RESEARCH ON THE TECHNICAL STANDARD OF THE TREATED WASTEWATER REUSE SYSTEM

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Project period: 2001-2004

OBJECTIVES

In Japan, treated wastewater is reused for many uses in the cities as low quality water resources. But there happened some serious problems such as facilities troubles caused by treated wastewater. It is very important to adopt the appropriate materials or constructions and maintain the facilities adequately in order to make use of the treated wastewater as water resources. The objectives of this research is to show the measures to construct the safe, comfortable and sustainable re-use system of treated wastewater to the many uses of treated wastewater by studying the measures to protect the troubles in the re-use of treated wastewater.

RESULTS

In 2004, we researched the below three things.

(1) The study on the factors which influence the generation of the biofilm, which is easily found in the re-use system of treated wastewater.

(2) The annual study on the water quality changes in the tank, because the large decrease of the residual chlorine in the tank may cause the generation of the biofilm in the customer's facilities.

(3) The study on the propriety of using the Langerier Index as the corrosion index of treated wastewater

As a result of the research of (1), we could find out the below things.

① The coloring of the surface of the tank is caused by Mn , and the surface is colored definitely on the condition that more than 3mg/m2 of Mn is attached to it.

② The higher Mn concentration in the treated wastewater is, the more Mn is attached to the surface of the tank. This shows that it is very important to decrease Mn concentration in the treated wastewater in order to protect coloring of the surface.

③ The higher water temperature is, the more Mn is attached to the surface of the tank. Treated wastewater by sand filtration does not color the surface so much on the case of 15℃, but Treated wastewater by flocculation and ozonation colors the surface so much on the case of 25℃.

As a result of the research of (2), we could find out the below thing.

① Nitrification proceeded and residual chlorination decreased so much in the tank, and there was little residual chlorination in the effluent from the tank.

As a result of the research of (3), we could find out the below things.

① The higher the temperature, residual chlorination, and electricity conduction in the treated wastewater is, the more the corrosion of iron proceeds. The temperature has a greatest influence on the corrosion of these factors.

② It may not be appropriate to estimate the corrosion by treated wastewater on the basis of only the Langerier Index.

RESEARCH OF LCA TO SEWERAGE SYSTEM

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Project period: FY2001-2004

OBJECTIVES

Recently, to solve global environmental problems including global warming, environmental load is analyzed quantitatively in each field, and various techniques to decrease the load are studied now. Moreover, to decrease the environmental load from public infrastructure facilities to public waters, it is important to evaluate the relationship between their effect on the water quality improvement and the environmental load derived from their construction and running. This research aims to apply LCA method to wastewater system at the design stage, and we are at work on making life-cycle inventory (LCI) model to standardize the method and improve its efficiency. In FY 2002, we executed the case study of the LCI model for the wastewater system, analyzed the environmental impact of different types of wastewater system and examined the applicability of the model. In addition, we examined the method in which we integrated and evaluated each of environmental elements in LCA analysis.

RESULTS

1. Calculation of amount of environmental load to different types of wastewater system

We practiced the case study of different types of wastewater system to evaluate the applicability of the LCI model. We selected three different types of wastewater system, namely advanced wastewater treatment process, conventional activated sludge process and oxidation ditch (OD) process. As a result we found that most of the environmental load from each of the processes was derived from the electricity consumption of their running and that the amount of the environmental load from OD process was the largest, that from advanced wastewater treatment process was the second largest and that from conventional activated sludge process was the least. We supposed that this result came from the characteristic of the running of OD process, the short length of its operation period and the ratio of the quantity of treated water to the ability of the treatment plant.

2. Analysis of consumption of electric power for each of the equipments of a wastewater treatment plant in the running stage

We analyzed consumption of electric power for each of the equipments in three different types of wastewater system to evaluate environmental load in the running stage of a wastewater treatment plant. As a result, we found that the blower discharged the most amounts of environmental load and the environmental load from the blower and the pump occupied the 90 % of the total environmental load. Moreover, we found that there were some features in the result of the calculation in each of the wastewater processes. As a result we suggested the possibility of the LCI model's simplification by extracting major equipment in the wastewater process and by calculating its environmental load with assuming its ability to treat and its time to operate to be a parameter.

3. Analysis of the LCI model through the operating period of a wastewater treatment plant

To study the influence of the time after operating start on the LCI model, we compared the result from the LCI model and the result from the actual data and analyzed the change of the amount of the consumption of the electric power through the operating period of a wastewater treatment plant. As a result, we suggested that the rate of the volume of wastewater influent to the facilities ability to treat had a great influence on the result of the environmental load calculated by the LCI model. It is important that we consider an evaluation point on the axis of time to evaluate different type of wastewater systems; wastewater process, facilities ability or the rate of the volume of wastewater influent to the facilities ability.

