coastal eutrophication of the Adriatic sea. Results clearly show that when normal agricultural practices are followed, this contribution is of some concern with regards to nitrogen and very low in regards to phosphorus

SWEDEN, SN n°11

### **NUTRIENTS AND BLOOM OF POISONOUS ALGAE**

Observations along the Swedish west coast contradicts the hypothesis of a direct link between nutrient concentration and algal bloom.

UNITED KINGDOM, SN n°10

### **DETERGENT PHOSPHATES AND THE ENVIRONMENT : AN ENVIRONMENTAL STUDY YIELDS NEW RESULTS**

The first comprehensive Life Cycle Assessment (LCA) study comparing two detergent builder systems - sodium tripolyphosphate and zeolite/PCA - was published by Landbank Environmental Research & Consulting, based in the United Kingdom

SWITZERLAND, SN n°10

### **NTA, EDTA AND WATER QUALITY**

A report on the environmental status of Winterthur (Switzerland) examines the presence of NTA and EDTA in water bodies of this area. NTA and EDTA were authorized as replacement to phosphates after the legislative restrictions introduced in 1986

CANADA, SN n°9

### **SIGNS OF CHANGE IN THE LAKE ONTARIO ECOSYSTEM**

The importance of maintaining a balanced food chain in the restoration of Lake Ontario

FRANCE, SN n°9

### **PHOSPHORUS IN MARINE ECOLOGY**

Phosphate substitutes are among a number of products which inhibit the self regulation properties of marine ecosystems.

FRANCE, SN n°9

### **EVALUATION OF ECOTOXICOLOGICAL IMPACT OF DETERGENTS EFFLUENTS USING LABORATORY MICROCOSMS**

According to tests made in laboratory microcosms, the presence of P-containing and P-free detergents in effluents exhibits similar effects on photosynthesis activity and the production of chlorophyll A

GERMANY, SN n°9

### **THE EFFECTS OF POLYCARBOXYLATES ON THE UPTAKE OF IRON BY 3 MARINE PHYTOPLANKTON SPECIES**

Polycarboxylates (PCA) used as co-builders in phosphate free detergents may act as a reservoir of iron when this element becomes limiting in the environment. In addition, Polycarboxylates stimulate Fe uptake by phytoplankton more than EDTA. They also enhance the growth of diatoms.



# SCOPE NEWSLETTER

IN EUROPE

SWITZERLAND, SN n°9

## **PHOSPHATE CONTAINING DETERGENTS AND EUTROPHICATION**

A study based on observations made from 1949 to 1991 in three lakes of the Zürich region questions the utility of the ban of phosphate from detergent products to reduce eutrophication phenomenon

SPAIN, SN n°9

## **STUDY OF EUTROPHICATION IN MESOCOSMS**

A study of Eutrophication in mesocosms shows that phosphate-free detergents induce a faster and greater algal growth than those containing phosphate

UNITED KINGDOM, SN n°8

## **"SNAPSHOT" STUDY OF EDTA AND NTA IN RIVERS**

UK study suggests that aquatic NTA and EDTA concentrations are currently low enough not to mobilise metal ions but raises questions over NTA in sewage sludge

AUSTRALIA - SWEDEN, SN n°8

## **ASSESSMENT OF EUTROPHICATION CONTROL STRATEGIES**

25 years' experience of lake restoration work across the world demonstrates that improvements can generally only be achieved by acting on multiple factors

FRANCE, SN n°8

## **DETERGENT AND MARINE ENVIRONMENT**

This article reviews current knowledge on marine pollution by detergents and gives a useful reminder of detergents main components.

ITALY, SN n°7,

## **MARINE EUTROPHICATION: SCIENTISTS OPEN DEBATE ON P-FREE DETERGENTS AND COASTAL MUCILAGE PROBLEMS**

Three Italian marine research scientists have published the hypothesis that zeolites and polycarboxylates, used as substitutes for phosphates in detergents in Italy since 1986, may be responsible for aggravating the production of floating mucilaginous aggregates by algae in coastal waters ("sea snow" slicks)

BELGIUM, SN n°7

## **PHOSPHORUS IN MARINE ECOLOGY**

An overview of current knowledge regarding phosphorus and marine eutrophication, presented at the IMPHOS International Conference 1992

HOLLAND, SN n°7

## **A NEW APPRAISAL OF MARINE EUTROPHICATION**

Mesocosm experiments confirm that because of effects on algae grazers (Zooplankton), algal biomass levels in coastal waters are more sensitive to toxic pollution than to nutrient inputs.

HOLLAND, SN n°7

## **EUTROPHICATION AND ALGAL PROLIFERATION IN COASTAL WATERS**

Phosphate concentrations in the North Sea have been considerably reduced, but nitrogen and silicate concentrations, as well as algal production, are not falling.

