A Microcosm-Based Investigation into Oxidized Nitrogen Removal in the Hypolimnetic Waters of the Occoquan Reservoir of Northern Virginia

by

Tawan Banchuen

Committee Chairman: Thomas J. Grizzard
Civil Engineering

(ABSTRACT)

The CE-QUAL-W2 model has been selected as a tool for use in water quality management studies of the Occoquan Reservoir. In order for the model to achieve its best possible predictive capability, additional quantitative information on denitrification rates in the reservoir was required. A microcosm operating protocol was developed to obtain such information and also to enhance the understanding of complex nitrate-sediment-phosphorus interactions. The microcosm system developed was a biphasic system, consisting of a single continuous stirred tank reactor (CSTR), or a series of CSTRs containing representative sediment and water samples from the reservoir. The system was configured to simulate the bottom waters in the upper reaches of the reservoir during anoxic conditions.

Nitrate concentrations in the microcosm system were monitored, and first-order denitrification-rate constants calculated to be used as an input to the reservoir water quality model CE-QUAL-W2. Other water chemistries were also monitored to investigate the nitrate effects on water quality. From the investigation results, it appears that the first-order denitrification-rate constant of the model should be set at 0.22 day^{-1} instead of the model default value. Nitrate was also observed to be removed by chemical and/or biologically mediated reduction by reduced forms of manganese. Once the nitrate was depleted, soluble manganese was released from the sediment first, followed by soluble iron. The release of phosphorus was not observed in this study after the depletion of nitrate, but nevertheless, was believed to occur. The absence of the release was attributed to phosphorus adsorption to the Plexiglas reactor walls.