4. Overall evaluation on environmental elements in the LCA analysis

There are some environmental elements in the LCA analysis. Global warming, consumption of energy, water quality improvement, acid rain and reclaimed wastes are the examples of some environmental elements in the LCA analysis. In the next study it will be necessary to establish how to unify these environmental elements and estimate the unification. In this time, we practiced the case study for an advanced wastewater treatment process and a conventional activated sludge process to analyze the evaluation method. In this research, we suggested the method to evaluate the relationship between nitrogen and phosphorus in eutrophication item and carbon dioxide in global warming item. We suggested the method to evaluate the unification of some environmental elements in the LCA analysis and showed the effect of an advanced wastewater treatment to reduce environmental load in the LCA analysis.

Evaluation method for advanced wastewater treatment system

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Project period: 2002-2004

OBJECTIVES

Advanced wastewater treatment is indispensable to improve the water quality in closed water bodies and the safety of treated wastewater, which are highly demanded in these days. This study aims to make suggestions for policy making to progress implementation of advanced wastewater treatment through the development of evaluation method for advanced wastewater treatment, the presentation of clear alternative scenarios based on the sound science and the proposal of the consensus-based decision making method. The feasibility of the suggestions were examined thorough the case study of the Lake Biwa watershed.

RESULTS

The research results in fiscal 2002 are as follows.

1. Development of a benefit evaluation method for advanced wastewater treatment

We developed a benefit evaluation method (so-called "alternative implementation cost method") in which we consider the minimum implementation cost for the water environment conservation efforts for the Lake Biwa as the benefit of the water environment of the lake because the implementation cost should be less than social Willingness-To-Pay of citizens when those efforts are implemented in the most efficient manner (Figure 1).

As the results, the unit benefit of water quality conservation is estimated to be 3,130 yen per Total CODs kg.

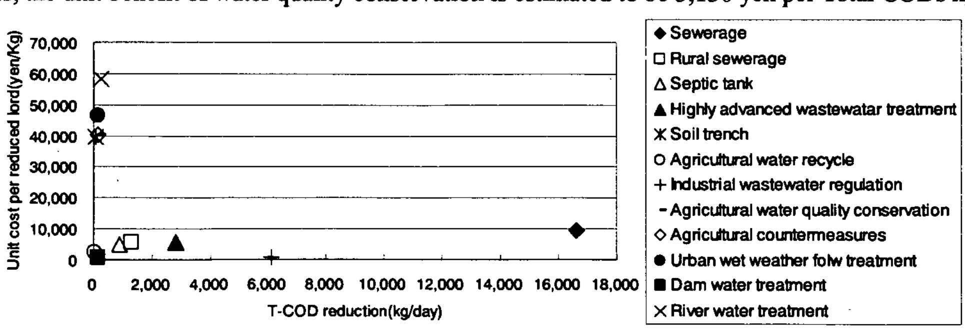

Figure 1 Relationship between T-COD reduction and unit cost per reduced lord

2. Evaluation of a nation wide benefit of water quality conservation through the implementation of sewerage

Total amount of investment for the construction, operation and maintenance of sewerage summed up to around 35 trillions yen while total reduction of pollution lord was calculated to be approximately 21 million Total CODs ton. Accordingly, the benefit of water quality conservation was estimated to be around 66 trillion yen through the calculation using the unit benefit 3,130 yen per Total CODs kg. Consequently, we obtained CBA results of B/C >1.9, which means that sufficient water quality conservation benefit has been produced compared to the investment needed. Considering other benefits of sewerage implementation such as convenience of flush toilet use and improvement of living environment, B/C would be much larger.

On the other hand, the cost and benefit of the advanced wastewater treatment was estimated to be 70 and 140 billion yen respectively. This suggested that the nation wide advanced wastewater treatment implementation strategy has given enough economical efficiency so far.

Technically based risk standard for wastewater treatment

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Project period: 2002-2004

OBJECTIVES

In Japan, as elsewhere, the water related health risk posed by pathogenic microorganisms such as outbreaks of Cryptosporidium and food poisonings caused by Noro viruses has become an increasing problem. This study aims to present a necessary technically based standard for the reliable safety of treated wastewater.

RESULTS

The research results in fiscal 2002 are as follows.