SWITZERLAND, SN n°7

## **LAKE EUTROPHICATION: CLIMATIC CONDITIONS RESULT IN CONTINUING DECLINE IN LAKE GENEVA'S DEEP-WATER OXYGEN LEVELS**

Significant reductions have been achieved in phosphate concentrations in Lake Geneva but climatic conditions in 1991 and 1992 have resulted in significant algal blooms and falling deep-water oxygen levels

UNITED KINGDOM, SN n°6

## **MANAGEMENT OF PLANKTONIC ALGAE**

Phosphorus reduction is not always the best approach to eutrophication problems.

FRANCE, SN n°6

## **COASTAL "GREEN SLICKS" ARE DUE TO NITRATE POLLUTION**

Britanny : reductions in nitrate input to coastal waters are the key to preventing algal proliferation

UNITED KINGDOM, SN n°5

## **ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION: REPORT ON FRESHWATER QUALITY**

Disappointment at deteriorating water quality in the UK. Assessment of surface and groundwater quality, covering a wide range of pollution sources and recommendations for monitoring and for improving water quality. Discussion of eutrophication problems and possible measures, including sewage treatment and reducing detergent phosphates

UNITED NATIONS, SN n°5

## **U.N. ECONOMIC COMMISSION: DETERGENT PHOSPHATE STUDY**

A comprehensive study on the use and environmental implications of detergent phosphates and of substitute products published by the UN Economic Commission for Europe. Full analysis of the current situation and of new developments. Impact of phosphates and of substitutes on sewage treatment and on the environment.

SWITZERLAND, SN n°5

**ECOTOXICITY OF CLEANING PRODUCTS**

Laboratory tests show that acute toxicity is principally related to surfactant concentrations

HOLLAND, SN n°5

**PHOSPHATE CONTROLS COULD COST FISHERIES DEARLY**

Dutch report on eutrophication and marine fish stocks links falling fisheries takings to lower North Sea phosphate inputs

GERMANY, SN n°5

**ORIGINS OF SURFACE WATER PHOSPHATE CONTENT**

Estimation of reduction in surface water phosphate loads resulting from the use of P-free detergents in Germany

UNITED KINGDOM, SN n°4

**ALGAE UNDER CONTROL**

Better understanding by British scientists and public of toxic algae problems.

SWITZERLAND, SN n°4

**LAKE GENEVA EUTROPHICATION SITUATION IMPROVING**

French-Swiss plan aims for further reductions of nutrient inputs to the lake.

GERMANY, SN n°4

**AUTHORITIES QUESTION "UNCALCULABLE RISKS" OF PHOSPHATE SUBSTITUTES**

Comparison of technical and ecological properties of detergent phosphates and substitute chemicals.

GERMANY, SN n°4

**GIANT BLOOM OF SILICA DIATOM ALGAE**

Controversy over possible role of detergents in North Sea.

ITALY, SN n°4

**DETERGENT PHOSPHATES NOT GUILTY IN ITALY**

Italian government report suggests detergent phosphates ban has not helped reduce eutrophication problems.

HOLLAND, SN n°4

**REDUCED NUTRIENT LEVELS IN RHINE**

Lower fish catches and bird populations feared as a result of cleaning up Rhine river

ITALY, SN n°3

**EUTROPHICATION PROBLEMS: ITALIAN WEATHER TOO GOOD**

Mucilage in the Adriatic caused by climatic conditions

HOLLAND, SN n°3

**EUTROPHICATION PROBLEMS, ALGAE GRAZERS AT RISK**

Dutch study shows how heavy metals are related to algal blooms

FRANCE, SN n°3

**PHOSPHATES USED TO FIGHT FOREST FIRES IN FRANCE**

FRANCE, SN n°2

**SYMPOSIUM: DETERGENTS AND MARINE ENVIRONMENT**

-Algal Growth Stimulation by Chelatisation : Risks Associated with Complexants in P-free Washing Agents (Germany)

-The partitioning of polycarboxylic acids in activated sludge (UK)

HOLLAND, SN n°2

**PHOSPHATES AND THE FRIESIAN BASIN**

A symposium on "Phosphates And The Friesian Basin: modelling, action, strategy" comes to the conclusion that agriculture is the principal contributor to eutrophication.

UNITED KINGDOM, SN n°2

**NATIONAL CONSULTATION ON DETERGENTS AND THE ENVIRONMENT**

Government commissioned study forms basis of UK national consultation on detergents and the environment.

UNITED KINGDOM, SN n°2

**ALGAL BLOOMS IN THE UNITED KINGDOM**

Toxic blue-green algae, a report of the National Rivers Authority.

