

Research on Combined Sewer Overflow During and After Rainfall by Nagoya City

Whole term

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(Purpose)

The Combined Sewer Overflow (CSO) from the rainwater drain outlet of the combined sewer system is one of the factors that pollutes the place of discharge and aggravates the water environment. Municipalities that have adopted the combined sewer system are now in the process of implementing some reliable improvement measures for it. However, the evaluation and verification of the effects of these measures for the CSO outflow waters have not been performed enough on a nationwide scale, and we need to work on them as quickly as possible in order to fulfill the responsibility of explaining the improvement measures to the city residents.

So we have been developing a pollutant dispersion model, analyzing the impacts on the CSO outflow waters by using this model and conducting a quantitative assessment of the effects of the combined sewer system improvement measures and so on, through this research project since 2004.

(Results)

(1) Pollutant dispersion model

In this research project, we obtained the continuity equation for water and a density anomaly equation, based on the Law of Conservation of Mass and also developed the "pollutant dispersion model" in which the pollutant dispersion factor, which consists of the production and consumption factors which show the increase and decrease in pollutants and the diffusion coefficient, has been added with the water temperature that is obtainable from the density anomaly equation and the water quality concentration balance law.

And, we assessed that the fluctuation of each factor concerning the width direction (y) of the river is little compared to that of the longitudinal direction (x) and the depth direction (z) and then created the vertical two-dimensional model that has omitted the change in the width direction (y) factor.

(2) Forecast analysis

Targeting the N river of about 10.2 km² in the drainage area, we analyzed the present and future situations (Combined sewer system improvement measures: assuming the retention of 6mm/ha) by using the actual rainfall (Total rainfall: 25mm, Max. rainfall strength: 6.0mm/hr) in order to estimate the CSO's pollutant dispersion situation. As a result, we could quantitatively grasp the effects of the combined sewer system's improvement measures by estimating that the improvement measures reduce the maximum value of the water quality concentration after CSO by about 30 to 40 % for BOD, COD, T-N and T-P and about 60% for pathogenic bacteria such as coliform. Also the analysis made it clear that the highly concentrated pollutants tend to stay in the surface layer of the river due to the halocline and then spread around with time.

(3) Examination of Water Quality Evaluation Index

We examined the Water Quality Evaluation Index, which is easy to understand from the city residents' point of view in regard to the effects of the water quality improvement through the combined sewer system improvement measures and the sophisticated sewage treatment. For examination, we collected "Criteria Concerning Water Quality", "Characteristics by Concentration of Water Quality Items", "Comparison with Concentration of Things Familiar to You", and "Water Quality Fish Can Live In" and "Phenomenon Changing through Implementation of Measures" from the reference materials and documents.

Based on these items, we analyzed such as the understandability, adaptability, and reliability and then created the easy-to-understand BOD water quality evaluation index (draft) for the water environment by quoting and applying these analyses.

(Future plans)

Plans are being drafted to verify the effects of this project in all junctions in the city through the combined sewer system improvement measures by modeling and analyzing outflow waters, including coastal seawaters.

It is necessary to acquire new knowledge in the future to improve the index as the examination of the evaluation index (draft) made us realize that some available viewer-friendly indexes of the water quality items other than BOD are difficult to set up.

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Key words

Overflow during and after rainfall, Tidal river, Pollutant load, Diffusion runoff analysis, Water quality evaluation index