

Combining mesocosm and field data, chemical analysis and laboratory tests to assess the impact of treated waste water

E.M. Foekema, A.C. Sneekes & C.C. Karman



E.M. Foekema



A.C. Sneekes



C.C. Karman

The impact of effluent from a sewage treatment plant (STP) on the receiving channel ecosystem was studied in flow-through mesocosms. Reduced phytoplankton development was the most striking ecological effect. In the laboratory algal growth tests were performed with effluents of 15 different STPs. The results were correlated with chemical and physical characteristics of the effluents and showed a unexpected negative correlation between high phosphorous contents and poor algal development.



Figure 1. View of the mesocosms with part of the STP on the background.

Conclusion

Growth of algae/phytoplankton is negatively correlated with high phosphate concentrations in the effluents, although not directly related to the phosphate concentration. Extreme phosphate concentrations may, however, be seen as a marker for the functioning of the STP as a whole, indicating the presence of potentially phototoxic components in the effluent.

Mesocosm study

Flow-through mesocosms were installed close to an STP (Figure 1). Replicated mesocosms received 0% (reference), 25%, 50% or 75% STP-effluent, diluted with the receiving surface water. On a regular basis, physical parameters were monitored and the development of the mesocosms ecosystem was monitored. Among other more expected effects, the Phytoplankton development was clearly inhibited in the systems with 75% effluent (Figure 2) despite ample availability of nutrients. Field observations in the receiving channel also showed reduced phytoplankton development directly downstream of the effluent discharge. The cause of this impact of the effluent on the algal development was further investigated using standard laboratory algal growth tests.

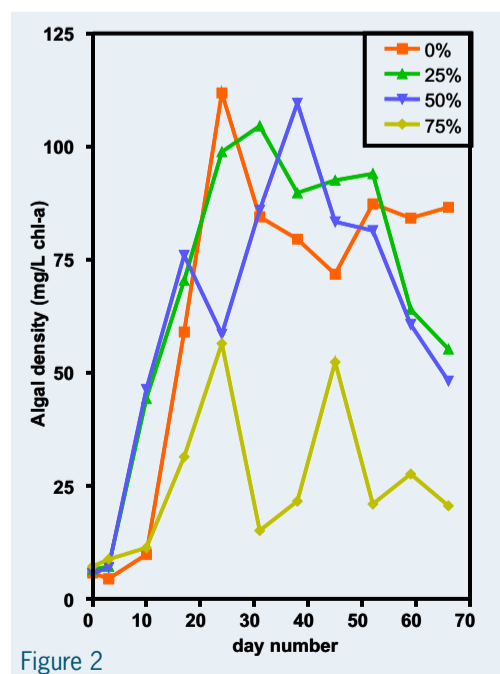


Figure 2

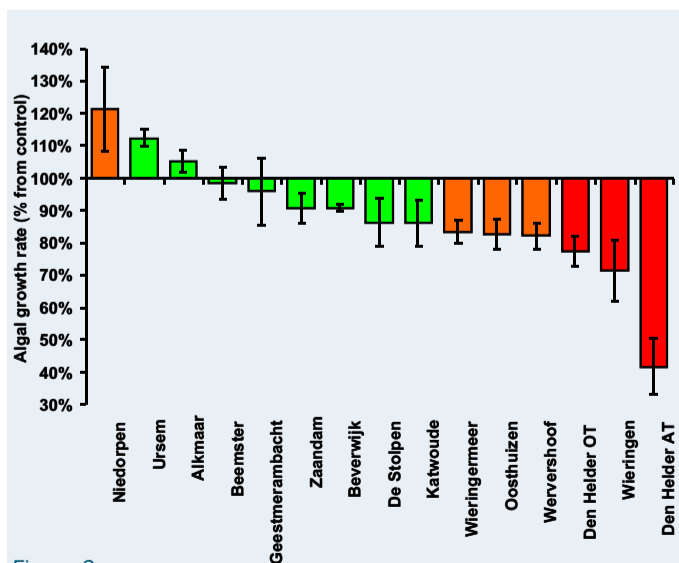


Figure 3

Laboratory tests

The algal growth test was performed with the unicellular green algae *Pseudokirchneriella subcapitata*, following ISO 8692 (2004). Samples from 15 different STPs were taken in the morning and subjected to the test within 24h. Algal growth was measured as chlorophyll-a concentration with a fluorometer. Water chemistry parameters were year-average values, based upon regular measurements by the district water board.

The algal growth test with the 15 different effluents showed significantly growth inhibition for 6 effluents and significant stimulation for 1 effluent (Figure 3). The growth of the algae in the laboratory test was significantly correlated with the sometimes extreme high phosphate concentration in the effluent (Figure 4). Testing the algae in standard culture medium with increasing phosphate concentrations, however, did not result in a reduced growth.

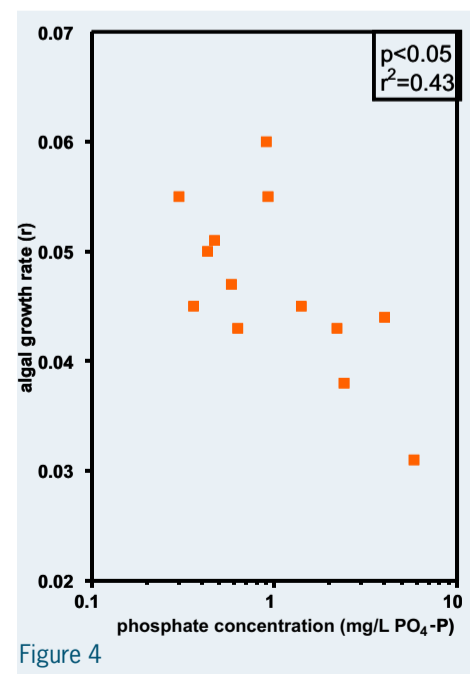


Figure 4

Figure 2. Phytoplankton development in the mesocosms during the study.

Figure 3. Algal growth rates relative to control exposure for 15 STP effluents. Significance of differences from control are presented orange ($p < 0.05$) and red ($p < 0.01$).

Figure 4. Negative correlation of algal growth rates with high phosphate concentrations of STP effluents.