1. Proposal of safety guideline for Cryptosporidium

   A general procedure for countermeasures in the event of a mass outbreak and annual average risk control was obtained as shown in Table 1. Annual infection risk 10-2 was set as a tentative control goal. Where observed values deviate significantly from the lognormal distribution based on measurement data taken after secondary treatment and after sand filtration, this indicates an abnormal situation with the potential to cause a mass outbreak and emergency procedures should be instituted. L1, the threshold for increased monitoring, may be defined as the upper limit of the 95% confidence range for the distribution obtained from the geometric mean of certain number of samples (i.e., several consecutive separate measurements). L2, the threshold for emergency procedures, may also be defined in the same way. When the threshold value is exceeded, the relevant countermeasures are instituted. Ideally, the geometric mean of the measurements would be used for comparison with the threshold values; however, in cases where the latter of the consecutive measurements is higher and the concentration level appears to be on the increase, this situation may satisfy the prerequisites for the geometric mean. For this reason, in order to allow for a margin of safety, all of the consecutive measurement values are required to be below the geometric mean.

Table 1 Threshold values for mass outbreak countermeasures

Form of contact/reuse	L1 (threshold for increased	L2 (threshold for emergency procedures)	Upper Limit	Category	Annual Risk
Bathing	**2.8**	**4.1**	6.0	Secondary treatment	$10^{-2.2}$
Source water for	**2.8**	**4.1**	6.6		$10^{-2.2}$
Recreational water (parks)	**0.39**	**0.49**	2.4	Sand filtration	$10^{-2.7}$
Landscape water (parks)	**0.39**	**0.49**	23.1		$10^{-3.7}$
Flush toilet water (office)	**0.39**	**0.49**	91.9		$10^{-4.3}$
Sprinkling water (parks)	**0.39**	**0.49**	40.0		$10^{-3.9}$

Upper Limit: Standards cannot be changed above these value
Concentration (Cryptosporidium per L)

2. Risk benefit analysis by QALYs (Quality Adjusted Life Years)

   The benefit of countermeasures against cryptosporidium was estimated as the avoidance of both personal and social excessive cost caused by the microorganism. The personal benefit included protection of health (measured by QALYs) and avoidance of economical loss (health care expenses and decrease of income caused by the absence from job). The social loss was the cost of public health care support for the infected individuals. The efficiency of the countermeasures were estimated to be more than 10 million yen / QALYs. Most countermeasures turned to more costly, mainly because average risk was as low as 10-2 to 10-5 and additional risk reduction gave little benefit compared the cost needed.

REDUCING CH_4 AND N_2O GAS EMISSION FROM WASTEWATER TREATMENT FACILITIES BY IMPROVING APPLICABILITY OF CORE CONTROLLING TECHNOLOGIES

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Project period: FY2000-2002

OBJECTIVES

Global warming is one of the most serious environmental problems, and we have to control emission of the green-house effect gas(GHG) such as carbon dioxide(CO_2), methane(CH_4) and nitrous oxide (N_2O). In wastewater treatment plants, these GHGs are emitted according to the biological wastewater treatment, the incineration of sludge and the use of electricity, fuels and chemicals. The CH_4 and N_2O gases are more problematic because these gases have higher green-house effect than the CO_2 gas. The CH_4 gas is emitted from biological wastewater treatment process and the N_2O gas is emitted from biological nitrogen removal process and sludge incineration. The CO_2 gas emitted from the treatment process is not the target because the CO_2 gas is globally recycling in the gas-vegetable life.

It was already cleared that the CH_4 gas emission is able to be suppressed by introducing anaerobic or anoxic zones to wastewater treatment process, and that the N_2O gas emission from sludge incineration process decreases according to the temperature increase in furnace. The purpose of this research is to improve applicability of core technologies controlling emission of GHG, and also to make the GHG emission inventory more accurate.

RESULT

We did the research of the Green House Gas (CH_4, N_2O) from the wastewater treatment plant. Research divided into 2 of the wastewater treatment process and sludge treatment process and did it.

The wastewater treatment process examined the Green House Gas that is discharged from an aeration tank to the object. The examination of CH_4 did the contrast experiment of anaerobic-oxic activated sludge process, recycled nitrification/denitrification process and conventional activated sludge process. As for the result, the recycled nitrification/denitrification process was high with effect of decrease, anaerobic-oxic activated sludge process and conventional activated sludge process were the same control effect almost. The examination of N_2O did experiment of the N_2O that occurs from the nitrification process. As for the result, there was much emission quantity when imperfect nitrification process in the time when treatment to bad time and nitrification promotion.

The sludge treatment process did the N_2O emission quantity survey of the fluidized bed furnace. As for the result N_2O density was fluctuating largely every progress time. Therefore, it became clear that it does not become a representative value in a short term survey, in the case that I decide the fluidized bed furnace. Furthermore, as for N_2O density the influence of the free board temperature is biggest, the estimation of the N_2O density is possible from free board temperature. From the result, the N_2O gross weight from the fluidized bed furnace of Japan was 3.6Gg-N_2O/year.

