REPORT SNO 3492-96

# Full Scale Testing of Chemical Precipitation at Touzim Wastewater Plant

Phase 1 & 2

In cooperation with


aquateam

Norwegian
Water Technology
Centre AS

Water Research Institute,
Praha

# NIVA - REPORT

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**Main Office**
P.O. Box 173, Kjelsås
N-0411 Oslo
Norway
Phone (47) 22 18 51 00
Telefax (47) 22 18 52 00

**Regional Office, Sørlandet**
Televeien 1
N-4890 Grimstad
Norway
Phone (47) 37 04 30 33
Telefax (47) 37 04 45 13

**Regional Office, Østlandet**
Rute 866
N-2312 Ottestad
Norway
Phone (47) 62 57 64 00
Telefax (47) 62 57 66 53

**Regional Office, Vestlandet**
Thormøhlensgt 55
N-5008 Bergen
Norway
Phone (47) 55 32 56 40
Telefax (47) 55 32 88 33

**Akvaplan-NIVA A/S**
Søndre Tollbugate 3
N-9000 Tromsø
Norway
Phone (47) 77 68 52 80
Telefax (47) 77 68 05 09


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Bjarne Paulsrud
Svein Stene-Johansen


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Abstract:

Full scale testing of chemical precipitation for phosphorus removal has been carried out during two phases.

The report in hand includes Phase 1 and 2, and gives recommendation for upgrading/rehabilitation based on the tests.



4 keywords, Norwegian

1. Kjemisk felling
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4 keywords, English

1. Chemical precipitation
2. Wastewater treatment
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Project manager

Svein Stene-Johansen


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# PREFACE

The project called "Upgrading of Wastewater Treatment Plants in the Czeck Republic" is part of the Environmental Programme of Coordination between the Government of Norway and the Government of the Czeck Republic on Cooperation in the Protection of the Environment.

The project has been executed by the Norwegian Institute for Water Research, NIVA in cooperation with Aquateam - Norwegian Water Technology Center A.S. As Czechian cooperation partner, the Water Research Institute (WRI) in Praha was appointed.

The team engaged in the project consisted of the following members:

Mr. Tomas Just, WRI
Mr. Enrico Matielli, WRI
Mr. Bjarne Paulsrud, Aquateam A.S.
Mr. Johan Ahlfors, NIVA
Mr. Svein Stene-Johansen, NIVA

Several wastewater treatment plants in South Bohemia have been investigated and proposals made for rehabilitation and upgrading. The reports have been handed over to WRI and JiVak. It was agreed that WRI should do the translation and submit the results and recommendations to the owners of the wastewater treatment plants (JiVak).

Touzim Wastewater Treatment Plant was the last plant added to the list. Toužim was first time visited by the team in November 1994, and during November and December full scale testing of chemical precipitation for phosphorus removal was performed (Phase 1). A preliminary report was handed over in January 1995.

One of the recommendations from Phase 1 was to continue the full scale testing with a commercial iron salt (Prefloc), easily available in the Czech Republic (Phase 2).

The report in hand includes the reports on Phase 1 and 2.

The project manager would like to thank the directors of JiVak, the operators at the treatment plant and the teammembers for fruitful cooperation.

Oslo May 1996

Norwegian Institute for Water Research

Svein Stene-Johansen

Norwegian Institute for Water Research / Aquateam A/S

# Full Scale Testing of Chemical Precipitation at Touzim Wastewater Treatment Plant

Phase I

# Table of Contents

# 1 Introduction

Touzim wastewater treatment plant is an old activated sludge plant (oxidation ditch) which has been operated with simultaneous precipitation for some time in order to reduce the eutrophication of the receiving water which is part of the water supply system for the city of Karlovy Vary.

The coagulant in use is aluminium sulphate in liquid form (40% solution) and this chemical is also utilised at the city's waterworks. Due to economical constraints, the Al-sulphate dosage has so far been very low at the wastewater treatment plant and the phosphorus removal has been moderate with an average effluent concentration of 2.5 mg P/l in 1994.

The main objective of the full scale testing was to optimise the point of coagulant dosing and the dosage required for achieving a certain effluent concentration of total phosphorus.

# 2 Test Programme

During the visit to the plant on November 14 and 15, 1994, the dosing of Al-sulphate was moved to the point where the effluent from the two parallel oxidation ditches were mixed together and before the split of the mixed liquor suspended solids to the parallel sedimentation tanks.

The dosage of Al-sulphate was checked at the same time and this control revealed that the dosing pump gave about 8 litres/day of 40% Al-sulphate solution. This corresponds to a dosing rate of only 4 g/m$^3$ of Al-sulphate (average wastewater flow ~900 m$^3$/d), which means that no significant phosphorus removal due to the coagulant addition can be expected.

Based upon jar tests performed during our visit, we suggested to increase the dosage rate to 50-75 g/m$^3$ of Al-sulphate during the test period in order to achieve an acceptable reduction of phosphorus. The dosage was raised in two steps (see Table 1) to adapt the activated sludge to the increasing coagulant dosage.

For economical reasons, the test period was only 3 weeks and this is shorter than desired for simultaneous precipitation with a very low preceding coagulant dosage.

The effect of increased coagulant dosage was determined by taking 24-hour composite samples from the plant influent and effluent using timer-controlled automatic samplers. These samples were taken from Monday to Thursday during 3 weeks from November 21, 1994.

The samples were analysed for:

- COD
- Suspended solids (SS)
- Orthophosphate
- Total phosphorus

at the laboratory of the treatment plant owner (VaK Karlovy Vary). The daily wastewater flow was monitored with the Parshall flume placed in the channel downstream the grit chamber.

# 3 Results and Discussion

The results of the analyses and wastewater flow measurements are summarized in Table 1 and the COD, suspended solids, total phosphorus and orthophosphate variations in the influent and effluent during the test period are presented in Figures 1-4. Table 2 shows the average pollutant loads, discharges and removal rates in this period.

***Table 1. Summary of analyses, wastewater flow measurements and coagulant dosages during the test period.***

| Date 1994 | Sampling point | Waste-water flow ($m^3/d$) | Coagulant dosage (l/day) | Average dosing rate of Al-sulphate ($g/m^3$) | pH | Total-P (mg P/l) | Ortho-P (mg P/l) | COD (mg/l) | SS (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| 21.11 | Influent | 630[1)] | 100 | 44 | 7.3 | 3.7 | 2.0 | 225 | 97 |
| | Effluent | | | | 7.3 | 1.4 | 0.36 | 41 | 24 |
| 22.11 | Influent | 989 | 100 | 40 | 7.3 | 4.8 | 3.1 | 285 | 122 |
| | Effluent | | | | 7.3 | 0.95 | 0.53 | 37 | 27 |
| 23.11 | Influent | 902 | 100 | 44 | 7.4 | 4.7 | 2.2 | 250 | 112 |
| | Effluent | | | | 7.4 | 1.0 | 0.77 | 20 | 6 |
| 24.11 | Influent | 932 | 100 | 43 | 7.5 | 5.5 | 2.4 | 350 | 185 |
| | Effluent | | | | 7.4 | 2.1 | 1.7 | 33 | 14 |
| 28.11[2)] | Influent | 946 | 144 | 61 | 7.3 | 7.7 | 5.5 | 360 | 169 |
| | Effluent | | | | -- | -- | -- | -- | -- |
| 29.11[2)] | Influent | 845 | 144 | 68 | 7.4 | 4.4 | 3.5 | 250 | 182 |
| | Effluent | | | | -- | -- | -- | -- | -- |
| 30.11[2)] | Influent | 711 | 144 | 81 | 7.5 | 6.7 | 3.4 | 330 | 165 |
| | Effluent | | | | -- | -- | -- | -- | -- |
| 1.12 | Influent | 802 | 144 | 72 | 7.4 | 10.7 | 6.5 | 770 | 418 |
| | Effluent | | | | 7.4 | 3.7 | 1.5 | 178 | 49 |
| 5.12 | Influent | 1272 | 144 | 45 | 7.3 | 4.3 | 2.6 | 210 | 133 |
| | Effluent | | | | 7.1 | 1.4 | 0.95 | 85 | 16 |
| 6.12 | Influent | 1019 | 144 | 57 | 7.4 | 4.8 | 2.8 | 320 | 110 |
| | Effluent | | | | 7.1 | 3.1 | 0.45 | 130 | 107 |
| 7.12 | Influent | 856 | 144 | 67 | 7.3 | 5.3 | 2.9 | 240 | 127 |
| | Effluent | | | | 7.1 | 0.72 | 0.39 | 37 | 2 |
| 8.12 | Influent | 877 | 144 | 66 | 7.6 | 5.3 | 2.8 | 270 | 123 |
| | Effluent | | | | 7.2 | 0.45 | 0.39 | 26 | 6 |

