Ⅱ－98

STUDY ON THE REMOVAL EFFICIENCY OF MICROBIAL INDICATORS USING BIOLOGICAL FILTER TREATMENT IN A POLLUTED POND

Tohoku Univ. student members O A. Surapunt J. Kim
Tohoku Univ. members N. Chiba K. Xu R. Sudo

1. Introduction

Lakes and ponds locating around parks play an important role in using for recreational and amenity purposes, such as bathing beaches, boating and fishing. Generally, lakes and ponds are the places for living and searching foods for birds, swans and waterfowls as well. The contamination in water with microorganisms may be increased when the ecosystem is unbalance, such as in summer, a lot of animal feces and excess of foods from sustaining people. Besides, lakes and ponds also store non poisoning water from municipal and agricultural areas. With regard to microorganisms, the pond water may be pathogenic and so it is necessary to treat the water before releasing. A biological treatment plant that is convenient to operate, economical and without chemical residual is obviously important at the present time. The objective of this study is to evaluate the removal of bacteria by using biological filter treatment at Oozutsumi pond in Sendai, north-east Japan.

2. Material and Methods

2.1 Removal of bacteria by biological filter treatment

A biological filter treatment plant was constructed at Oozutsumi pond in Sendai for treating the microorganisms. This plant consists of a raw water tank and two kinds of filter media, ring lace and non woven. The operating condition for ring laces is designed by hydraulic retention time (HRT) = 30 minute, and for non woven by linear velocity (LV) = 10 meters per hour. Water samples were taken from three stations: raw water, outlet of ring laces, and outlet of non woven. Three kinds of microorganisms and methods of determination were applied, as follows: fecal coliform by membrane filter technique, *Pseudomonas aeruginosa* by multiple tube fermentation, heterotrophic bacteria by pour plate count technique. Turbidity, suspended solids and nitrogen were also investigated in this study.

2.2 Effects of predators on fecal coliforms in the laboratory batch culture

The 1000 ml of sterilized water and a determined amount of fecal coliforms were kept in the sterilized beakers under six conditions. Air was blown into each beaker. The room temperature was controlled at 20°C. The amount of bacteria in the water was determined by using the membrane filter technique every day for 12 days. And the amount of zooplankton was counted by using a microscope before and after the experiment .

2.3 Growth rate of protozoa in a laboratory batch culture

The amounts of bacteria from 10^2 to 10^8 and 80 ml of sterilized water were kept in sterilized flasks, to which was added *Opercularia* sp. in the first set of experiments.

The second set of experiments was done in the same way, but *Tetrahemena* sp.was added to each flask instead of *Opercularia* sp. The samples were incubated at 20°C for 8 days.

The amount of bacteria was determined by using the membrane filter technique, and the amount of protozoa was counted by using a microscope.

3. Results and Discussion

The ring lace filter medium had high removal efficiencies of 67 % and 54 % for fecal coliform and heterotrophic bacteria, respectively, while the non woven filter medium showed lower efficiency of about 52 % for both fecal coliform and heterotrophic bacteria. The numbers of fecal coliform and heterotrophic bacteria in raw water, ring lace and non woven effluents are shown in Fig.1 and Fig.2, respectively. The percentage removal of turbidity and suspended solids were about 34 % and 41%, respectively in both ring lace and non woven filter media. Nitrogen reductions were 11 % by ring lace and 16.8 % by non woven media. These two kinds of filter media have no effect on the removal of *Pseudomonas aeruginosa*.

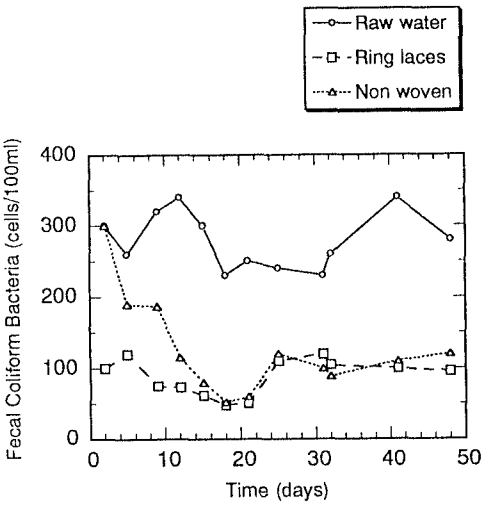

Fig. 1 The amounts of fecal coliform bacteria in the pond raw water, ring lace effluent and non woven effluent from July to August.

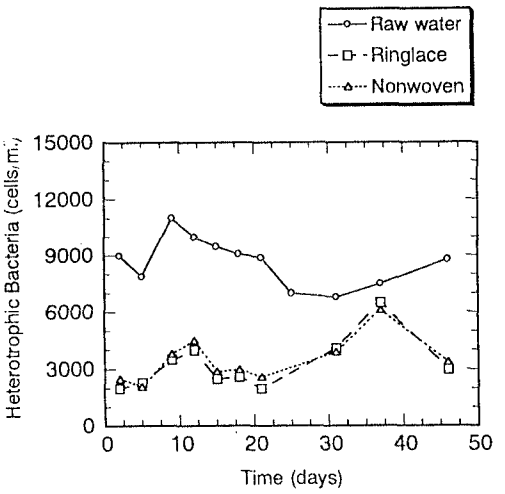

Fig. 2 The amount of heterotrophic bacteria in the pond raw water, ring lace effluent and non woven effluent from July to August.

In the batch culture, protozoa had an effect on the reduction of fecal coliform which is shown in Fig. 3, while sterilized ring lace and non woven media had no effect on the reduction of fecal coliform. Specific growth rates per day of *Opercularia* sp. and *Tetrahymena* sp.were 0.9 and 1.25, respectively.

FC = fecal coliform + sterilized pond water
FC + SR = FC+ sterilized ring laces
FC + SN = FC+ sterilized non woven
FC + Z = FC+ zooplankton
FC + R + Z = FC+ ring laces + zooplankton
FC + N + Z = FC+non woven+zooplankton

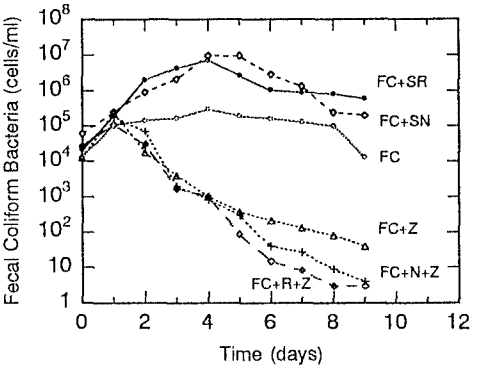

Fig. 3 The decline of fecal coliform bacteria in sterilized pond water solution initially containing (FC+Z) = 1.3×10^4, (FC+R+Z) = 2.8×10^4 and (FC+N+Z) = 2.4×10^4 cells/ml.

4. Conclusion

1) The ring lace filter medium has higher removal efficiency of fecal coliform and heterotrophic bacteria than the non woven filter medium.

2) In the batch culture, protozoa has an effect on the reduction of fecal coliform.

3) The specific growth rates per days of *Opercularia* sp. and *Tetrahymena* sp. are 0.9 and 1.25, respectively.

References

1. Sudo, R., Aiba S. (1973). Mass and Monoxenic Culture of *Vorticella Microstoma* Isolated from Activated Sludge. Water Research **7**, 615-621.

2. A.P.H.A., A.W.W.A., W.P.C.F. ed. (1992).Standard Methods for the Examination of Water and Wastewater. 18th ed, Washington D.C.