Table 1 Results of CH_4 balance in the wastewater treatment process

	recycled nitrification/denitrification process	anaerobic-oxic activated sludge process	conventional activated sludge process
The concentration of CH_4 in the wastewater influent (mg/m^3)	617.5	431.3	550.9
The concentration of CH_4 in the treated wastewater (mg/m^3)	5.0	0.5	0.0
CH_4 emission volume (mg/m^3)	195.0	335.2	424.6
CH_4 balance ((emission+outflow)/inflow)	0.32	0.78	0.77

Table 2 Results of N_2O emission from sludge incineration

Incinerator		A	B			C			D		E	F		
Measurment		A	B1	B2	B3	C1	C2	C3	D1	D2	E	F	Mean	Capacity weighted mean
Measuring period		Jan-01	May-00	Dec-01	Sep-02	Dec-00	Aug-01	Oct-02	Sep-01	Feb-03	Mar-01	Nov-01		
Mean N_2O emission, O_2=6%		64	119	270	153	325	311	275	392	319	181	338		
Conversion of N in sludge to N_2O, %		1.62	2.25	4.55	3.33	5.42	5.95	4.11	7.36	6.74	3.35	7.31		
Emision factor, g-N_2O/t-WS	Mea	307	359	792	470	1,007	1,087	636	1,213	1,033	726	1,080	792	866
	Min.	150	207	401	272	239	632	191	600	380	257	522	350	363
	Max.	971	554	1,558	748	1,592	1,440	1,637	1,955	1,456	2,260	1,405	1,416	1,555
Emision factor, g-N_2O/t-DS	Mea	1,520	1,830	3,770	2,188	4,700	4,400	2,848	6,400	4,863	2,880	5,910	3,755	4,024
	Min.	750	1,040	1,910	1,265	1,190	2,560	855	3,160	1,790	1,020	2,850	1,672	1,697
	Max.	4,900	2,780	7,410	3,482	7,520	5,830	7,333	10,300	6,853	8,970	7,690	6,643	7,134

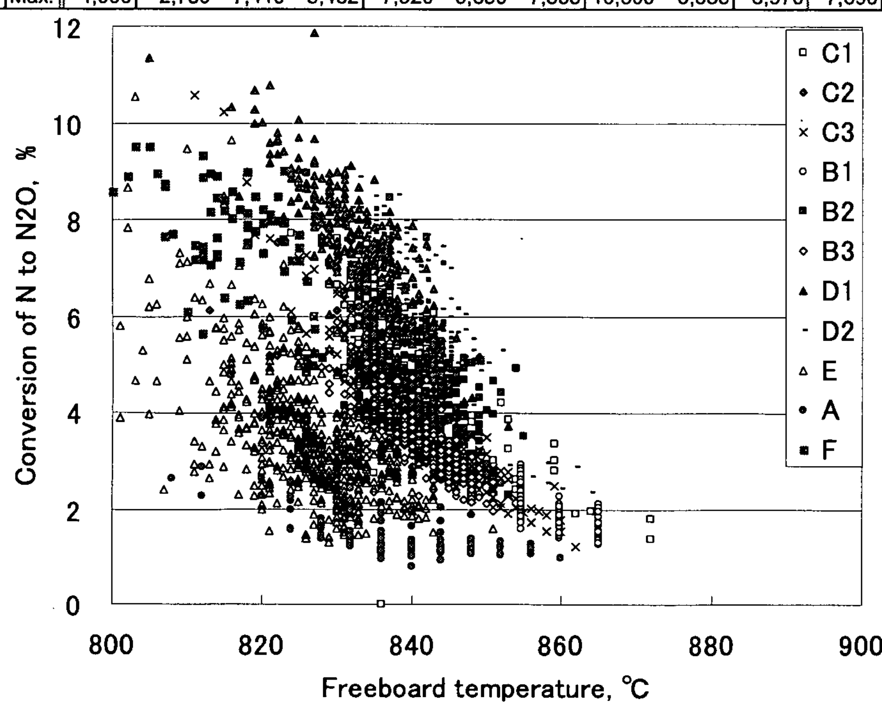

Figure 1 Connection between conversion of N in sludge to N_2O and freeboard temperature

DECOMPOSITION OF ENDOCRINE DISRUPTERS UTILISING MICROORGANISM GROUPS

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Project period: FY2001-2003

OBJECTIVES

It is necessary to efficiently reduce endocrine disrupters (EDs) through sewage treatment processes because EDs generated by urban activities are discharged to sewerage systems. Although the majority of EDs are removed, some cannot be removed. On the other hand, microorganisms which effectively decompose EDs have been found (Ogoshi, et al. 2001) , and have the potential to be used in existing wastewater treatment facilities.