1) Wastewater flow registered from 09:30 to 24:00 this day
2) Effluent sampler was out of function on these days

***Table 2. Average pollutant loads, discharges and removal rates during the test period.***

| Parameter | Influent (kg/d) | Effluent (kg/d) | Removal rate (%) |
|---|---|---|---|
| COD | 269 | 62 | 77 |
| SS | 146 | 27 | 82 |
| Total-P | 5.1 | 1.6 | 69 |
| Ortho-P | 2.8 | 0.7 | 75 |

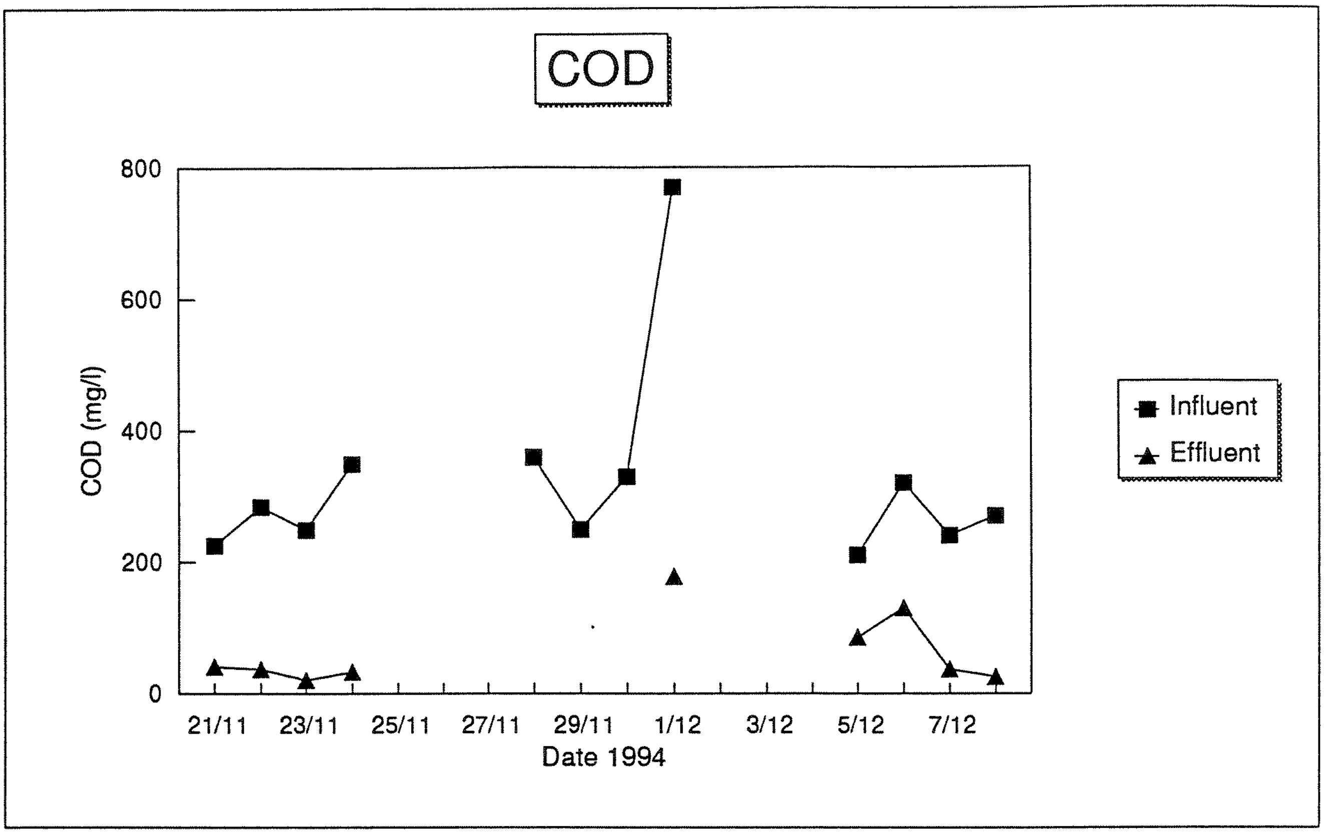


*Figure 1. Variations in influent and effluent COD concentration during the test period.*

