POINT SOURCES OF POLLUTION

Yuhei Inamori
National Institute for Environmental Studies, Tsukuba, Japan, and

Naoshi Fujimoto
Faculty of Applied Bioscience, Tokyo University of Agriculture, Tokyo, Japan

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Contents

1. Introduction
2. Kind of point sources
2.1. Percentage of point source loading to total pollution loading
2.2. Domestic wastewater
2.3. Industrial wastewater
2.3.1. Food industry
2.3.2. Chemical industry
2.3.3. Livestock industry and fish farm
3. Countermeasures for point sources
4. Wastewater treatment processes
4.1. Activated sludge process and modified process
4.2. Biofilm process
4.3. Anaerobic treatment
4.4. Thermophilic oxic process
Glossary
Bibliography
Biographical Sketches

Summary

Point source loading refers to pollutants produced by identified pollution sources. Point source loadings include treated and untreated wastewater from factories, domestic wastewater, treated water from sewerage treatment plants, and wastewater from feedlots and fish farms. Organic matter, nitrogen and phosphorus are discharged into water bodies by inflow of domestic wastewater and industrial wastewater causing organic pollution and eutrophication.

The point source loading of organic matter, nitrogen, and phosphorus as percentages of the total loading in Lake Kasumigaura in Japan are 55%, 58%, and 77% respectively. Among point source loadings, the largest loading is domestic wastewater, which supplies 33% of COD_{Mn}, 34% of nitrogen and 45% of phosphorus.

In Japan, the amount of wastewater, BOD, nitrogen and phosphorus were calculated approximately to 200 L, 40g, 10g, and 1g, respectively, per person per day. Averaged

water quality of domestic wastewater is BOD 200 mg/l, total nitrogen (T-N) 50 mg/l and total phosphorus (T-P) 5 mg/l.

The concentrations of organic matter, nitrogen, and phosphorus in wastewater from food factories are generally high and each vary widely according to the factories producing them. For reduction of pollution from food factories, it is important reduce output of pollutants from each stage of production, e.g. pretreatment, manufacturing, finalization, machine and instrument washing, and wastewater treatment. Separation of solid waste and wastewater, and water saving are also important.

Wastewater from leather manufacturing factories and electroplating factories can contain heavy metals and organochloride compounds. Wastewater from electroplating factories can be highly toxic because it can contain hexavalent chromium and trichloroethylene.

Treatment of wastewater at source, provision of sewerage, construction of small scale wastewater treatment plants in regions where it is difficult to construct sewage works, construction of other kinds of industrial wastewater purification facilities and septic tanks (on-site domestic wastewater treatment facilities called JOHKASOU), are all important for control of point source pollution.

Because wastewater from kitchens accounts for a high percentage of the pollutants in domestic wastewater, and contains large quantities of organic matter, nitrogen, phosphorus and suspended material, measures to deal with wastewater must be implemented in order to conserve the aquatic environment.

1. Introduction

Many kinds of pollutants affect the living environment, human health and ecosystems. Pollutants such as organic matter, nitrogen, phosphorus, heavy metals, organochlorine compounds, dioxins and agricultural chemicals, etc. are discharged to surface water bodies by human activity. Increase of organic matter in water bodies causes depletion of dissolved oxygen, proliferation of pathogens, alteration of environmental conditions for aquatic life, offensive odors and landscape deterioration. Increase of nitrogen and phosphorus causes eutrophication, which leads to many problems such as toxic algal blooms, blockages in water works, and depletion of dissolved oxygen in the bottom layer. Most of the organic matter, nitrogen and phosphorus are discharged into water bodies in domestic and industrial wastewater. Harmful compounds affecting human health are discharged by the chemical industry, landfills, agricultural fields and incinerators.

Pollution sources are categorized as point source and non-point source. The former refers to pollutants discharged from identified pollution sources. Non-point source refers to pollutants discharged from a wide area. Because the location of a point source can be readily identified, it is possible to control its pollution loading. Point source loadings include domestic and industrial wastewater, treated water from sewage and industrial wastewater treatment plants and Johkasous, feedlots and fish farms. Pollutants discharged from point sources include organic matter, nitrogen, phosphorus, heavy

metals, and organochlorine compounds, etc. In this chapter we provide an outline of point source loading, typical kinds of point sources and their water quality, countermeasures for point source loading, and an introduction to wastewater treatment processes.

