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ALGAL GROWTH POTENTIAL TEST: AN INDICATIVE METHOD TO ESTIMATE THE INFLUENCE OF WATER QUALITY CHANGES ON THE ALGAL BIOMASS

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ABSTRACT

Algal Growth Potential Tests as known from literature cannot simply be applied in water quality management in the Netherlands; adaptation to the Dutch situation is necessary. Points of research were: pretreatment of the water to be tested, species of test algae, conditions of the cultivation, monitoring of the algae growth.

KEYWORDS

Algal Growth Potential Test (AGP-test); eutrophication; water quality management.

INTRODUCTION

In the field of water quality management in the Netherlands there is a preference for the use of a biological test to estimate the influence of measures to reduce the eutrophication of water systems.
Primary producers, especially the algae, are the first elements to react to changes in concentrations of N and P-compounds, so they are considered representatives of the ecosystem.
Changes of the quality of the water involved can be simulated on a laboratory scale, and algal cultures can be used to measure the response of those algae (Forsberg and Forsberg, 1972; Miller, Greene and Shiroyama, 1978; Skulberg, 1964). With the algal biomass produced, the AGP of a water can be determined. By AGP is understood the maximum growth of a specific alga in contact with the water to be tested.
After studying the relevant literature, we chose to use one algae species, developed from a laboratory-culture, cultivated in batch-cultures. The tests based on this principle (Kallqvist, 1973; Miller, Greene and Shiroyama, 1978) could not simply be applied for the Dutch situation: adaption to Dutch eutrophic surface water is necessary. Important considerations were:

1. Pretreatment of the water to be tested.
2. Species of the test algae.
3. Conditions of the cultivation.
4. Monitoring of the algal growth.

1. PRETREATMENT OF THE WATER TO BE TESTED

The aim of pretreatment is to remove or to inactivate indigenous organisms and, if possible, to loosen bound nutrients. However, the physical-chemical composition of

of the water should not be affected (or only very slightly). Autoclaving meets the requirements most effectively. Precipitation, very likely appearing in high P and Ca-compounds containing water, can be avoided by proper dilution of the sample.

2. TEST ALGAE

Requirements for test algae are that they be:
- sensitive to a wide range of eutrophication compounds.
- representative of Dutch surface water.

A comparison between the greenalgae *Scenedesmus quadricauda* and *Selenastrum capricornutum* results in the choice of the former, *Scenedesmus quadricauda*.

3. THE CULTIVATION OF THE ALGAE

During the exponential growth phase the pH of the culture increases rapidly, so there may be growth limitation due to lack of CO_2. This can be dealt with by enlarging the specific gas exchanging interfacial area, and improving the air supply. The sample-to-volume ratio for the culture flask is only 1:5. Cotton-wool plugs, covering the system, are replaced by small beakers fitted to the necks of the flasks.

4. THE MONITORING OF THE ALGAL GROWTH

The maximum biomass is taken to express the response of the algae on the water being tested and will be achieved in the stationary phase of the culture. Optical density (λ : 750 nm) is used as a simple and quick parameter to check the daily growth. To calculate the biomass at the end, dry weight is used.

APPLICATIONS

To avoid precipitation appearing in high P and Ca-compounds containing water, dilution is necessary. The relation between the maximum biomass and the dilution rate is represented in Fig. 1. A linear relation exists between those parameters.

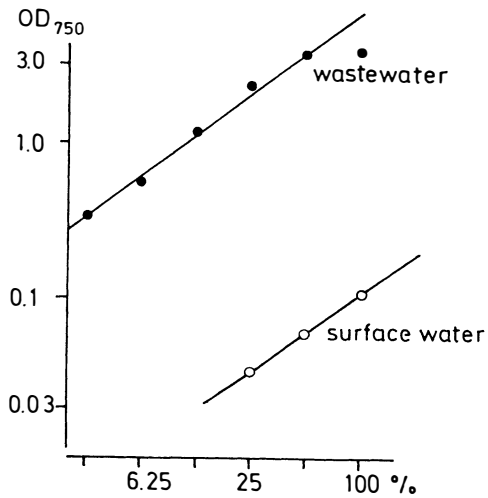

Fig. 1. Relation between extent of dilution of wastewater and surface water and the maximum biomass (expressed as OD_{750})

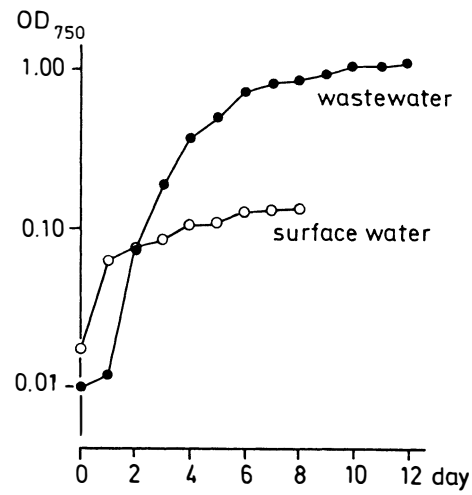

Fig. 2. Growth curves of algae cultivated on wastewater and surface water.

The regression coefficients for wastewater and for surface water are respectively 0.83 and 0.76. Based on the results, calculation of the AGP from the results of diluted samples is permitted in those cases where another grade of dilution has to be considered.
The shape of the growth curve is also an important consideration. It can be drawn up based on the daily measurements (Fig. 2). From the shape of these curves it is possible to derive:

- presence of growth inhibiting factors.
- availability of nutrients.
- relative quantity of nutrients.

The AGP of a water has only relative value, because of the laboratory conditions. Obtainment of absolute values which one can relate with the field situation is not possible at this moment.

REFERENCES

Forsberg, C., and A. Forsberg (1972). Algal growth potential test improves sewage effluent control. Ambio, 1, 26-29.

Kallqvist, T. (1973). Algal assay procedure (bottle test) at the Norwegian Institute for Water Research. In: Algal assays in water pollution research, publ. 1973: 2. Nordforsk, Helsinki. p. 5-17.

Miller, W. E., J. C. Greene, and T. Shiroyama (1978). The Selenastrum capricornutum Prinz algal assay bottle test. EPA-600/9-78-018. U.S. Environmental Protection Agency, Corvallis, Oregon.

Skulberg, O. M. (1964). Algal problems related to the eutrophication of European water supplies, and a bioassay method to assess fertilizing influences of pollution on inland waters. In: D. F. Jackson (Ed.), Algal and Man. Plenum Press, New York. p. 262-299

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