Estimation of CSO reduction effect utilizing of storage pipe for flood prevention

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1. Introduction

Japan has been experienced natural disasters such as typhoons and torrential rains due to its geographical and meteorological characteristics. It often brings about flood disasters such as pluvial and fluvial floodings, and causes property and human damages. Consequently, many storage facilities have been constructed in the underground as a countermeasure against the flood disasters in Japan. However, the storage facilities are used only several times a year. Therefore, several storage facilities have started to be used as a countermeasure against combined sewer overflow (CSO) (Ozaki, et al. 2011). The most important thing is that, even if the storage facilities are used as a countermeasure against CSO, flood prevention must be given priority over CSO prevention. In this study, the first objective is how to decide the prevention measures for flood disaster or CSO in their storage facilities. The second objective is to estimate the amount of reduction load with using the storage facilities.

2. Methods

Combined sewer system is installed which is consist of two drainage area of Kikusui and Kuwazai in Osaka Japan. Kikusui and Kuwasai have an area of 196 ha and 829 ha, respectively. Each drainage area has pumping station at the downstream and each CSO setting is 3 times as much as dry weather flow (DWF). A storage pipe was constructed because this area has been often damaged by pluvial flooding. The pipe diameter is 6,250mm, the length is 1,132m and the storage capacity is approximately 36,000m^3. The inflow was controlled by movable weir. The height above weir has been fixed 20 times DWF for flood prevention. The storage pipe was used for flood prevention only several times a year.

To achieve the purpose, we examine the usage of the storage pipe for flood prevention and CSO prevention through a case study. In the case 0, the storage pipe is only used for flood prevention throughout the year. In the case 1, the storage pipe is only used for flood prevention from June to October in pluvial season in Japan and the storage pipe is switched by movable weir for flood prevention and CSO prevention according to intensity of rainfall on the other month. In case 2, the storage pipe is used to switch for flood prevention and CSO prevention throughout the year. Here, the height of weir in flood prevention and CSO prevention are set 20 times DWF and 1 times DWF, respectively. The switching condition is decided on the basis of the relationship between rainfall intensity and amount of BOD reduction using the storage pipe. The annual simulation using the InfoWorks CS is conducted to estimate the CSO reduction effect by average rainfall such as 1,315mm in total rainfall volume and 87 times in rainfall events, except for less than 1mm in total rainfall.

3. Results and discussion

Condition of switching the prevention for flooding and CSO

We must consider that how to decide the prevention measures the prevention for flood disaster and CSO in storage pipe. We expected that the reduction in BOD is related to rainfall intensity and capacity of storage facility. Therefore, we examined the relationship rainfall intensity and reduction in BOD using the storage pipe for CSO prevention. As a result, the reduction in BOD is increased less than 7 mm/hr in rainfall intensity, after that the reductions remain on the same level. This result indicates that the capacity of storage pipe can only retain less than 7 mm/hr in rainfall intensity. Therefore, we decided that the height of movable weir is switched from CSO prevention to flood prevention if the rainfall intensity is forecasted over the 7mm/hr.

Estimation of the reduction load

Number of occurrence of discharge into stream in Case 0, Case 1and Case 2 are 63 times, 60 times and 59 times, respectively. The utilizing of storage pipe as CSO prevention makes a tiny contribution to decrease frequency of discharge into stream. The table 1 shows the results of each case during the wet weather period. The storm-water can be captured by the storage pipe. The amount of primary treatment flow and discharge flow decrease. The total pollution in Case 0, Case 1 and Case 2 are 424, 398 and 385 ton/year during the wet weather period, respectively. The primary treatment load account for the greatest proportion of total load. The reduction rates of Case 1 and Case2 to Case 0 are 6% and 9%, respectively.

Table 1 BOD discharge volume during the wet weather period (unit: ton / year)

	Secondary Treatment	Primary Treatment	Non-treated discharge	Stored and treatment	Total
Case 0	85	229	109	1	424
Case 1	85	215	94	4	398
Case 2	85	208	86	6	385

4. Conclusions

The main conclusions can be summarized as follows.

- The utilizing of storage pipe as CSO prevention makes a tiny contribution to decrease frequency of discharge into stream.
- In case of using the storage pipe for CSO prevention from November to May (in Case 1), the pollutant discharge rate is reduced more than 6 % compared to the case of using the storage for flooding prevention (in Case 0).
- In case of using the storage through the year (in Case2), the pollutant discharge rate is decreased 9 % compared to the Case 0.
- This study has shown that the storage pipe for flooding prevention is able to use for CSO prevention.

5. Acknowledgement

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6. References

Ozaki T., Ishigaki T.. and Toda K. (2010). Estimation of BOD in Combined Sewer Overflow during Short Time Heavy Rain. *12ICUD proceedings*, CD-ROM.