SPAIN, SN n°2

**ENVIRONMENTAL IMPACT OF P-FREE DETERGENTS**

A study on environmental impacts of P-free detergents examines four parameters: suspended matters, organic carbon content and COD, biodegradability and ecotoxicity

GERMANY, SN n°1

**PHOSPHATE SUBSTITUTES**

German scientists question use of P-free detergents

ITALY, SN n°1

**SYMPOSIUM**

Marine Coastal Eutrophication Conference

# SCOPE NEWSLETTER

IN EUROPE

UNITED KINGDOM, SN n°1

## **TOXIC ALGAE**

Straw may be the solution for controlling growth of toxic algae

GERMANY, SN n°1

## **POLYCARBOXYLATES**

Analysis of the environmental effects of polycarboxylates

## **PHOSPHATE RECOVERY AND RECYCLING**

SWEDEN, SN n°10

## **SPREADING OF SLUDGE ON ARABLE LAND**

A report from Sweden examines the results of long term experiments of sludge spreading on arable land

SWEDEN, SN n°10

## **PROBLEMS AND RISKS IN AGRICULTURAL SLUDGE USE**

An article by the manager of the VAV, water and sewage works association in Stockholm examines how fears about using sewage sludge in agriculture are based on a lack of information instead of real health or environment risks

JAPAN, SN n°8

## **PHOSPHATE REMOVAL, MAGNESIUM CRYSTALLISATION**

A new process allows removal of phosphates from industrial wastewater in the form of solid magnesium ammonium phosphate usable for fertiliser

HOLLAND, SN n°7

## **SEWAGE TREATMENT: MAGNETIC SEPARATION OF PHOSPHATES FROM SEWAGE**

Full-scale plant trials prove efficiency of magnetic removal process in meeting EC requirements for phosphate concentrations after sewage treatment and potential for recycling of phosphates

UNITED KINGDOM, SN n°6

## **COST/BENEFIT ANALYSIS OF SEWAGE PHOSPHATE REMOVAL**

A forthcoming report from Imperial College, London, assesses costs and environmental benefits of EC sewage treatment policy

FRANCE, SN n°6

## **NTA, EDTA AND PHOSPHATE REMOVAL**

Chelating agents reduce the efficiency of sewage treatment

HOLLAND, SN n°6

## **RECOVERY OF PHOSPHATE FROM SEWAGE**

Side stream pellet reactor installation for 160 000 population equivalents commissioned for mid-1993

SWEDEN, SN n°5

## **HELSINGBORG INTRODUCES PHOSPHATES-STRIPPING**

Authorities' leaflet advises consumers on detergent choice

HOLLAND, SN n°1

## **PHOSPHATE RECYCLING**

Pilot plant allows recycling of phosphates in sewage

## **WATER TREATMENT AND WATER QUALITY**

SWEDEN, SN n°8

## **PHOSPHATES, SUBSTITUTES AND SEWAGE TREATMENT**

Stockholm Water Authority assessment concludes that there is no really adequate alternative to detergent phosphates

DENMARK, SN n°6

## **NUTRIENT RUN-OFF MANAGEMENT**

Sewage sources meet Government objectives

FRANCE, SN n°6

## **NTA, EDTA AND PHOSPHATE REMOVAL**

Chelating agents reduce the efficiency of sewage treatment

UNITED KINGDOM, SN n°2

## **ENVIRONMENTAL IMPACT OF SEWAGE SLUDGE DISPOSAL AT SEA**

Utility of experimental measures of biological effects for monitoring marine sewage sludge disposal sites.

GERMANY, SN n°2

## **N.T.A. AND HEAVY METALS IN WATER**

Content of heavy metals in sewage treatment during field tests.

UNITED KINGDOM, SN n°2

**THE PARTITIONING OF POLYCARBOXYLIC ACIDS IN ACTIVATED SLUDGE**

Removal of PCAs from wastewater is done essentially by a process of binding to activated sludge settleable solids.

GERMANY, SN n°2

**ELIMINATION OF PHOSPHORUS IN TRADITIONAL SEWAGE TREATMENT SYSTEMS**

Long term study on concentration of phosphorus, nitrogen and boron in mechanical-biological sewage treatment.

ITALY, SN n°2

**SEWAGE TREATMENT USING WATER PLANTS**

Domestic waste water spreading on crops and biological water treatment.