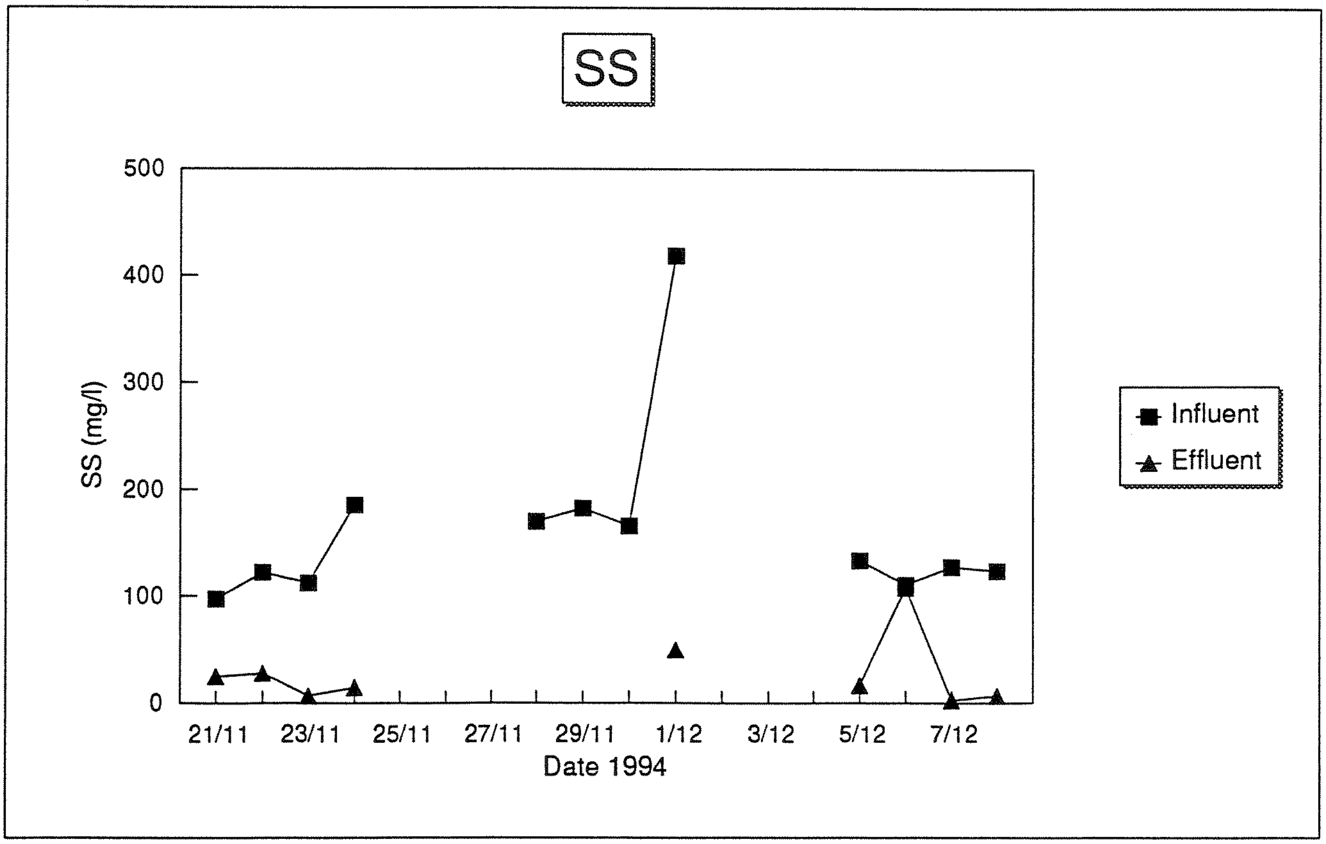


*Figure 2. Variations in influent and effluent suspended solids concentration during the test period.*

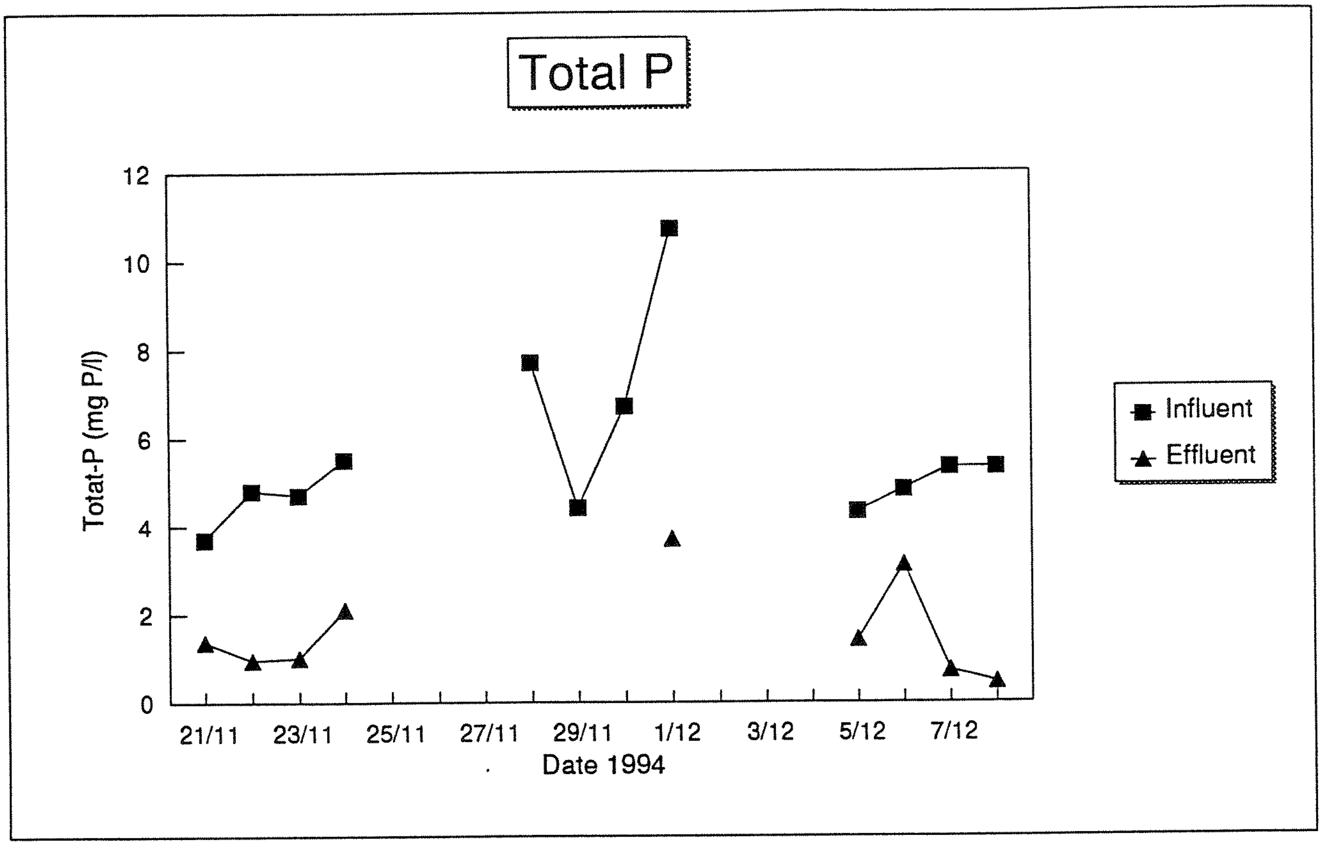


*Figure 3. Variations in influent and effluent total phosphorus concentration during the test period.*

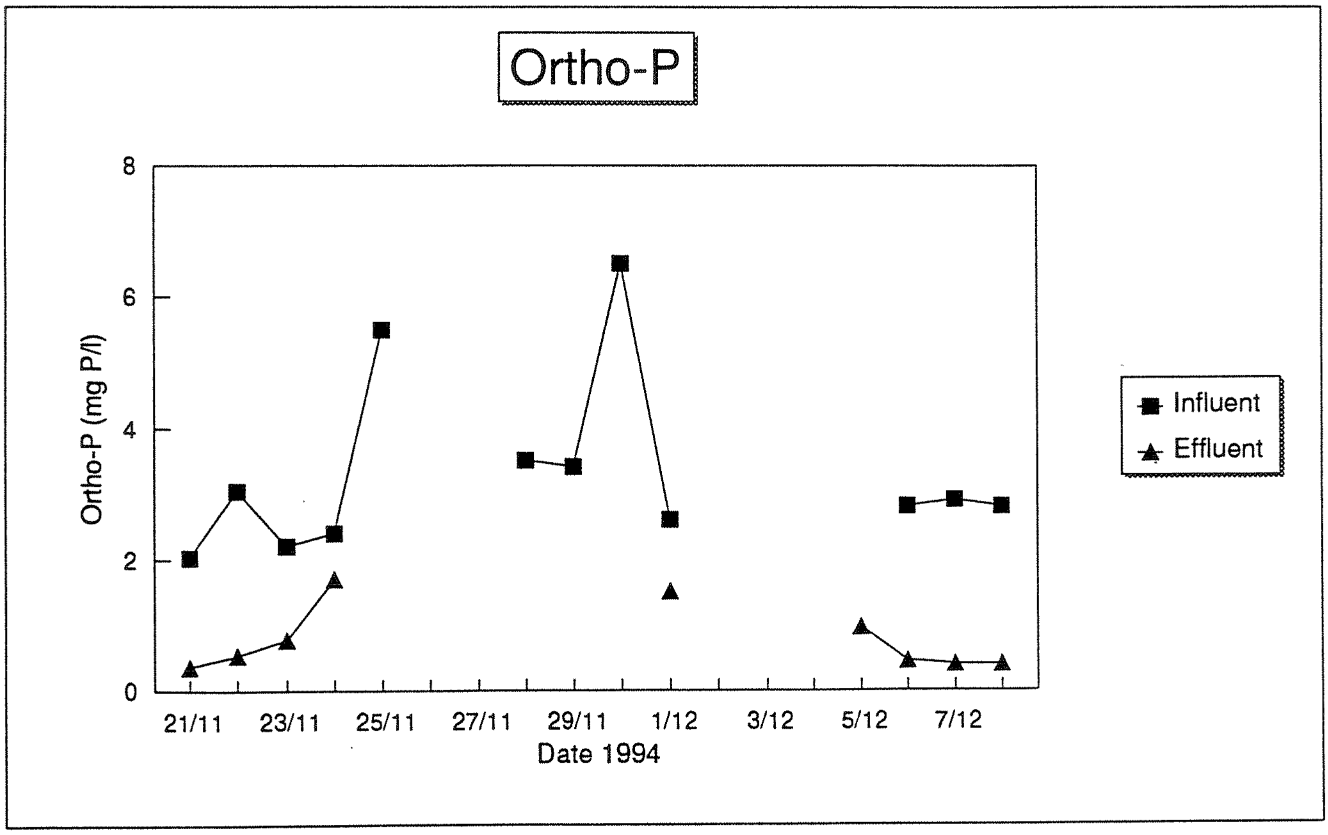


*Figure 4. Variations in influent and effluent orthophosphate concentration during the test period.*