This research examined how such microorganisms act, and how wastewater treatment processes could be controlled to utilize such microorganisms. Finally, wastewater treatment technologies which reduce the risk of EDs were developed.

METHOD

The performance of EDs which decompose microorganisms was investigated by using a wastewater treatment pilot plant. In FY 2002, before the performance investigation, the relationship between MLSS, which is one of the main indicators for controlling microorganisms in activated sludge, and removal of EDs were surveyed.

This investigation was conducted using pilot plants of the conventional activated sludge process at 20℃. The influent was the primary effluent of an actual wastewater treatment plant. 17 β estradiol (E2) was added to the influent, to give a concentration of 1μg/L or 10μg/L.

RESULTS

Fundamental data concerning the removal of EDs and MLSS were obtained. The results of the studies in FY2002 are summarized as follows.

1) In the case of higher E2 concentration in influent, the higher the MLSS, the lower the concentrations of E2 and Estrone (E1) in effluent. However, in the case of lower E2 concentration, both E2 and E1 were effectively removed, and no correlation between EDs and MLSS was observed (Fig. 1, 2).
2) The removal conditions of E2 and E1 in each tank were studied. E2 was decomposed rapidly, whereas the decomposition of E1 was delayed. The reason was thought to be that E2 was decomposed to E1, and the decomposition velocity of E1 was slower than that of E2 (Tanaka, et al. 2002). However, the amount of E1 generated did not correspond to the amount of E2 decomposed, so most of the E1 may have been decomposed, too (Fig. 3).

In FY 2003, the reduction of EDs using a carrier with ED decomposing microorganisms will be investigated using the same pilot plant.

REFERENCE

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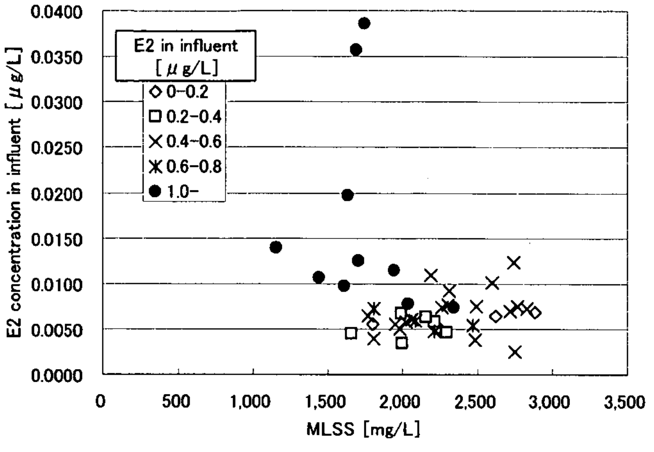

Fig. 1 The relationship between MLSS and E2 in effluent

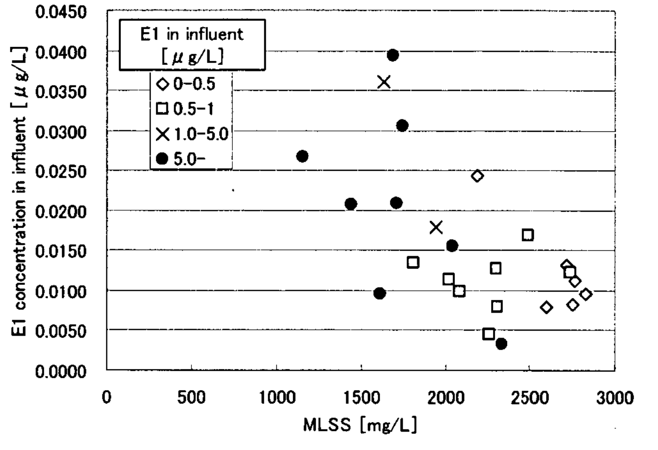

Fig. 2 The relationship between MLSS and E1 in effluent

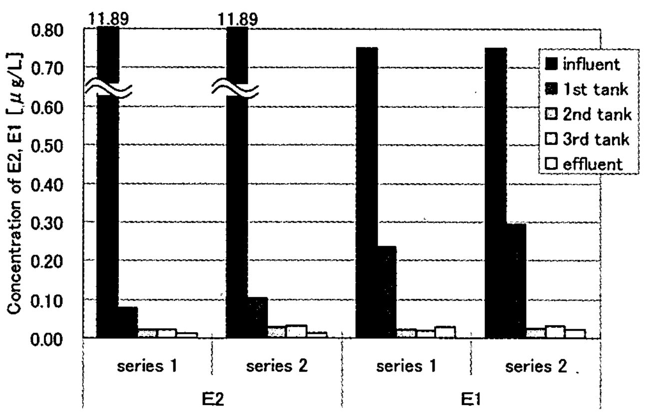

Fig. 3 E2 and E1 in each tank

STUDY ON WASTEWATER RECLAMATION SYSTEM FOR RIVER ECOSYSTEMS

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Project period: FY 2001-2005

