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学位論文題目	The effect of coagulation with aluminum sulfate as in-lake treatment on toxic <i>Microcystis</i> cells
論文審査委員	主査 教授 朴 虎東 教授 戸田 任重 准教授 國頭 恭 准教授 宮原 裕一 准教授 北澤大輔（東京大学）

論文内容の要旨

The presence of cyanobacteria in reservoirs, lakes, and rivers is a worldwide environmental health issue because some cyanobacterial strains produce toxins, as well as taste and odor compounds, as secondary metabolites. Aluminum salt has long been used in several water treatment or lake restoration. Most studies have only investigated cyanobacteria removal by alum treatment during the coagulation process in water treatment processes.

Although humans do not directly ingest cyanobacteria, they might be regularly exposed to sub-lethal dosages of extracellular microcystin in drinking water or several water recreational activities derived from contaminated lakes and reservoirs. Therefore, the release of toxins by the cyanobacteria removal treatment including adding alum should be considered not only in the conventional water treatment but also in lake treatment.

Therefore, in this study, the effect of alum treatment on toxic *Microcystis* cells was evaluated in several experiments: (1) the long term effect of alum coagulation in the flask experiment, (2) the microcosm experiment designed to simulate the conditions found in common lakes and reservoirs, (3) The effect of aluminum hydroxide on *Microcystis* cells through the analysis of precipitates.

The cell concentrations in supernatant were significantly decreased at 1 day after adding alum resulted from co-precipitation with aluminum hydroxide, and the

extracellular MC-LR concentration increased continuously after adding alum with maximum dose both in the flask and in the microcosm experiments. Moreover, precipitated cells were surrounded or coated with aluminum hydroxide floc, and cell membrane was torn, which was observed under a SEM. Therefore, it could be concluded that *Microcystis* cells have seriously damaged by alum treatment at the maximum dose. Moreover, alum treatment caused damage to bacteria existed in the sediment as well as *Microcystis* cells.

Many studies of the removal of cyanobacteria by alum treatment have reported that alum does not cause any cell damage and resultant toxin release. However, it should be considered that the treatment time which means the reaction between alum and cyanobacterial cells. Common water treatments did not exceed a maximum of 24 hours, meanwhile it might take more than a few months in-lake treatment. Therefore, it could be concluded that alum treatment is not suitable for removing toxic cyanobacterial bloom in lakes, reservoirs, and ponds, because floc would remain for a long time in the sediment.