Change analysis of dissolved organic matter on effect of water release operations in Dae-Cheong Dam Reservoir

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Reservoirs are the main sources of drinking water in South Korea and these sources may be contaminated by agricultural activity, domestic wastewater discharge or industrial effluent. These inputs promote eutrophication and cause algal blooms in the reservoirs. In addition, the accumulation of dissolved organic matter (DOM) may exceed consumption by microorganisms so that the composition of DOM is changed (Wen et al., 2003).

Sudden intrusions of high loads of suspended solids (SS) during storms, particularly during typhoons, may change total phosphorous (TP) and DOM loads in reservoir water. In consequence, dissolved oxygen (DO) may decrease and sediment deposition increase causing water treatment difficulties. The authors have also found in the Daecheong Dam Reservoir that, under storm flows, allochthonous organic carbon input was higher than autochthonous origin carbon (Yu and Ha et al., 2004).

Turbidity may influence populations of aquatic organisms, including macroinvertebrates, by interfering directly with grazing and predation, and by reducing primary production as increased light attenuation limits food available for secondary production. In a stratified reservoir, the turbidity flow from storm runoff may intrude to a water depth having the same density as the turbidity flows, further complicating water management. This may result in secondary water pollution by turbid water if the water is retained in the reservoir for a number of weeks (Yu 2006).

The present study aims to identify the dynamic behaviour of diffuse pollution introduced into a reservoir, by turbidity flows after storms. Effects of the gate operation on the retention of turbid water in the reservoir were depicted with a load duration curves. The key indicators in water at 5 m depth in the vicinity of two intake towers (Muneui and Daejeon) were turbidity (measured by NTU) and total nitrogen to phosphorus ratio (N/P). These indicators are predictors for algal blooms.

Local quality standards for raw water require turbidity to be < 5 NTU and N/P ratio > 20-25. When water is released, the intake water depth for hydropower generation at the dam location can be changed to alter the hydraulic conditions in the deep water of the reservoir. The dynamic response of turbidity distribution and nutrient balance in the water bodies are monitored on the basis of simulation results from CE-Qual-W2 hydrodynamic model.

Different scenarios were modelled using two different water release conditions and used to calculate duration curves at water intake towers. In 2003, water release followed guidelines set by the reservoir water authority. The turbidity exceeded 5 NTU at Muneui and Daejeon intake towers on 121 and 89 days and N/P ratios exceeded guidelines on 69 and 67 days. Alternative water release operation conditions increased the duration when NTU and N/P exceeded guidelines by 2 days and 8 days at Muneui and 13 and 3 days at Daejeon.

Even though there is no significant impact of water release operation changes on the duration difference in terms of N/P ratio in the water around the two intake towers, the duration of total phosphorous concentration in the water is reduced by active release of turbid water.

This means that prompt release of turbid water from the reservoir may improve water quality. The objective is to reduce the duration of turbidity and decrease the probability of eutrophication by reducing total phosphorus concentration around the intake tower during monsoon period to N/P > 25.

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