INTRODUCTION

As the sewerage system diffuses, the amount of wastewater to be treated increases proportionally. When treated wastewater is discharged to public water bodies, it has a serious impact on the ecosystem of the receiving water body that cannot be ignored. Treated wastewater is increasingly being re-used as landscaping water in urban areas in an attempt to restore the waterside environment lost by urbanization. Such places provide oases in cities for the growth of aquatic life.

Aquatic biota, including algae, aquatic insects, and fish that live in these artificially restored waterside areas are mainly species known to survive in somewhat polluted waters. This means that a genuinely good living environment has yet to be restored, as the objectives of the wastewater reclamation system are limited, with primary emphasis on BOD, hygienic safety, and appearance (coliform count, SS, chromaticity, etc.). In fact, when treated wastewater is discharged to rivers and channels, wastewater is simply given advanced treatment using sand filtration or other similar processes. There have been few cases where more advanced treatment is employed to remove nitrogen or phosphorus or apply disinfection by ozone or ultraviolet light. Also, it has not been fully clarified yet what impact or effect such highly advanced treatment processes have on aquatic life.

Further knowledge is needed on wastewater treatment methods and treatment levels necessary to create good habitats for aquatic life at artificial watersides to which treated wastewater is discharged.

Aiming to restore and create genuinely good habitats for aquatic life at receiving waters, we studied the relationship between aquatic biota, including algae, benthos, and fish, and environmental factors, including the quality of treated wastewater and hydraulic conditions at wastewater receiving waters, and propose an ideal form of wastewater reclamation system acceptable for the ecosystem in terms of effectiveness and economy.

Method

The research this year includes implementation of a control experiment of discharging wastewater treated by different processes and of varying water quality, in order to identify differences in aquatic biota created in the test channel under different conditions. We discussed the relationship between the quality of treated wastewater and aquatic biota.

The test channel was constructed inside an experiment building to eliminate the influences of natural conditions and keep the experiment conditions almost constant. Two types of stainless steel channel were used: one measured 2 m long and 5 cm wide and the other 2 m long and 9.5 cm wide. Six of each, totaling 12 channels, were installed for various conditions, such as supply water volume or flow rate. A plate for algae to grow on was installed in the upstream part of each channel, while gravel was laid on the downstream part for the benthic life experiment.

Experiments conducted this year were based on the following conditions, focusing on the relationship between concentration of nutrient salts or chlorination and periphytic algae or benthic life.

In the first experiment, dilute wastewater treated by an actual treatment plant using the anaerobic-anoxic-oxic process and sand filtration discharged

Channel 1: dilute wastewater treated by an actual treatment plant using the anaerobic-anoxic-oxic process and sand filtration

Channel 2: wastewater used for Channel 1 with nutrient salts added (set concentration: 5 mg/l for NO3-N and 0.05 mg/l for PO4-P)

Channel 3: wastewater used for Channel 1 with nutrient salts added (set concentration: 5 mg/l for NO3-N and 0.1 mg/l for PO4-P)

Channel 4: wastewater used for Channel 1 with nutrient salts added (set concentration: 5 mg/l for NO3-N and 0.5 mg/l for PO4-P)

Channel 5: wastewater used for Channel 1 with nutrient salts added (set concentration: 2 mg/l for NO3-N and 0.5 mg/l for PO4-P)

Channel 6: wastewater used for Channel 1 with nutrient salts added (set concentration: 1 mg/l for NO3-N and 0.5 mg/l for PO4-P)

- In the second experiment, wastewater treated by an actual treatment plant using the anaerobic-anoxic-oxic process and sand filtration discharged with chlorination

Channel 1: wastewater treated by an actual treatment plant using the anaerobic-anoxic-oxic process and sand filtration without chlorination

Channel 2: wastewater used for Channel 1 with chlorination (set concentration: 5 mg/l for residual chlorine)

Channel 3: wastewater used for Channel 1 with chlorination (set concentration: 3 mg/l for residual chlorine)

Channel 4: wastewater used for Channel 1 with chlorination (set concentration: 1 mg/l for residual chlorine)

Channel 5: wastewater used for Channel 3 with chlorination (set concentration: 0.3 mg/l for residual chlorine)

Channel 6: wastewater used for Channel 3 with chlorination (set concentration: 0.1 mg/l for residual chlorine)

Results

In the first experiment, it was found that Chl-a (alga biomass (mg/cm2)) and the growth rate of periphytic algae tended to increase with increase in phosphorus concentration. But algae appeared with a smaller number of species, which is inversely proportional to phosphorus concentration.

