外 国 語 要 旨

学位論文題目　Application of the light irradiation to the inhibition and removal of algae in water purification

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Rapid algal growth in water purification process such as sedimentation and filtration basins often causes problems such as turbidity leak, odor etc. As a solution of the algal problems, increase of chlorine and/or flocculants are usually implemented. But they might increase treatment cost and/or the possibility of by-product. As alternative control methods without major changes to the process, the light irradiation was investigated. Both of ultraviolet and visible light were applied in this research.

At first, it was investigated whether the application of ultraviolet (UV) radiation (254 nm) was effective to control algal growth. In 2010-2012, we have investigated inactivation effect of UV light on the indigenous algae in the resource water using on-site UV systems which consist of sedimentation and filtration basin to simulate slow sand filtration process. As a result, the algal growth with UV was significantly controlled more than without UV. Applied UV dose was approx. 160 mJ/cm^2. Furthermore, UV can not only inactivate the proliferative ability, but also induce the algal cell decrease after irradiation. Then UV inactivation effect on some isolated algae was investigated. Three algae which obstructed water purification such as diatoms of *Cyclotella*, green algae of *Dictyosphaerium*, and flagellate of *Cryptomonas* were selected and investigated the inactivation effect with conventional UV dose such as 50 to 200 mJ/cm^2 or with high UV dose such as 500 to 1000 mJ/cm^2. As a result, it was observed the algal cell density was decreased or kept in a week after conventional UV dose in all algal species. *Dictyosphaerium* had higher resistance or faster growth rate compared with *Cyclotella* and *Cryptomonas*. And when UV was irradiated intermittently the inhibition effect on algal growth was improved. Moreover, it was observed that algal cell exposed with high UV dose were destructed and cell number were decreased in case of *Cryptomonas* and *Dictyosphaerium*. On the other hand, the contents of cell interior were changed but the shape of cell wasn't in *Cyclotella* case. Then it was concluded that the different mechanisms other than gene damage was confirmed by the microscopic observation. If UV irradiation could control algae without lose its outline

of the cell, it is possible to prevent release of algal content which inhibit aggregation. In 50 to 400 mJ / cm^2, not only the genetic damage, also damage on interior of cell led to decrease the number of cells in the culture period. In particular, 400 mJ/cm^2 or higher irradiation, the destruction of the cell immediately after irradiation was observed.

On the other hands, visible light application to control algae was investigated. The flocculation effect on the turbidity containing high algae under the visible light (ex. LED lamp) irradiation was compared with no visible light condition. The jar-test for water containing indigenous algae or isolated algae such as *Microcystis*, *Cycrotella* and *Dictyosphaerium* was conducted. The injection rate of PAC (poly aluminum chloride), which was used as the flocculant, was decided referring to the applied dose in actual water purification plant. As a result, the turbidity removal rate in flocculation with visible light and sedimentation in a dark condition was improved more than in other conditions. It was confirmed that visible light could improve the turbidity removal rate by 2% - 10% in the case of water highly containing algae. However, under the conditions of constant pH and initial turbidity, the significant difference in removal rate with/without visible light irradiation was not observed. There was a possibility that a significant difference occurs in case of flocculation following filtration process especially to the water containing picoplankton.