SWEDEN, SN n°1

**WATER QUALITY**

Swedish water authorities indicate their preference for phosphate based detergents in certain circumstances

GERMANY, SN n°1

**SEWAGE TREATMENT**

Göttingen City Authorities question use of P-free detergents

**NATIONAL POLICIES ON PHOSPHATES**

USA, SN n°11

**FEDERAL POLICY ON PHOSPHATES IN DETERGENTS**

Federal phosphate ban replaced by an in-depth study of environmental impacts of phosphates and their substitutes

BELGIUM, SN n°7

**ENVIRONMENTAL DETERGENT MANUFACTURERS ASSOCIATION GREEN LABEL PROPOSAL**

The European association of manufacturers of "green" detergents have put forward their own criteria for a European detergent Green Label

GERMANY, SN n°5

**SCIENTISTS AGAINST RETURN TO DETERGENT PHOSPHATES**

Two articles published in GWF Wasser-Abwasser cover positions criticising a possible return to the use of detergent phosphates

SCANDINAVIA, SN n°4

**PROJECT FOR WHITE SWAN EXCLUDES PHOSPHATES**

Scandinavian project criteria for Green Labelling suggest detergents must be P-free to be eligible

UNITED KINGDOM, SN n°3

**BRITAIN REJECTS P-BAN**

UK Government announces that detergent phosphates will be monitored but not banned

DENMARK, SN n°3

**PHOSPHATES OK FOR DENMARK**

Danish Government report on Green Labelling of detergents

GERMANY, SN n°3

**BLUE ANGEL FOR DETERGENTS**

Component system detergents eligible for German environment label

FRANCE, SN n°2

**PROGRESS REPORT ON FRENCH DETERGENT MANUFACTURERS' AGREEMENT WITH GOVERNMENT**

Actions agreed in the conventions signed with the AISD (Association des Industries des Savons et des Détergents) in 1989 and 1990.

FRANCE, SN n°1

**PHOSPHATE LIMITATION**

France opts for low-key detergent phosphate limitation and further research

SWEDEN, SN n°1

**CONSUMER PROTECTION**

Swedish Market Court condemns advertising of P-free detergent

# SCOPE NEWSLETTER

IN EUROPE

## WASHING PERFORMANCE

FRANCE, SN n°10

### **COMPARISON OF PHOSPHATE BASED AND PHOSPHATE FREE DETERGENTS REGARDING THE CAPACITY TO REMOVE BACTERIA AND GERMS FROM FABRICS**

Comparative tests were performed by Pasteur Institute in Lyon to compare the elimination of germs and bacteria from fabrics washed with 2 detergents, one built with phosphates and the other with a substitute. Both types of detergent had similar results except for the removal of bacteria *Pseudomonas Aeruginosa* and total aerobic micro-organisms. In this case, the phosphate based detergent showed a better performance

FINLAND, SN n°10

### **PHOSPHATE-FREE DETERGENTS, RINSING PERFORMANCE AND POSSIBLE DAMAGE TO WASHING MACHINES**

Several studies are being conducted in Finland to investigate the cause of growing concerns about possible side effects due to the use of phosphate-free detergents. These products are accused of bad rinsing performance and of damaging washing machines

FRANCE, SN n°7

### **DETERGENTS COMPARATIVE WASHING EFFICIENCY STUDY FOR DISHWASHING DETERGENTS**

French national consumer institute study of 15 hand and 8 machine dishwashing detergents

UNITED KINGDOM, SN n°3

### **FOCUSING ON DIRT**

New methods for visualising detergent washing performance

FRANCE, SN n°3

### **SOME DETERGENTS ARE CLEANER THAN OTHERS**

International studies on detergent performance and environmental impact: Performance study shows advantages of P-containing compacts. Relations between performance and environmental impact

SPAIN, SN n°3

### **SOME DETERGENTS ARE CLEANER THAN OTHERS**

Spanish study looks at environmental implications of P-free formulations

## MISCELLANEOUS

UNITED KINGDOM, SN n°6

### **PHOSPHORUS FROM FISH FARMS**

Phosphorus pollution costs estimated at 3 % of wholesale value of fish produced

UNITED KINGDOM, SN n°6

### **TROUBLE WITH ALGAE**

Educational booklet on nutrients and eutrophication sent out to all UK secondary schools

The SCOPE Newsletter is produced by the SCIENTIFIC COMMITTEE ON PHOSPHATES IN EUROPE, a non commercial, non profit-making association (Association Sans But Lucratif) based in Brussels.

The association includes international groups headquartered in Belgium, France, Spain, Sweden and the UK, producers of a wide variety of detergent ingredients including phosphates. Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

The SCOPE Newsletter is open to input from its readers across Europe and we welcome all comments or information. Contributions from readers are invited on all subjects concerning phosphates, detergents, sewage treatment and the environment. You are invited to submit scientific papers for résumé, to send comments on the studies mentioned in this Newsletter or other scientific or technical news.