2. Kind of point sources

2.1. Percentage of point source loading to total pollution loading

The point source loading of organic matter (COD_{Mn}),, nitrogen, and phosphorus as percentages of the total loading in Lake Kasumigaura in Japan are 56%, 58%, and 77% respectively. Note that the point source loading of phosphorus is particularly high (see Figure 1). A breakdown of point source loading reveals that the largest loading is domestic wastewater, which supplies 33% of COD_{Mn}, 34% of nitrogen and 45% of the phosphorus. The second largest source of COD_{Mn} and nitrogen is livestock wastewater, which supplies 10% of these substances. Fisheries wastewater supplies about 20% of the phosphorus. The point source loading as a percentage of the total pollution loading in Lake Biwa is organic matter (COD_{Mn}) 53.1%, nitrogen 45.3%, and phosphorus 64.8%, revealing that, as in Lake Kasumigaura, the percentage of phosphorus loading from point sources is highest.

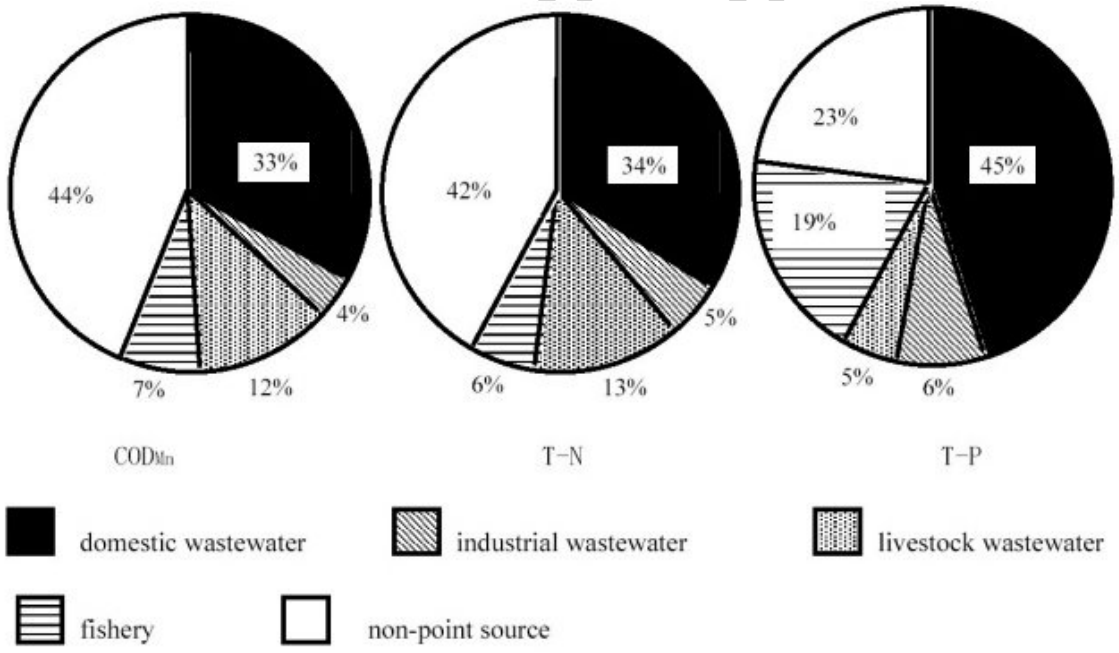

Figure 1. Percentage of pollution sources of Lake Kasumigaura

Percentages of pollution loadings to typical enclosed coastal seas in Japan from industrial and domestic wastewater are shown in Figure 2. Pollution loading of industrial wastewater to Tokyo Bay, Ise Bay, Seto Inland Sea and three other sea areas account for 21%, 34%, 41% and 35% respectively. Pollution loading of domestic wastewater account for more than 50% in three sea areas.

2.2. Domestic wastewater

The point source with the largest pollutant loading is domestic wastewater. The unit quantities of organic matter, nitrogen, and phosphorus in gray water, after excluding feces and urine from domestic wastewater are: BOD, 27 g/person/day; nitrogen, 2 g/person/day; and total phosphorus, 0.4 g/person/day (see Figure 1 in *Pollution Sources*). The unit quantities of organic matter, nitrogen, and phosphorus in feces and urine are BOD 13 g/person/day, nitrogen 8 g/person/day, and phosphorus 0.6 g/person/day. This reveals large nitrogen and phosphorus loadings in feces and urine. Such point source loadings appear where domestic wastewater is discharged without treatment in regions with no sewage treatment systems or Johkasous. In the home, pollutants are generated mainly from excretion, cooking, washing and bathing. Major pollutants are organic matter, nitrogen and phosphorus. They come from cooking oil, detergent, body soap, and food, in addition to excrement. In Japan, the amount of wastewater, BOD, nitrogen and phosphorus were calculated approximately to 200 L, 40g, 10g, and 1 g per person per day. Averaged water quality of domestic wastewater is BOD 200 mg/l, T-N 50 mg/l and T-P 5 mg/l.