The wastewater treatment plant had problems with the settling of the activated sludge flocs in parts of the test period and together with the sampling problems, this makes it rather difficult to perform an unambiguous evaluation of the effects of chemical precipitation and the necessary dosage for a certain phosphorus removal. The reason for the poor settleability of the activated sludge is unknown, but we doubt that this was due to the increased Al-sulphate addition, since the floc settleability recovered in about one week, even with a higher coagulant dosage in the latter part of the test period.

In order to achieve an effluent total phosphorus concentration below for instance 1 mg P/l, the orthophosphate concentration should normally be lower than 0.3-0.4 mg P/l unless the suspended solids removal is very good (effluent SS-concentration ≤20 mg/l). For simultaneous precipitation plants there will be a fairly good correlation between coagulant dosage and the effluent orthophosphate concentration. During the test period with actual Al-sulphate dosages in the range of 100-144 l/day or 40-80 g/m$^3$ (see Table 1), the effluent orthophosphate concentration varied between 0.36 mg P/l and 1.7 mg P/l. Even though the highest ortho-P values are hard to explain; these data show that the Al-sulphate dosage (40% solution) needs to be about 100-150 l/day and that the activated sludge flocs should have normal settling properties in order to obtain a good removal of total phosphorus.

## 4 Conclusions and Recommendations

Based upon 3 weeks of full scale testing with simultaneous precipitation (Al-sulphate) at Touzim wastewater treatment plant, the following conclusions can be drawn:

- Unless the activated sludge flocs exhibit poor settleability effluent total phosphorus concentrations below 1 mg P/l can be expected with an Al-sulphate (40% solution) dosage of 100-150 litres/day, corresponding to a dosage rate of 40-80 g/m$^3$ of Al-sulphate ($Al_2(SO_4)_3 \cdot 18H_2O$).

- The coagulant dosage should preferably be proportional to the wastewater flow by controlling the dosing pump by a signal from the flow meter. Manual regulation of the dosing rate is also acceptable for simultaneous precipitation (with recycling of coagulant with the return activated sludge) if the flow meter does not have a signal output.

- Practical experiences have shown that iron salts are more suitable for simultaneous precipitation than Al-sulphate, since they normally enhance the settleability of the activated sludge flocs. We therefore strongly support the plans to run a new test at Touzim using ferric sulphate or ferric chloride as coagulant.

Norwegian Institute for Water Research / Aquateam A/S

# Full Scale Testing of Chemical Precipitation at Touzim Wastewater Treatment Plant

## Phase II

# Table of Contents

# 1 Introduction

During November and December 1994 full scale testing of chemical precipitation for phosphorus removal was performed at Touzim wastewater treatment plant (Phase I). The coagulant was a liquid aluminium sulphate (40% solution) normally used for the treatment of potable water at the waterworks of Karlovy Vary. In order to achieve an effluent total phosphorus concentration below 1 mg P/l, the necessary dosage of aluminum sulphate had to be 100-150 litres per day.

When employing simultaneous precipitation for phosphorus removal, like in Touzim, our experience is that adding iron salts will produce similar or better results with a lower coagulant dosage than with aluminium sulphate. One of the recommendations from the Phase I investigation was to continue the full scale testing with a commercial iron salt (Prefloc), easily available in the Czech Republic.

# 2 Test Programme

For several local reasons the Phase II testing was postponed until 21 June 1995. Table 1 shows the different periods with varying dosages of ferric sulphate (Prefloc). The coagulant was added in liquid form as a 40% solution of ferric sulphate.

***Table 1. Periods with varying dosage of Prefloc***

| No. | Test period | Dosage of Prefloc (l/day) | Number of 24-hours sampling days |
|---|---|---|---|
| 1 | 21.06.95 - 31.07.95 | 22 | 2 |
| 2 | 01.08.95 - 08.08.95 | 63 | 1 |
| 3 | 09.08.95 - 15.09.95 | 35 | 2 |

The 24-hours sampling programme included sampling of influent and effluent every hour. Each sample was analysed for total phosphorus at the laboratory of Vak Karlovy Vary. The wastewater flow was also recorded every hour in the sampling periods.

# 3 Results and Discussion

All the data from the 5 sampling days are summarized in Appendix 1. In figures 1-5 the variations in influent and effluent phosphorus concentration are shown for each of the sampling days.