For each study or paper mentioned in the SCOPE Newsletter, the full document can be obtained directly from :

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# SCOPE NEWSLETTER

IN EUROPE

Number Eleven - June 1994

## AUSTRIA

### Comparison of a detergent containing phosphates with compact detergents without phosphates

A popular brand of compact detergent containing phosphates was compared to three different brands made with phosphate substitutes. Four parameters were examined : washing efficiency, damage to fabrics, biodegradation and aquatic toxicity. It appears that for similar cleaning performance, the phosphate containing brand obtains better results in terms of potential environmental impacts than its competitors ..... p. 2

## THE NETHERLANDS

### The development of an Eutrophication Index for ecosystems

Preliminary results of a study conducted by TNO, the Netherlands research institute, shows that rather than the impact of nutrients, the effect of toxicants on zoo-plankton and macrophytes which compete with algae can be largely responsible for eutrophication phenomena..... p. 3

## CANADA

### The relative importance of biological and chemical processes in the release of phosphorus from a highly organic sediment

A study was conducted on sediments extracted from a Canadian shield lake in order to measure the role of bacteria on phosphorus and iron release from sediments. It appears that, as opposed to the prediction of the Eisenle/Mortimer model, P and Fe movements are independent. Most of P-release occurs following bacterial cell destruction after sterilization, implying the importance of bacteria as a reservoir of P ..... p. 4

## USA

### Interaction of toxicants and communities : the role of nutrients

The interaction between community nutrient status and toxicity was studied. Results reveal that communities living in a microcosm with a high nutrient value show better resistance to toxicants and faster recovery. It also shows that once it reaches a certain level qualified as eutrophic, the increase in concentration of nutrients does not affect the nutrient consumption by periphyton nor its productivity ..... p. 5

## ITALY

### Contribution of drainage waters from agricultural sources to the concentration of phosphate and nitrogen in coastal waters

A study was conducted in order to assess the contribution of nitrogen and phosphate originating from agriculture in the Po Valley to coastal eutrophication of the Adriatic sea. Results clearly show that when normal agricultural practices are followed, this contribution is of some concern with regards to nitrogen and very low in regards to phosphorus ..... p. 6

## SHORT NEWS - SHORT NEWS - SHORT NEWS

## USA

Federal phosphate ban replaced by an in-depth study of environmental impacts of phosphates and their substitutes ..... p. 8

## SWEDEN

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## **AUSTRIA**

### **Comparison of a detergent containing phosphates with compact detergents without phosphates**

**A popular brand of compact detergent containing phosphates was compared to three different brands made with phosphate substitutes. Four parameters were examined : washing efficiency, damage to fabrics, biodegradation and aquatic toxicity. It appears that for similar cleaning performance, the phosphate containing brand obtains better results in terms of potential environmental impacts than its counterparts.**

The study was carried out by the VKI laboratory, the Austrian consumer association. The VKI test was applied to a phosphate containing compact detergent. The results were compared to results of tests carried out in 1992 on three phosphate-free compact brands.

The four products were tested with respect to dosage recommended by their producers, i.e. 60 g/wash for the P-containing brand as opposed to 100 g/wash for the other brands.

The tests included the assessment of washing performance and environmental impact.

For washing performance, the following parameters were considered :

- cleaning efficiency (soil removal) on cotton and polyester cotton,

- bleaching efficiency,
- efficiency of enzymes,
- redeposition (greying),
- damages to fabrics,
- inorganic and organic encrustations.

The tests were carried out on artificially soiled test fabrics in washing machines loaded with naturally soiled clothes. Regarding environmental compatibility, biodegradation and aquatic toxicity were studied.

The phosphate containing brand ranked first as regards to washing efficiency with soiled cotton with a score qualified as very good and obtained a score considered as average as regards to performance on fabrics containing polyester.

When considering the bleaching efficiency, i.e. the capacity to remove stains from material, despite the fact that the P-free brands contained a bleach and the P-containing brand did not, the P-free brands performed only slightly better than the P-containing. However, for the removing of wine stains on cotton and of cocoa on polyester, the P-containing brand came out better after the first wash.

The absence of bleaching agent might also explain why similar results were obtained with respect to redeposition. Despite these differences, the bleaching efficiency of the P-containing brand was qualified as "very good".

The phosphate containing brand obtained the best score for both inorganic and organic encrustation and tear resistance.



# SCOPE NEWSLETTER

In this last case, results for the P-containing brand were considered very good as opposed to average or less satisfactory for the other brands.

When considering bio-degradability, the P-containing detergent obtained results similar to the other brands, except for bio-degradability of non-ionic surface-active agent where its performance was significantly better. When considered as a whole, the degree of bio-degradability of the P-containing brand was classified as "very good".