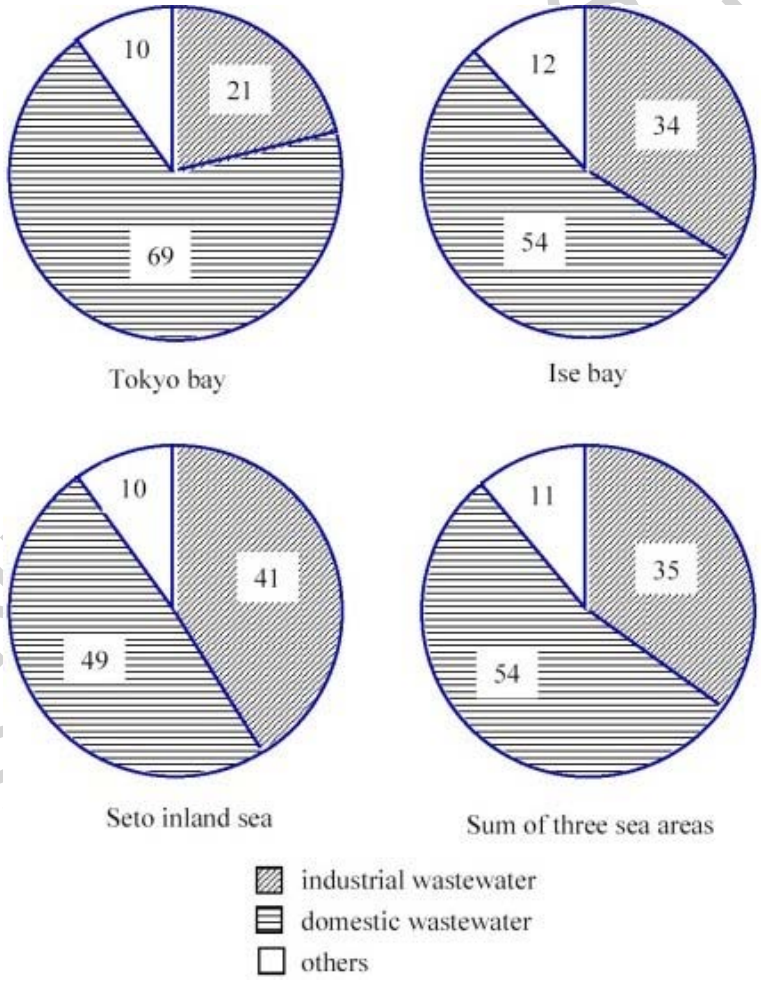

Figure 2. Percentage of COD loading from industrial and domestic wastewater in three typical enclosed coastal seas in Japan

Domestic wastewater is treated by biological treatment such as the activated sludge process and the biofilm process. Treatment facilities are classified into sewage works,

rural community sewerage, and Johkasous installed in individual house. If domestic wastewater is treated effectively by sewage works, rural community sewerage and Johkasou, pollution loading from domestic water use can be greatly reduced. However, if domestic wastewater is not treated and flows directly to water bodies, the result is decrease of dissolved oxygen, bad smell, proliferation of pathogens and eutrophication. In the past, Johkasou treatment only of night soil was popularized in Japan, causing pollution of water bodies by the organic matter, nitrogen and phosphorus contained in gray water. Today, installation of Johkasous that only treat night soil is forbidden.

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Biographical Sketches

Yuhei Inamori is an executive researcher at the National Institute for Environmental Studies (NIES), where he has been in his present post since 1990. He received B.S. and M.S. degrees from Kagoshima University, Kagoshima Japan, in 1971 and 1973 respectively. He received a PhD degree from Tohoku University, Miyagi, Japan in 1979.

From 1973 to 1979, he was a researcher for Meidensha Corp. From 1980 to 1984, he was a researcher for NIES, and from 1985 to 1990, a senior researcher for NIES. His fields of specification are microbiology, biotechnology and ecological engineering. His current research interests include restoration of aquatic environments using Bio-Eco engineering applicable to developing countries. He received an Award of Excellent Paper, from the Japan Sewage Works Association in 1987, an Award of Excellent Paper from the Journal "MIZU" in 1991, an Award of Excellent Paper, from the Japanese Society of Water Treatment Biology in 1998, and an Award for Environmental Preservation from the Prime Minister of Korea in 1999.

Naoshi Fujimoto is Assistant Professor of Tokyo University of Agriculture, where he has been at his present post since 2000. He received B.E. and M.E. degrees from Tohoku University, Miyagi, Japan, in 1991 and 1993 respectively. He received a D.E. degree in civil engineering from Tohoku University in 1996. From 1996 to 1999, he was a research associate of Tokyo University of Agriculture. His specialized field is environmental engineering. His current research interests include control of cyanobacteria and its toxins in lakes and reservoirs.