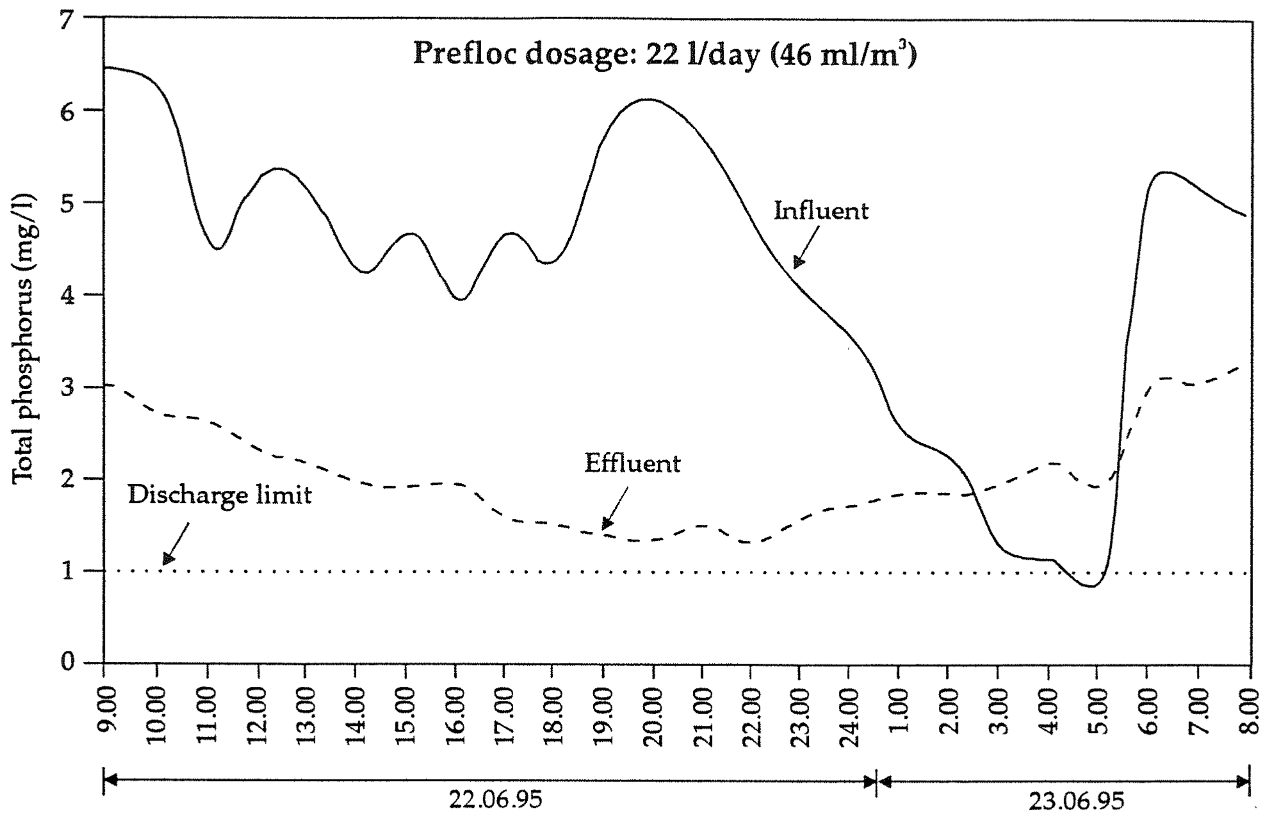


***Figure 1.** Variations in influent and effluent total phosphorus concentration during one day (22-23 June, 1995) with a Prefloc dosage of 22 l/day (46 ml/m³).*

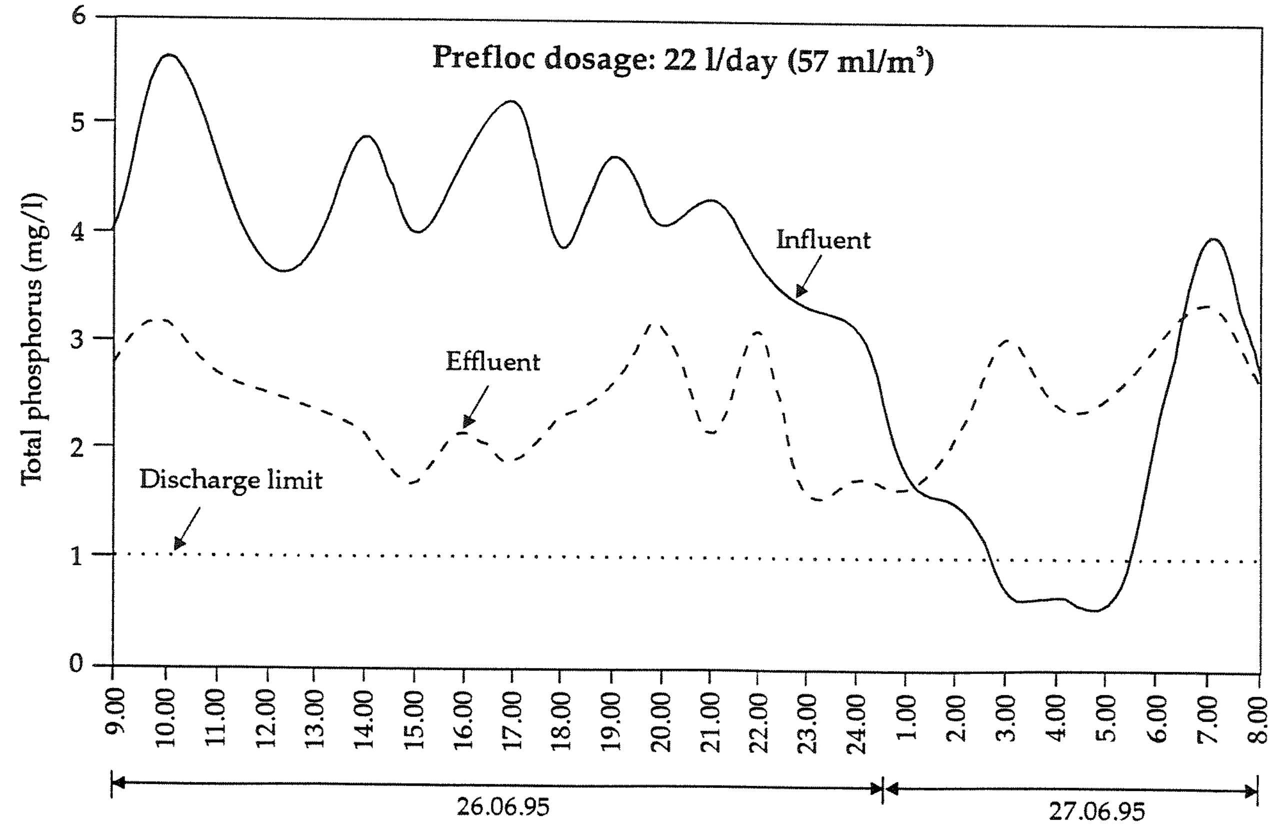


***Figure 2.** Variations in influent and effluent total phosphorus concentration during one day (26-27 June, 1995) with a Prefloc dosage of 22 l/day (57 ml/m³).*

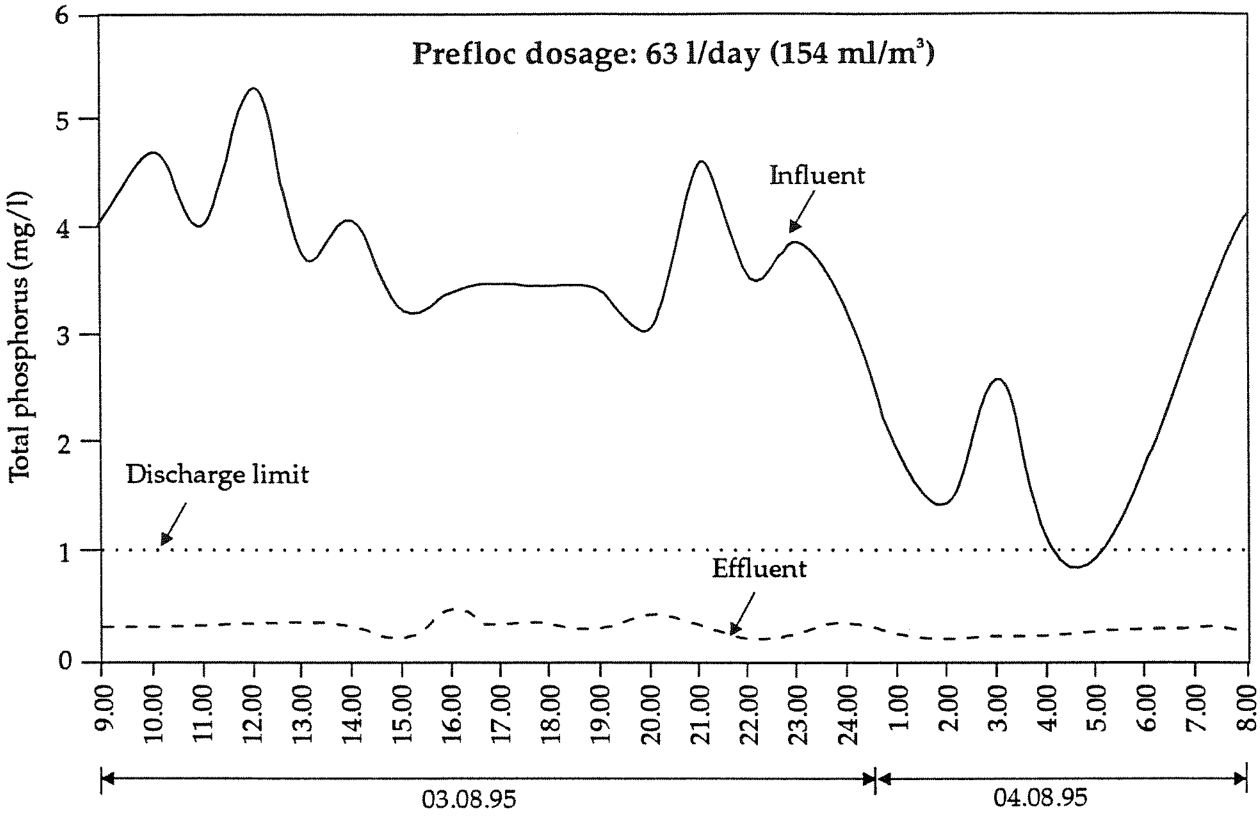


***Figure 3. Variations in influent and effluent total phosphorus concentration during one day (3-4 Aug., 1995) with a Prefloc dosage of 63 l/day (154 ml/m³).***