Finally, the last parameter assessed was aquatic toxicity. Results of the 4 brands were similar with respect to toxicity on fish and daphnia. But with respect to algae, the P-free detergents need a higher dilution than the phosphate-containing brand in order to prevent toxic effects.

*Comparison of the detergent "X" containing phosphates with compact detergents without phosphates, H. Sedy, S. Furst & T. Van Le, VKI, September 1993.*

## THE NETHERLANDS

### The development of an Eutrophication Index for ecosystems

Preliminary results of a study conducted by TNO, the Netherlands research institute, show that rather than the impact of nutrients, the effect of toxicants on zooplankton and macrophytes which compete with algae can be largely responsible for the eutrophication phenomena.

In order to obtain a better understanding of what causes eutrophication in a body of water, the authors of the study recommend the use of a Eutrophication Index (E.I.) which takes into account both algal production and algal consumption rates.

$$\text{E.I.} = \frac{\text{Algal production rate}}{\text{Algal consumption rate}}$$

The production rate is influenced by nutrient load but the algal consumption rate depends mainly on zooplankton grazing and macrophyte competition. An E.I. > 1 indicates eutrophication. In a healthy ecosystem, the microalgal density is controlled by competition with macrophytes and by zoo-plankton grazing. Inhibition of macrophyte growth or zoo-plankton response by introduction of toxicants decreases the ecosystem's inherent capacity to control algal production, which might lead to eutrophication.

Tests performed in the Wallensea showed that even at a daily phosphorus and nitrogen fertilisation up to 64 times the normal nutrient release rate, algal growth was controlled by the copepod *Eurytemora* which increased in abundance in relation to the increase in algal productivity (i.e. food supply). On the other hand, the introduction of several types of toxicants in waterbodies provoked an increase of microalgal density, despite unchanged nutrient conditions, which was due to an inhibition of algal consumption.

The Eutrophication Index is established for a particular aquatic ecosystem. It allows the estimation of the concentration level at which phosphate starts changing the value of the index. This concentration level is called no effect phosphate level (NEPL).

Tests were conducted in microcosms in order to validate the concept of Eutrophication Index. The reaction of plankton communities to the introduction of household effluent with phosphate containing and phosphate free detergents were compared.

Preliminary results show that at a dosage which corresponds to equal performance for P-containing and P-free detergents (3 g and 5.2 g per litre respectively), eutrophication effect appears (i.e. the rate of algal production exceeds the rate of consumption by higher organisms only with the P-free detergent).

Eutrophication effect occurs similarly when a P-containing detergent is used at a 5.2 g/litre dosage. The authors conclude that eutrophication effects are probably due to an ineffective zoo plankton response to microalgal growth as a result of toxic effects of detergent surfactants.

The final report of this study including experiments in mesocosms will be available later this year.

*The development of an eutrophication index for ecosystems based on microcosm studies: M. C.Th. Scholten, E.M. Foekema, R.J. Jak, TNO Institute of Environmental Sciences, Den Helder, the Netherlands, Interim report, April 1994.*

**CANADA**  
**The relative importance of biological and chemical processes in the release of phosphorus from a highly organic sediment**

**A study was conducted on sediments extracted from a Canadian Shield lake in order to measure the role of bacteria on phosphorus and iron release from sediments. It appears that, as opposed to the prediction of the Eisenle/Mortimer model, P and Fe movements are independent. Most of P-release occurs following bacterial cell destruction after sterilization, implying the importance of bacteria as a reservoir of P.**

Experiments were conducted in order to verify, under specific conditions, the classical Einsele/Mortimer model which explains phosphorus release from sediments by the reduction of ferric iron (Fe(III)) at the sediment surface. These experiments were conducted in a laboratory under aerobic and anaerobic conditions, with or without sterilization and at different pH. The sediments were obtained from the fully oxygenated littoral zone of the small dystrophic Lake Cromwell located on the Canadian Shield.

From these experiments, it appears that in lake Cromwell, the cycling of P and Fe are not tightly related as predicted by the model. Sterilization as well as acidification caused a drop in total dissolved iron (TDFe) concentration and a simultaneous increase in total dissolved phosphorus (TDP) concentration.

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The Fe movements between sediments and water appear to be controlled mainly by a chemical mechanism that is strongly pH-dependent.

Another likely explanation for the release of Fe(II) is an active bacterial reduction of Fe, but further tests are needed to verify this hypothesis.

In addition to the refutation of the model for this specific sediment, this research also challenges the hypothesis of bacteria catalysed P release from Fe hydroxides. Although bacterial reduction of Fe does appear to occur in the sediments observed, it did not mediate P release.

The experiments suggest that almost all P-release seems to be of direct bacterial origin.

