World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:08, 2016

Improving a Stagnant River Reach Water Quality by Combining Jet Water Flow and Ultrasonic Irradiation

Authors : A. K. Tekile, I. L. Kim, J. Y. Lee

Abstract : Human activities put freshwater quality under risk, mainly due to expansion of agriculture and industries, damming, diversion and discharge of inadequately treated wastewaters. The rapid human population growth and climate change escalated the problem. External controlling actions on point and non-point pollution sources are long-term solution to manage water quality. To have a holistic approach, these mechanisms should be coupled with the in-water control strategies. The available in-lake or river methods are either costly or they have some adverse effect on the ecological system that the search for an alternative and effective solution with a reasonable balance is still going on. This study aimed at the physical and chemical water quality improvement in a stagnant Yeo-cheon River reach (Korea), which has recently shown sign of water quality problems such as scum formation and fish death. The river water quality was monitored, for the duration of three months by operating only water flow generator in the first two weeks and then ultrasonic irradiation device was coupled to the flow unit for the remaining duration of the experiment. In addition to assessing the water quality improvement, the correlation among the parameters was analyzed to explain the contribution of the ultra-sonication. Generally, the combined strategy showed localized improvement of water quality in terms of dissolved oxygen, Chlorophyll-a and dissolved reactive phosphate. At locations under limited influence of the system operation, chlorophyll-a was highly increased, but within 25 m of operation the low initial value was maintained. The inverse correlation coefficient between dissolved oxygen and chlorophyll-a decreased from 0.51 to 0.37 when ultrasonic irradiation unit was used with the flow, showing that ultrasonic treatment reduced chlorophyll-a concentration and it inhibited photosynthesis. The relationship between dissolved oxygen and reactive phosphate also indicated that influence of ultra-sonication was higher than flow on the reactive phosphate concentration. Even though flow increased turbidity by suspending sediments, ultrasonic waves canceled out the effect due to the agglomeration of suspended particles and the follow-up settling out. There has also been variation of interaction in the water column as the decrease of pH and dissolved oxygen from surface to the bottom played a role in phosphorus release into the water column. The variation of nitrogen and dissolved organic carbon concentrations showed mixed trend probably due to the complex chemical reactions subsequent to the operation. Besides, the intensive rainfall and strong wind around the end of the field trial had apparent impact on the result. The combined effect of water flow and ultrasonic irradiation was a cumulative water quality improvement and it maintained the dissolved oxygen and chlorophyll-a requirement of the river for healthy ecological interaction. However, the overall improvement of water quality is not guaranteed as effectiveness of ultrasonic technology requires long-term monitoring of water quality before, during and after treatment. Even though, the short duration of the study conducted here has limited nutrient pattern realization, the use of ultrasound at field scale to improve water quality is promising.

Keywords : stagnant, ultrasonic irradiation, water flow, water quality
Conference Title : ICEES 2016 : International Conference on Environmental and Ecological Systems
Conference Location : London, United Kingdom
Conference Dates : August 25-26, 2016