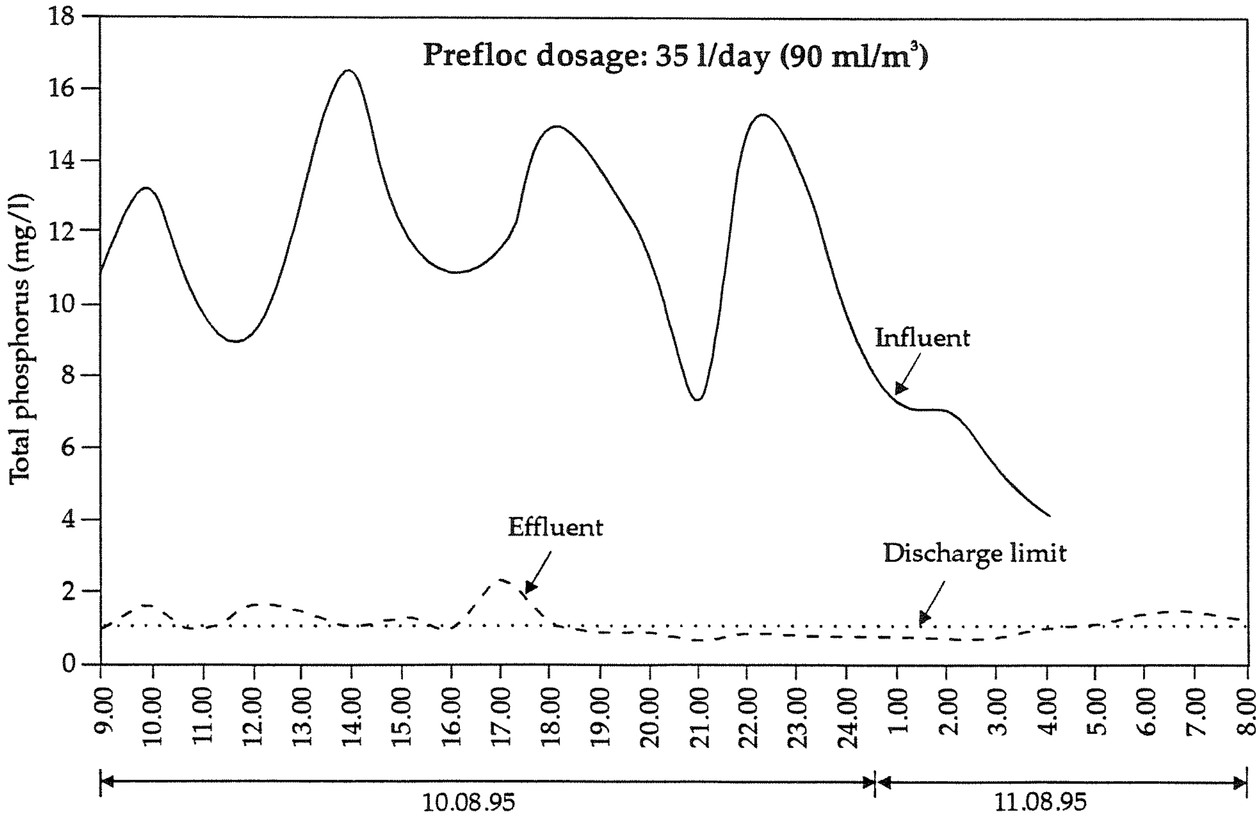


***Figure 4. Variations in influent and effluent total phosphorus concentration during one day (10-11 Aug., 1995) with a Prefloc dosage of 35 l/day (90 ml/m³).***

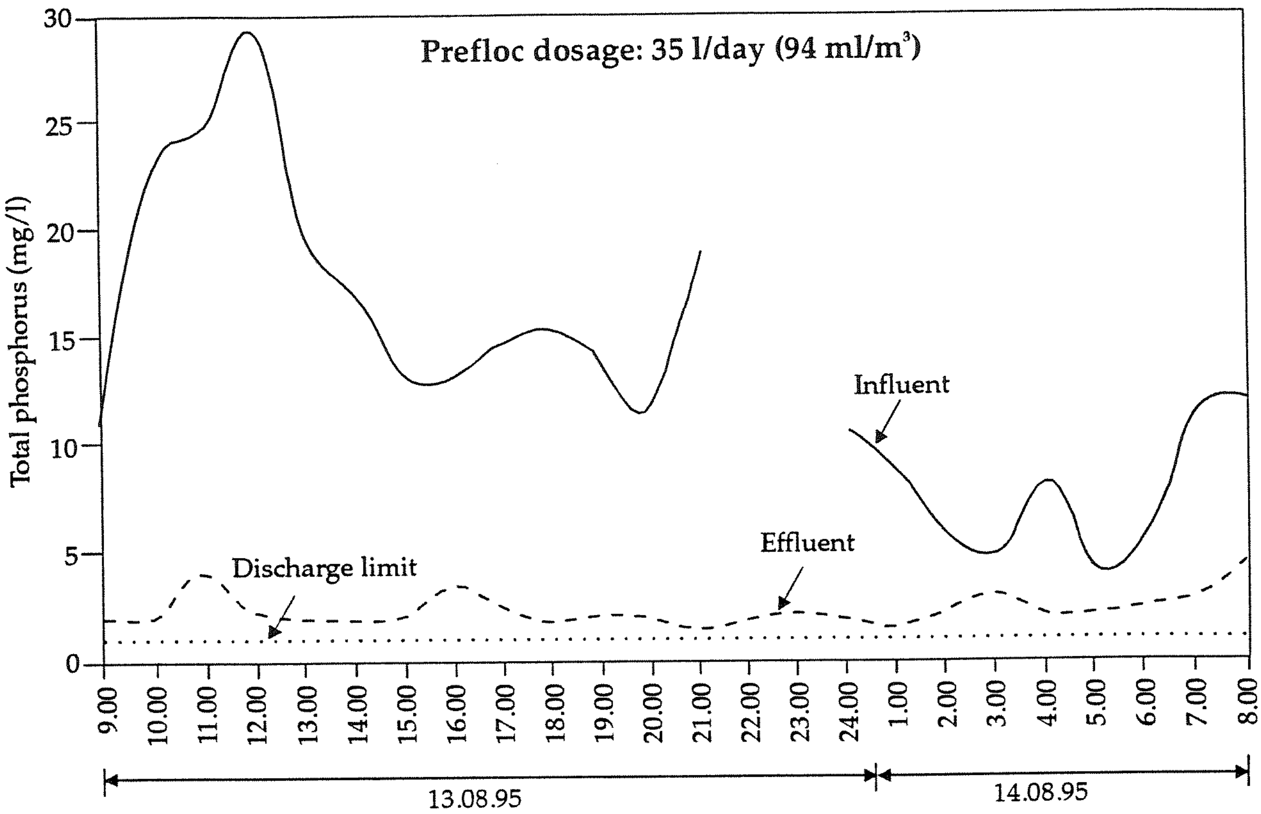


***Figure 5.** Variations in influent and effluent total phosphorus concentration during one day (13-14 Aug., 1995) with a Prefloc dosage of 35 l/day (94 ml/m³).*

Only the period with the highest dosage of Prefloc (63 l/day) has documented a phosphorus removal efficiency complying with the discharge standard of 1 mg P/l. These results can be explained by the data presented in table 2.