The maximum release occurred after addition of  $\text{HgCl}_2$ , when bacterial activity and the number of bacteria dropped dramatically. The fact that increased rate of release declined three days after sterilization seems to indicate that the bacterial source of P was exhausted. Thus, P release can probably be attributed to bacterial cell lysis.

The authors conclude that, for sediments of Lake Cromwell, and probably other oligodystrophic lakes as well, living micro-organisms act as an important P reservoir and that processes inducing cell lysis can result in a significant P release from the sediments.

*De Montigny, C. & Y. T. Prairie, The relative importance of biological and chemical processes in the release, in Hydrobiologia, 253: 141-150, 1993.*

### USA

#### **Interaction of toxicants and communities : the role of nutrients**

**The interaction between community nutrient status and toxicity was studied. Results reveal that communities living in a microcosm with a high nutrient value show better resistance to toxicants and faster recovery. It also shows that once it reaches a certain level qualified as eutrophic, the increase in concentration of nutrients does not affect the nutrient consumption by periphyton nor its productivity.**

The relationship between community nutrient status and toxicity was studied in laboratory microcosms containing natural periphyton communities.

The three experimental nutrient treatments, (low, medium, high) increased by an order of magnitude from 0.05 mg/litre N + 0.01 mg/litre P and were chosen in order to represent 3 lake and reservoir categories, i.e. oligomesotrophic, eutrophic and hypertrophic. Communities were developed with nutrient treatments for 25 days at the end of which they were exposed to 3.5 mg/litre diquat; a photosynthetic inhibitor. The communities were then studied for 23 days.

The effects of toxicant addition were assessed by measuring changes in biomass (protein, chlorophyll), enzyme activities (alkaline phosphatase, electron transport), nutrient release, diurnal changes in microcosm oxygen (gross productivity), and toxicant fate.

Although communities under medium and high treatment were exposed to quite different nutrient levels, the actual nutrient consumption was not so different. Therefore, the high treatment should be considered hypertrophic only in the sense of the standing stocks of nutrients, not in terms of the community that develops.

The diquat concentration in water was different depending on the nutrient status following the pattern low<high<medium. This change in toxicant bio-availability with trophic status agrees with previous model simulations.

None of the structural parameters (chlorophyll, protein) were significantly affected by the presence of toxicant, probably a consequence of both the low concentration of toxicants and the short exposure time.

On the contrary, the microcosm Electron-Transport-System Activity (ETSA) and the community Gross Productivity (GP) were clearly affected by diquat. The nutrient treatments did not seem to affect the sensitivity to the toxicant but had more influence on the capacity for recovery. The decrease of GP was comparable in all nutrient treatments.

The addition of toxicant led to a strong loss of productivity in the low treatment microcosm. In the medium and high treatment, microcosms showed signs of recovery after a period of acclimatization. Levels of productivity then returned to almost the same productivity as the control microcosms.

Given more time, both medium and high nutrient treatments could have been able to recover completely to control values.

*Barreiro Lozano, R. & J. R. Pratt, Interaction of toxicants and communities : the role of nutrients, Environmental Toxicology and Chemistry, Vol. 13. N° 3, 1994.*

## ITALY

### **Contribution of drainage waters from agricultural sources to the concentration of phosphate and nitrogen in coastal waters.**

A study was conducted in order to assess the contribution of nitrogen and phosphate originating from agriculture in the Po Valley to coastal eutrophication of the Adriatic sea. Results clearly show that when normal agricultural practices are followed, this contribution is of some concern with regards to nitrogen and very low in regards to phosphorus.

The contribution of agricultural practices in the Po Valley to the concentration of nitrogen and phosphate was studied. The use of chemical fertiliser is common in this area with application rates of around 100-150 and 20-30 kg/ha/year of nitrogen and phosphorus respectively.

Contribution of N and P also arise from other sources like manure, compost or sludge from waste water purification systems. Most of the contribution of these elements to surface waters comes from underground drainage water. This technique has been widely implemented in this region. Surface runoff or erosion are particularly low due to a relatively flat landscape.

In order to evaluate the share attributable to agriculture, concentrations of N and P in (i) drainage waters coming directly from the soil, (ii) water in the rivers and their effluents flowing into the Adriatic Sea, and (iii) the coastal waters of the Adriatic Sea itself were compared.

On the basis of the chemical analyses carried out on the underground drainage waters, the amounts of nutrients removed by the drainage per year were 40-50 kg/ha for nitrogen and 50-75 g/ha for phosphorus. Concentrations of N appeared to be much higher in soil solutions than in waters taken from rivers. 86% of the soil solution samples showed N values ranging from 5 to 50 mg/l as opposed to 5 mg/l in rivers and streams.