In the second experiment, the total cell count of algae (cells/cm2) is not proportional to increase in concentration of residual chlorine. And algae appeared with a smaller number of species under the influence of chlorination. But it was not fixed concentration of residual chlorine that influences algae growth. The authors consider it necessary to test cases with lower nutrient concentration according to the same procedure used this time in order to clarify the relationship between nutrients and periphytic alga.

Benthic life also appeared during both experiment, but with a smaller number of species. Leeches was the dominant types. The observed fact may be attributed to the amount of benthic life contained in untreated water. When analyzing the amount of benthic life that may exist or grow in the receiving water body, it is necessary to consider the amount of benthic life supplied by treated wastewater in addition to nutrient concentration and chlorination.

FATE OF SANITARY INDICATORS IN TREATED WASTEWATER

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Project period: 2002-2004

OBJECTIVES

As a sanitary indicator of water, coliform bacteria are used for effluent standards, and fecal coliforms are used for bathing water at present. However, their fate in natural water is not known, for example, it is well known that coliform group often increases after disinfection, so these sanitary indicators may be unsuitable.

The Ministry of Health, Labour and Welfare therefore revised the water quality standards for drinking water, in which the use of coliform bacteria as a sanitary indicator was changed to E. coli. These standards will be enforced from April 1, 2004.

This study examined the propriety of sanitary indicators, the actual conditions in natural water and fates of sanitary indicators including conventional indicators such as coliform bacteria and new indicators such as E. coli, fecal streptococci, and enterococci.

METHODS

In FY2002, data on sanitary indicators in treated wastewater was gathered, and the tendency of whether these indicates are increasing or decreasing in water to which treated wastewater is discharged, was investigated. Therefore, in FY2002, an investigation using an experimental channel and a field study were conducted.

In the investigation using the experimental channel, the fates of sanitary indicators were studied by flowing treated wastewater disinfected by chlorine through the channel. The concentration of chlorine was set as 2.0 mg/L, and contact time was set as 15 min. The water was passed through the experimental channel cyclically. The experiment was continued for 6 months and samples were taken every week.

In the field study, the fates of sanitary indicators were studied at various actual sites to which treated wastewater was discharged from an actual wastewater treatment plant. Samples were taken from Lake Kasumigaura, Kokai River, landscaped spaces utilizing reclaimed wastewater in Yokohama city, and modified effluent in Hachioji city.

Coliform bacteria, fecal coliform, standard plate count, E. coli, and fecal streptococci in every sample were measured.

RESULTS

Some fundamental data concerning sanitary indicators were obtained through these studies. The results of the studies in FY2002 were as follows.

(1) From the investigation using the experimental channel, E. coli and fecal streptococci were thought to be more suitable as sanitary indicator because the other indicators increased greatly. However, the causes of the increase of indicators could not be determined, so other investigations should be conducted (Fig. 1).

(2) Concerning the field study, sanitary indicators except for E. coli increased at the landscaped spaces utilizing

reclaimed wastewater, and the modified effluent. On the other hand, only E. coli did not increase and remained almost constant.

(3) Concerning the field study, the difference between river or lake water and treated wastewater was clear, but the increase or decrease of sanitary indicators in the process of mixing or flowing was not observed (Table 1).