***Table 2.** Total phosphorus concentrations and coagulant dosages for each sampling day.*

| Test period | Sampling day | Average Tot-P (mg P/l) | | Dosage of Prefloc (ml/m³) | Molar ratio Fe/P |
|---|---|---|---|---|---|
| | | Influent | Effluent | | |
| 1 | 23-24 June<br>26-27 June | 4,3<br>3,4 | 2,1<br>2,5 | 46<br>57 | 1,0<br>1,6 |
| 2 | 2-4 Aug. | 3,3 | 0,3 | 154 | 4,5 |
| 3 | 10-11 Aug.<br>13-14 Aug. | 10,8<br>13,7 | 1,1<br>2,4 | 90<br>94 | 0,8<br>0,7 |

Practical experiences with simultaneous precipitation for many years have shown that the coagulant dosage, given by the molar ratio (Fe/P), should be at least 1,5 - 2,0 to achieve effluent total phosphorus concentrations below 1 mg P/l with a normal sludge volume index of the activated sludge.

According to these criteria we would have expected a lower total phosphorus concentration in the effluent on the second sampling day (26-27 June) of period 1. The reason for this can be:

- The molar ratio (Fe/P = 1,6) has been lower the days before sampling and the biological system has not yet adapted to the increased molar ratio.

- The high effluent total phosphorus concentration (2,5 mg P/l) is due to high content of suspended solids (bad settleability of the activated sludge flocs) and not a high orthophosphate concentration.

The fairly good results in the first part of test period 3 (10-11 Aug.) can be explained by the high coagulant dosage in the former period, resulting in an accumulation of coagulant in the activated sludge system, influencing the effluent quality for several days afterwards.

Handling the data from the phase II test at Touzim wastewater treatment plant has brought up some queries which are not settled in this report due to lack of information:

- The large variations in influent total phosphorus concentration between different test periods without any significant difference in wastewater flow (371-476 $m^3/d$). Is it a result of dry and wet weather flow conditions and the use of an effective storm water overflow device to maintain a fairly constant wastewater flow through the plant?
- The wastewater flow in phase II is only about 50 percent of the values given for phase I (Nov.-Des., 1994), but with similar concentrations of influent total phosphorus. This makes it difficult to compare the necessary dosage of aluminium sulphate from phase I with the dosages of ferric sulphate in phase II.
- Tests for evaluating phosphorus removal efficiencies should always include orthophosphate analysis of the effluent in order to differentiate between the phosphorus content that is due to a low coagulant dosage and what is due to a high content of suspended solids (settling problems).

## 4 Conclusions

Based upon the full scale tests with ferric sulphate (Prefloc) at Touzim wastewater treatment plant during the summer of 1995, the following conclusions can be drawn:

- In order to achieve an effluent total phosphorus concentration below 1 mg P/l the dosage of Prefloc should be in the range of 20-120 litres/day with an average of about 60 litres/day. The highest dosages should be used during dry weather flow with high influent phosphorus concentrations.

- Ferric sulphate seems to be a more cost-effective coagulant than aluminium sulphate for phosphorus removal (simultaneous precipitation) at Touzim wastewater treatment plant.

# Appendix 1

## Summary of data from the 5 sampling days

## Experiment N1

| | | | Total P | Total P | |
|---|---|---|---|---|---|
| Number | Date | Hour | Inflow mg/l | Outflow mg/l | Flow m3/h |
| 1 | 23.6.1995 | 9.00 | 6.48 | 3.06 | 22 |
| 2 | 23.6.1995 | 10.00 | 6.19 | 2.71 | 24 |
| 3 | 23.6.1995 | 11.00 | 4.53 | 2.64 | 23 |
| 4 | 23.6.1995 | 12.00 | 5.36 | 2.31 | 24 |
| 5 | 23.6.1995 | 13.00 | 5.15 | 2.19 | 25 |
| 6 | 23.6.1995 | 14.00 | 4.28 | 1.96 | 18 |
| 7 | 23.6.1995 | 15.00 | 4.68 | 1.91 | 18 |
| 8 | 23.6.1995 | 16.00 | 3.99 | 1.94 | 17 |
| 9 | 23.6.1995 | 17.00 | 4.72 | 1.57 | 22 |
| 10 | 23.6.1995 | 18.00 | 4.40 | 1.53 | 25 |
| 11 | 23.61995 | 19.00 | 5.94 | 1.38 | 25 |
| 12 | 23.6.1995 | 20.00 | 6.14 | 1.36 | 28 |
| 13 | 23.6.1995 | 21.00 | 5.72 | 1.52 | 27 |
| 14 | 23.6.1995 | 22.00 | 4.81 | 1.33 | 23 |
| 15 | 23.6.1995 | 23.00 | 4.09 | 1.61 | 17 |
| 16 | 23.6.1995 | 24.00 | 3.58 | 1.75 | 14 |
| 17 | 23.6.1995 | 1.00 | 2.54 | 1.88 | 14 |
| 18 | 24.6.1995 | 2.00 | 2.20 | 1.85 | 12 |
| 19 | 24.6.1995 | 3.00 | 1.28 | 1.99 | 12 |
| 20 | 24.6.1995 | 4.00 | 1.15 | 2.22 | 12 |
| 21 | 24.6.1995 | 5.00 | 0.95 | 1.95 | 12 |
| 22 | 24.6.1995 | 6.00 | 5.30 | 3.08 | 18 |
| 23 | 24.6.1995 | 7.00 | 5.20 | 3.11 | 22 |
| 24 | 24.6.1995 | 8.00 | 4.85 | 3.40 | 22 |
| | | | | | 476 |

**Experiment N2**

| | | | Total P | Total P | |
|---|---|---|---|---|---|
| Number | Date | Hour | Inflow mg/l | Outflow mg/l | Flow m3/h |
| 1 | 27.6.1995 | 9.00 | 4.12 | 2.84 | 19 |
| 2 | 27.6.1995 | 10.00 | 5.61 | 3.19 | 18 |
| 3 | 27.6.1995 | 11.00 | 4.72 | 2.73 | 18 |
| 4 | 27.6.1995 | 12.00 | 3.72 | 2.53 | 21 |
| 5 | 27.6.1995 | 13.00 | 3.83 | 2.39 | 18 |
| 6 | 27.6.1995 | 14.00 | 4.91 | 2.18 | 18 |
| 7 | 27.6.1995 | 15.00 | 4.03 | 1.68 | 14 |
| 8 | 27.6.1995 | 16.00 | 4.65 | 2.18 | 14 |
| 9 | 27.6.1995 | 17.00 | 5.22 | 1.89 | 13 |
| 10 | 27.6.1995 | 18.00 | 3.90 | 2.32 | 16 |
| 11 | 27.6.1995 | 19.00 | 4.74 | 2.57 | 20 |
| 12 | 27.6.1995 | 20.00 | 4.14 | 3.19 | 20 |
| 13 | 27.6.1995 | 21.00 | 4.36 | 2.15 | 19 |
| 14 | 27.6.1995 | 22.00 | 3.73 | 3.12 | 17 |
| 15 | 27.6.1995 | 23.00 | 3.37 | 1.62 | 15 |
| 16 | 27.6.1995 | 24.00 | 3.13 | 1.75 | 15 |
| 17 | 27.6.1995 | 1.00 | 1.80 | 1.68 | 12 |
| 18 | 28.6.1995 | 2.00 | 1.51 | 2.19 | 12 |
| 19 | 28.6.1995 | 3.00 | 0.71 | 3.05 | 12 |
| 20 | 28.6.1995 | 4.00 | 0.67 | 2.39 | 12 |
| 21 | 28.6.1995 | 5.00 | 0.64 | 2.55 | 14 |
| 22 | 28.6.1995 | 6.00 | 2.46 | 3.06 | 15 |
| 23 | 28.6.1995 | 7.00 | 4.05 | 3.37 | 18 |
| 24 | 28.6.1995 | 8.00 | 2.63 | 2.66 | 19 |
| | | | | | 389 |

