Field trial of water flow and ultrasonic irradiation to improve the water quality of a stagnant river reach

Tekile Andinet\textsuperscript{a}, Ilho Kim\textsuperscript{a,b,*}, Jai-Yeop Lee\textsuperscript{b}

\textsuperscript{a}Department of Construction Environment Engineering, University of Science and Technology, Daejeon 305-333, Korea, Tel. +82-10-4314-6822; email: andinetm@gmail.com
\textsuperscript{b}Korea Institute of Civil Engineering and Building Technology (KICT), Gyeonggi-Do 411-712, Korea, Tel. +82-10-8728-6898; Fax: +82-31-910-0291; email: ihkim@kict.re.kr (I. Kim), Tel. +82-10-4525-9889; email: pas2myth@kict.re.kr (J.-Y. Lee)

Received 19 October 2016; Accepted 16 February 2017

\textbf{ABSTRACT}

Even though lab-scale ultrasonic irradiation has successfully improved water quality, the few field applications of this environmentally friendly solution have shown mixed results. In this work, jet water flow and ultrasonic irradiation with a 200-kHz frequency were integrated to study the effect of the system operation on the water quality of a stagnant Yeo-cheon River section. Samples were continuously collected only under jet flow and then under the combined system for 2 and 10 weeks, respectively. In general, the integrated system showed a localized improvement in the water quality in terms of Chlorophyll-a (Chl-a) and dissolved reactive phosphate. Dissolved oxygen (DO) increased by more than 100% at 5 and 25 m, and increased in average by 60% further downstream. Even though flow was expected to suspend the sediments and increase turbidity, in the combined treatment, there was no increase, which was likely due to the agglomeration and settling out of particles due to sonication. However, the nitrogen and dissolved organic carbon concentrations showed a fluctuating trend. The inverse association between DO and Chl-a decreased from a coefficient of 0.51–0.37 when the ultrasonic irradiation unit was coupled with the flow, which resulted in a reduction effect on the Chl-a concentration from ultrasonication. The relationship between DO and reactive phosphate also indicated a higher influence of ultrasonication than flow on the phosphorus concentration. In general, the cumulative effect of the water flow and ultrasonic irradiation met the water quality requirement of the river for a healthy ecological interaction.

\textit{Keywords:} Stagnant; Ultrasonic irradiation; Water flow; Water quality

* Corresponding author.