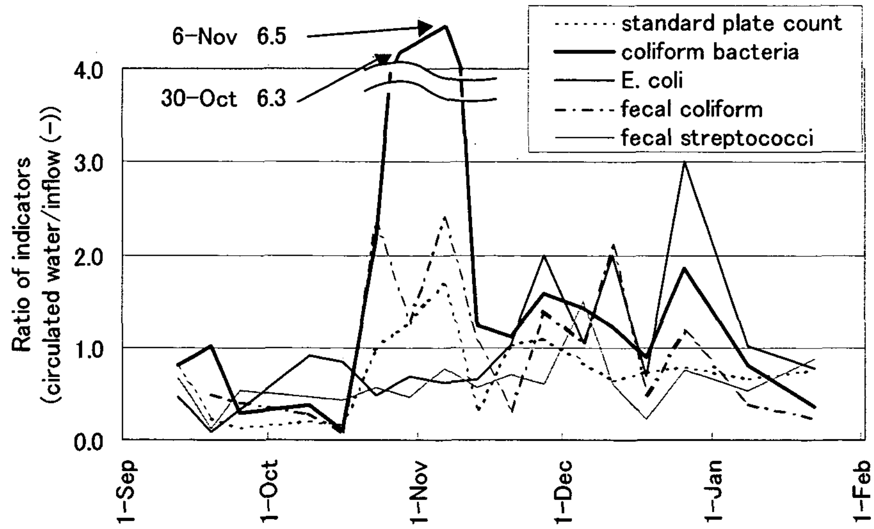

Fig. 1 The fates of indicators in the experimental channel

Table 1 Sanitary indicators of field study

Lake Kasumigaura

Oct. 8, 2002	water temp. [°C]	pH	DO [mg/L]	EC [mS/cm]	chlorine [mg/L] total	free	SS [mg/L]	COD [mg/L]	standard plate count	coliform group MPN	E. coli plate	fecal streptococci MPN
50 m upstream	23.6	6.71	5.50	0.49	0.07	0.03	6.5	5.5	3,680	>1,600	10	23
outlet of WTP	25.2	7.40	7.40	0.61	0.10	0.02	0.5	4.8	100	33	0	3
5 m downstream	24.5	6.39	6.70	0.60	0.11	0.05	2.0	5.3	85	79	0	3
10 m downstream	25.0	6.42	6.20	0.58	0.09	0.04	10.5	5.5	65	130	0	3
50 m downstream	23.8	6.50	5.95	0.50	0.08	0.06	14.5	5.9	1,710	>1,600	5	13

WTP: wastewater treatment plant

Kokai River

Mar. 10, 2003	water temp. [°C]	pH	DO [mg/L]	EC [mS/cm]	chlorine [mg/L] total	free	SS [mg/L]	COD [mg/L]	standard plate count	coliform group MPN	fecal coliform plate	E. coli plate	fecal streptococci MPN
50 m upstream	8.3	7.22	13.02	0.21	0.03	0.02	8.6	4.3	2,700	290	14	2	1
outlet of WTP	15.1	6.43	8.10	0.45	0.08	0.04	7.2	11.6	44,900	6,340	2,825	135	500
around the confluence	9.0	7.11	12.64	0.21	0.09	0.04	10.6	4.3	2,840	377	38	2	12
0.3 km downstream	8.7	7.17	12.96	0.21	0.06	0.04	8.8	4.3	3,180	377	29	3	3
1 km downstream	8.8	7.19	12.67	0.21	0.07	0.05	8.8	4.3	3,635	321	36	2	2

EFFICIENT REMOVAL OF SLIGHT HAZARDOUS MATERIALS BY OZONATION

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OBJECTIVES

The problems of the slight hazardous materials represented by the endocrine disruptors are getting more serious year by year. These materials may have a bad influence on natural environment, ecosystem and human health even if these are slightly contained. Endocrine disruptor is said to decrease sharply in process of wastewater treatment by some researches, but the influence which endocrine disruptor have on ecosystem is unknown and it may be needed to decrease more on the basis of the influence. The objectives of this research is to establish the way of efficient removal of slight hazardous materials by ozonation.

RESULTS

We decided organic materials, endocrine disruptors(E2, NP, BPA, BZP), TOX and bacteria(E.coli, fecal coliform) as the target materials, and researched the influence which the factor of ozonation have on the amount of decrease of the target materials. As a result of this research, we could find out the below things.

(1) E2, NP, BPA decrease up to less than detected level by 5mg/l~20mg/l of ozone injection. On the other hand, BZP decreases up to less than detected level by more than 10mg/l of ozone injection.

(2) The removal percentage of TOX increases according to the increase of amount of ozone injection, and 60% of TOX is cut by 20mg/l of ozone injection.

(3) The removal percentage of E.coli and fecal coliform is about 1.5log ~2.5log, and the percentage is almost the same by 5mg/l~20mg/l of ozone injection.

(4) The removal percentage of all kinds of the target materials is almost the same by 7~20min of ozone contact time.

(5) 50~70% of E260 is cut by ozonation. On the other hand, the removal percentage of COD is 20~30% and TOC isn't cut almost at all. As a result of this, organic materials which have unsaturated combination are easily oxidized by ozonation, but are not inorganized.

(6) The higher the ozone gas concentration is, the higher ozone adsorption efficiency is on the condition of the constant rate of ozone injection.

(7) The rate of ozone injection is in proportion to the sum of electricity consumption of ozonizer. As a result of this, it is important to ozonize by the minimum rate of ozone injection in order to cut down the expense.