The authors consider that nitrogen losses definitely merit critical examination directed toward achieving considerable reduction.

On the contrary, examination of data showed that 73% of the soil solution samples indicated a concentration of P below 0.05 mg/l as opposed to 0.2 mg/l in waters of the Po Valley rivers.

Therefore, the drainage water coming directly from the soil cannot be considered as being a primary cause for phosphorus pollution of the coastal waters.

Indeed, drainage water from the cultivated soils examined has a dilution effect on the phosphorus concentrations in streams and rivers.

The overall dynamics of nutrients in soil are particularly complex and controlled by a group of factors, including climate, chemical, physical and biological properties of the soil and agricultural practices.

Many aspects of the behaviour of phosphorus in the soil are different from those of nitrogen, which explains the difference of concentration between P and N in drainage water.

Firstly, the ionic forms of phosphates are more or less strongly adsorbed by the mineral colloids at all pH values found in soil. Secondly, the remaining P is precipitated in the form of sparingly soluble calcium phosphates and insoluble iron and aluminium phosphates. For these reasons, the concentration of P in the soil solution, after an initial temporary increase, rapidly returns to the values preceding fertilisation.

*Rossi, N., C. Caviatti and P. Sequi, Contribution of Agricultural land in the Po Valley to coastal eutrophication of the Adriatic Sea, Science of the total environment, supplement 1992, Amsterdam.*

## SHORT NEWS

### USA

#### **Federal phosphate ban replaced by an in-depth study of environmental impacts of phosphates and their substitutes**

A US federal detergent phosphate ban bill which was introduced in July 1993 by Senator Mitchell (D. Maine) was superseded in February 1994 by a new bill omitting the ban provision. The phosphate ban would have required EPA to regulate household laundry detergents to 0.5% phosphorus within two to five years of enactment. Instead, the proposed bill proposed asks for an EPA study of phosphates in detergents, to be carried out within 4 years of enactment. The study would include :

- an assessment of phosphate quantities and their trends,
- an evaluation of the environmental consequences of reduced phosphate levels in detergents,
- an assessment of possible operational and capital cost savings, at sewage treatment plant,
- an assessment of the availability, cost, and effectiveness of phosphate substitutes for dish washing, commercial, and industrial detergent products,
- EPA recommendations deemed appropriate regarding these matters.

*Edwin A. Matzner Consulting, Cleaning Agent Newsletter, 1994/2, February.*

### SWEDEN

#### **Observations along the Swedish west coast contradicts the hypothesis of a direct link between nutrient concentration and algal bloom**

News reports from Sweden reveal that, despite similar weather and chemical conditions, no algal bloom like the one which occurred in May 1988 has been observed this spring.

At the end of April, Norwegian scientists warned of large masses of contaminated water coming from the North Sea, containing high amounts of nutrients which could support an algal bloom. In 1988, most of the blame was attributed to nutrients accused of feeding the algae.

Conditions observed this spring are similar to the ones observed in 1988 when poisonous algae bloomed, affecting cell membranes of plants and animals : the N/P ratio is high (100 :1 instead of 15:1) and spring temperatures have also been high. Stratification in the sea, i.e. the boundary between deep water and surface water at a depth of about 10 meters, is also similar.

However, no incidence on the production of a bloom of poisonous algae has appeared, and scientists are looking for other parametres which could explain the difference between 1988 and 1994 situations.

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It is not possible to predict an outbreak of an explosive growth of algae in the sea just by knowing the contents of phosphorus and nitrogen only. The population of zoo-plankton in the sea could be one of the reasons.

Scientists recall that the blooming of algae is a natural thing and that marine life is closely related to their growth. An increase of algal production will therefore support an increased fish population in a healthy system.

After mid June, weather conditions are normally unfavourable to excessive algal growth, so it seems that, for this year, the supposed link between nutrient concentrations and algal blooms has failed to manifest itself.

The SCOPE Newsletter is produced by the SCIENTIFIC COMMITTEE ON PHOSPHATES IN EUROPE, a non commercial, non profit-making association (Association Sans But Lucratif) based in Brussels.

The association includes international groups headquartered in Belgium, France, Spain, Sweden and the UK, producers of a wide variety of detergent ingredients including phosphates. Its aim is to provide a platform for objective and scientific information on the effects of phosphate-containing and phosphate-free detergents on the environment.

The SCOPE Newsletter is open to input from its readers across Europe and we welcome all comments or information. Contributions from readers are invited on all subjects concerning phosphates, detergents, sewage treatment and the environment. You are invited to submit scientific papers for résumé, to send comments on the studies mentioned in this Newsletter or other scientific or technical news.

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