CSO measurement system

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1. Introduction

The combined sewer system is a system to collect both wastewater and stormwater through the same conduits.However, this system involves the problem of Combined Sewer Overflow (CSO). Amid the general demand for realizing a comfortable waterfront zone, by a partial amendment of the enforcement regulations of the Sewerage Law of 1 April 2004, the Biological Oxygen Demand (BOD_5) value permissible for CSO from Fiscal 2014 will be controlled to 40mg/L (70mg/L as an interim value at present) (From Fiscal 2024 this will be applied to public sewerage systems where the water treatment area exceeds 1,500ha). In the Tokyo Metropolitan area where more than 80% of the treatment area is of the combined sewer system type, it calls for far more effective improvements. To cope with such requirements, our cooperative research group developed a turbidity sensor to be used for the measurement of the CSO turbidity load to contribute to the improvement of wastewater treatment efficiencies by providing data by measuring the environmental influence in existing facilities.

2. Materials and methods

The specifications for development were defined as described below
(1) Place of application; Pumping stations, storm overflow chambers, etc.
(2) Measuring range; 0～400mg/L or above in BOD_5 conversion
(3) Measuring accuracy; Correlation coefficient between BOD_5 values and analytical values, R : 0.7 or above
(4) Maintenance intervals; One month or more (provided with an automatic cleaning mechanism with wiping)
(5) Construction; No formation of obstacles for wastewater flowing by
(6) Data transmission; Wireless transmission
(7) Working place; Sewerage manholes (maintenance possible in a short time)

A pilot testing facility was installed in the grit chamber of Pumping Station A for the testing of continuous turbidity measurement. In this pilot facility, wastewater is continuously pumped up from the grit chamber to the testing water tank. The sensor is a turbidimeter of the 90-degree light scattering type. When the sensor block is functioning, it protrudes to the outside during measurement. When idle, it is stored in the main body, where the light emitting/detecting parts are cleaned with a wiping mechanism. Since the sensor is provided with a float, the sensor block goes up and down with the water level so that the measurement can be carried out near the overflow point. The sensor output can be transmitted through the monitoring system using a mobile phone network. Therefore, the real-time trend can be monitored over the Internet. As a feature of the water-sampling place, meanwhile, there is drainage from the storm water wet well according to the water level. This feature has been anticipated to show turbulence in measurements.

3. Results and discussion

Automated cleaning of the light emitting/detecting parts of turbidimeter was conducted twice a day based on the result of a preliminary test. The measured values of the turbidimeter were collected in a data logger once a minute. Calibration of the turbidimeter was made with a formazin standard solution prior to the test. Except for a peak value due to turbulence, the output value of the CSO turbidimeter varied from 20 to 300NTU. This diagram also indicates that there are two clear peaks in the turbidity: one appears after 9:00 due to residential wastewater in the morning and the other comes around 13:30 due to garbage drainage from kitchens for the lunchtime meal. The pulse-state data shows that the return water facility of the storm water wet well in the pumping station began to work and the grit on the bottom of the grit chamber rolled up. Judging from this performance, the system is sufficiently applicable to a sudden fluctuation of the water quality at the storm overflow chamber due to the first flush of stormy rainfall. Moreover a strong correlation of 0.97 is obtained in regard to the correlation coefficient between the measured turbidity values and BOD_5 .

4. Conclusions

We developed a CSO turbidity meter for the automatic and continuous measurement of organic pollutant concentration in the combined sewer overflow. Continuous measurements were also carried out for the wastewater in a pumping station for the purpose of performance evaluation. With the use of the auto-cleaning mechanism of the sensor block, we confirmed that continuous measurements are possible. We also confirmed that there is a strong correlation in the analytical values of BOD_5 . At the next stage, we will continue this testing to investigate the wastewater during seasonal changes, difficult-to predict heavy rain on the regional area in a short time, and in cases of long-term rainfall. We are planning to install a CSO turbidity meter near the overflow weir at the storm overflow chamber for the evaluation of untreated wastewater overflow measurement in stormy rainfall. The following conditions have to be satisfied for the installation of a sensor at the storm overflow chamber:

(1) Secure the power supply; The CSO turbidity meter requires a power supply for its telescopic mechanism of the lighting and sensing block.

(2) Method of sensor installation; The sensor shall withstand stresses caused by violent wastewater flows in conduits in the case of stormy rainfall.

(3) Water level detection; The CSO turbidity meter is devised to measure the intensity of overflow, actuated in compliance with the water level. Therefore, it shall be provided with a level switch that can measure the water level in the conduit or detect the specified water level.

5. References

Saito S, Ohashi H, Toyooka K(2010). Pollutant Load Measurement System of Combined Sewer Overflow. Proc. 47th Annu. Conf. JSWA, Yokohama, pp.372～374 (in Japanese)