Application of coagulant originated from natural materials using cyclonic-DAF reactor for algae removal

Hong Sok Oh[1,2], Seon Hong Kang[2], Tae-Mun Hwang[3,†]

[1]Kyong-Ho Engineering & Architects Co., Ltd, South Korea
[2]Department of Environmental Engineering, Kwangwoon University, South Korea
[3,†]Korea Institute of Civil Engineering and Building Technology, 283 Goyangdar-Ro, Ilsan-Gu, Goyang-Si, Gyeonggi-Do 411-712, South Korea
Keywords: Algae removal, Dissolved air flotation(DAF), Cyclonic-DAF, Coagulant
Presenting author email:taemun@kict.re.kr

Introduction

Dissolved air flotation (DAF), one of the most representative physico-chemical processing technologies used to remove algae, is a vehicle-mountable aqua-mobile freshwater lake water treatment technology. This technology removes suspended substances or algae in aquatic environments using physical treatment processes that employ the flotation of air. Cyclonic-dissolved air flotation (DAF), a dissolved air flotation method demonstrating improved performance, has a structure capable of forming spiraling flows that produce microbubbles that adhere to suspended matter and float to the surface of the water passing through the float separation tank. In this study, the coagulant that originated from natural materials was applied as the chemical in order to examine the application of using coagulant to the developed cyclonic-DAF.The experiment result was evaluated by chlorophyll-a and blue-green algae removal efficiency.

Methods

The capacity of Cyclonic-DAF is 10 m^3/h that enables in field experiment, and this is the size that can be loaded and transported by a 5-ton truck. The equipment consists of cyclonic-dissolved air flotation equipment, microbubble generator, algae recovery pond, and coagulation setting pond.For the chemical, the coagulant originating from natural materials (R-119; MCE Korea Inc., Korea) was used. Jar-tester was used in order to calculate the optimal chemical dosage according to the concentration of chlorophyll-a.The experiment was carried out in a tractional pond in W area where blue-green species appeared.The chemical in its optimal chemical dosage was injected into Cyclonic-DAF according to the concentration of chlorophyll-a in the experimental field.In order to analyze the experiment result, chlorophyll-a, cell number of blue-green species, and TOC were analyzed.

Results and Discussion

In order to calculate the optimal chemical dosage of the coagulant originating from natural materials, river water where blue-green algae occurred was sampled. As a result of carrying out the Jar-tester by changing chlorophyll-a dosage to 30 mg/m^3, 70 mg/m^3, 100 mg/m^3, 150 mg/m^3 and 200 mg/m^3, the chemical dose calculation formula $\text{Chlorophyll-a} = 3.42(\text{Dose}) - 127.7$was obtained, and R^2=0.97. The cell number of blue-green species in the tractional pond in W area was 1,342,500 cells/mL and the species primarily comprised *Microcystis* sp. The pH of 7.4 chlorophyll-a was 102.9 mg/m^3 and the pH of TOC was 6.0 mg/L. The pH according to the chemical dosage calculation formula was 67 mg/L, and the test was carried out in the field by injecting the chemical at a pH of 40 mg/L and 60 mg/L. For the treatment result obtained by applying microbubbles generated from Cyclonic-DAF, the pH of 7.4 chlorophyll-a was 85.6 mg/m^3 and the pH of TOC was 5.8 mg/L. The cell number of blue-green species was 12,500 cells/mL. The removal rate of chlorophyll-a, TOC, and the cell number of blue-green species was 16.8%, 3.3%, and 99.07%, respectively.When 40 mg/L of natural coagulant was injected into Cyclonic-DAF as the chemical, the pH of 7.5 chlorophyll-a was 16.8 mg/m^3 and the pH of TOC was 4.1 mg/L. The cell number of blue-green species was 1,100 cells/mL. The removal rate of chlorophyll-a, TOC, and the cell number of blue-green species was 83.7 %, 31.7%, and 99.9%, respectively.When 60 mg/L of natural coagulant was injected into Cyclonic-DAF as the chemical, the pH of 7.3 chlorophyll-a was 9.6 mg/m^3 and the pH of TOC was 4.0 mg/L. The cell number of blue-green species was 500 cells/mL. The removal rate of chlorophyll-a, TOC, and the cell number of blue-green species were 90.7%, 33.3%, and 99.96%, respectively.The experiment result showed that the cell number of blue-green species was removed by over 99% using only microbubbles of Cyclonic-DAF. However, the removal effect of organic matters and chlorophyll-a was insignificant.As a result of injecting natural chemicals into Cyclonic-DAF, organic matters and blue-green species were removed by over 99.9% and chlorophyll-a was removed by over 80%.As a result of applying optimal drug dosage (coagulant dosage) to the field, 60 mg/L showed the highest blue-green species and

chlorophyll-a removal rate. It was also proven that the optimal coagulant calculation formula determined through the lab test could be applied to the field.

Conclusions

As a result of examining the flocculantoptimal for the pilot scale cyclonic-DAF, it was confirmed that the use of coagulant of natural material (R-119) was superior for blue-green species removal, and it was confirmed that the application is high in the field.

References

[1] Yan, Y., Jameson, G. J. (2004) Application of the Jameson cell technology for algae and phosphorus removal from maturation ponds, *International Journal of Mineral Processing*, 73(1), 23-28.

Acknowledgement

This subject was supported by “Field evaluation of best available technique for algae control in river” (code 18AWMP-B098632-04) funded by by Korea Environmental Industry & Technology Institute.