**Experiment N3**

| Number | Date | Hour | Total P Inflow mg/l | Total P Outflow mg/l | Flow m3/h |
|---|---|---|---|---|---|
| 1 | 3.8.1995 | 9.00 | 4.09 | 0.31 | 18 |
| 2 | 3.8.1995 | 10.00 | 4.74 | 0.33 | 16 |
| 3 | 3.8.1995 | 11.00 | 4.06 | 0.32 | 17 |
| 4 | 3.8.1995 | 12.00 | 5.32 | 0.33 | 17 |
| 5 | 3.8.1995 | 13.00 | 3.78 | 0.32 | 22 |
| 6 | 3.8.1955 | 14.00 | 4.10 | 0.33 | 19 |
| 7 | 3.8.1995 | 15.00 | 3.25 | 0.20 | 17 |
| 8 | 3.8.1995 | 16.00 | 3.44 | 0.46 | 16 |
| 9 | 3.8.1995 | 17.00 | 3.53 | 0.32 | 16 |
| 10 | 3.8.1995 | 18.00 | 3.51 | 0.37 | 19 |
| 11 | 3.8.1995 | 19.00 | 3.48 | 0.32 | 22 |
| 12 | 3.8.1995 | 20.00 | 3.12 | 0.43 | 22 |
| 13 | 3.8.1995 | 21.00 | 4.64 | 0.37 | 24 |
| 14 | 3.8.1995 | 22.00 | 3.56 | 0.2 | 19 |
| 15 | 3.8.1995 | 23.00 | 3.89 | 0.28 | 17 |
| 16 | 3.8.1995 | 24.00 | 3.20 | 0.37 | 14 |
| 17 | 4.8.1995 | 1.00 | 1.88 | 0.25 | 12 |
| 18 | 4.8.1995 | 2.00 | 1.49 | 0.21 | 12 |
| 19 | 4.8.1995 | 3.00 | 2.60 | 0.25 | 13 |
| 20 | 4.8.1995 | 4.00 | 1.07 | 0.25 | 12 |
| 21 | 4.8.1995 | 5.00 | 1.00 | 0.29 | 12 |
| 22 | 4.8.1995 | 6.00 | 1.88 | 0.30 | 17 |
| 23 | 4.8.1995 | 7.00 | 3.20 | 0.33 | 19 |
| 24 | 4.8.1995 | 8.00 | 4.15 | 0.29 | 18 |
| | | | | | 410 |

**Experiment N4**

| Number | Date | Hour | Total P Inflow mg/l | Total P Outflow mg/l | Flow m3/h |
|---|---|---|---|---|---|
| 1 | 10.8.1995 | 9.00 | 10.80 | 0.93 | 16 |
| 2 | 10.8.1995 | 10.00 | 13.23 | 1.54 | 17 |
| 3 | 10.8.1995 | 11.00 | 10.00 | 0.93 | 18 |
| 4 | 10.8.1995 | 12.00 | 9.09 | 1.57 | 22 |
| 5 | 10.8.1995 | 13.00 | 12.73 | 1.42 | 18 |
| 6 | 10.8.1995 | 14.00 | 16.61 | 1.03 | 17 |
| 7 | 10.8.1995 | 15.00 | 12.15 | 1.26 | 16 |
| 8 | 10.8.1995 | 16.00 | 10.99 | 0.96 | 15 |
| 9 | 10.8.1995 | 17.00 | 11.66 | 2.26 | 15 |
| 10 | 10.8.1995 | 18.00 | 14.96 | 1.12 | 16 |
| 11 | 10.8.1995 | 19.00 | 13.72 | 0.84 | 16 |
| 12 | 10.8.1995 | 20.00 | 11.24 | 0.85 | 21 |
| 13 | 10.8.1995 | 21.00 | 7.36 | 0.61 | 22 |
| 14 | 10.8.1995 | 22.00 | 15.05 | 0.84 | 19 |
| 15 | 10.8.1995 | 23.00 | 13.89 | 0.73 | 17 |
| 16 | 10.8.1995 | 24.00 | 9.26 | 0.72 | 15 |
| 17 | 11.8.1995 | 1.00 | 7.26 | 0.68 | 12 |
| 18 | 11.8.1995 | 2.00 | 6.95 | 0.71 | 12 |
| 19 | 11.8.1995 | 3.00 | 5.29 | 0.71 | 12 |
| 20 | 11.8.1995 | 4.00 | 4.05 | 0.99 | 12 |
| 21 | 11.8.1995 | 5.00 | | 1.07 | 12 |
| 22 | 11.8.1995 | 6.00 | | 1.35 | 15 |
| 23 | 11.8.1995 | 7.00 | | 1.34 | 16 |
| 24 | 11.8.1995 | 8.00 | | 1.14 | 16 |
| | | | | | 387 |

## Experiment N5

| Number | Date | Hour | Total P Inflow mg/l | Total P Outflow mg/l | Flow m3/h |
|---|---|---|---|---|---|
| 1 | 13.8.1995 | 9.00 | 11.98 | 1.93 | 17 |
| 2 | 13.8.1995 | 10.00 | 23.15 | 1.98 | 16 |
| 3 | 13.8.1995 | 11.00 | 24.89 | 4.07 | 18 |
| 4 | 13.8.1995 | 12.00 | 29.35 | 2.30 | 22 |
| 5 | 13.8.1995 | 13.00 | 19.84 | 2.00 | 20 |
| 6 | 13.8.1995 | 14.00 | 17.20 | 1.98 | 18 |
| 7 | 13.8.1995 | 15.00 | 13.31 | 2.02 | 13 |
| 8 | 13.8.1995 | 16.00 | 13.23 | 3.52 | 13 |
| 9 | 13.8.1995 | 17.00 | 14.88 | 2.56 | 14 |
| 10 | 13.8.1995 | 18.00 | 15.54 | 1.92 | 18 |
| 11 | 13.8.1995 | 19.00 | 14.14 | 2.23 | 20 |
| 12 | 13.8.1995 | 20.00 | 11.82 | 2.05 | 22 |
| 13 | 13.8.1995 | 21.00 | 18.77 | 1.57 | 22 |
| 14 | 13.8.1995 | 22.00 | | 2.10 | 17 |
| 15 | 13.8.1995 | 23.00 | | 2.25 | 14 |
| 16 | 13.8.1995 | 24.00 | 10.91 | 2.00 | 12 |
| 17 | 14.8.1995 | 1.00 | 8.85 | 1.72 | 9 |
| 18 | 14.8.1995 | 2.00 | 5.87 | 2.45 | 9 |
| 19 | 14.8.1995 | 3.00 | 5.04 | 3.09 | 9 |
| 20 | 14.8.1995 | 4.00 | 8.35 | 2.12 | 9 |
| 21 | 14.8.1995 | 5.00 | 4.30 | 2.25 | 10 |
| 22 | 14.8.1995 | 6.00 | 6.12 | 2.58 | 15 |
| 23 | 14.8.1995 | 7.00 | 11.66 | 3.12 | 17 |
| 24 | 14.8.1995 | 8.00 | 12.24 | 4.66 | 17 |
| | | | | | 371 |

**Norwegian Institute for Water Research**

P.O. Box 173 Kjelsås Telephone: + 47 22 18 51 00
N-0411 Oslo Telefax: + 47 22 18 52 00

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