Particles and resuspension in constructed stormwater wetland during dry days

Jianghua Yu, Yeonseok Kim, Heidi B. Guerra and Youngchul Kim

Department of Environment Engineering, Hanseo University, Seosan City 356-706, Korea,
Corresponding author, email: ykim@hanseo.ac.kr Tel. 82-10-3257-1432

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1. Introduction

The transport of particles is critical to the functioning of stormwater wetland. Microscopic particles are capable of binding a variety of contaminants in water due to their high specific surface area. The major processes responsible for particle behaviour are sedimentation, filtration, resuspension and algal growth. In particular, resuspension has a large influence on particle numbers (Kadlec, 2009). The objective of this study was to investigate particle behaviour in stormwater wetland during dry days.

2. Materials and Method

The wetland examined for this study is located in Gimje City, Korea. Its surface area is 7,800 m^2, with a water quality volume (WQv) of around 2275 m^3; the watershed area (A) is about 75 ha, mostly rice paddy and cropland (Figure 1). Samples were collected over a period of four months from June to September in 2009. During this period, the antecedent dry days ranged from two to six days and the water depth in wetland was no more than one meter. All the samples were analyzed for their particle size distributions using an AccuSizerTM780A particle analyzer.

Figure 1. View of constructed stormwater wetland investigated in this study

3. Results and discussion

Overall, the particles of inflow were coarser than those of outflow. This was mainly due to the resuspension of fine particles as well as algal growth; this observation was supported by the fact that particles number density was higher in the outflow than the inflow (Figure 2). In addition, settling of coarse particles and antecedent dry days (ADD) were also important factors. Normally, a shorter ADD results in a low settling and a strong resuspension. It is well known that fine particles (< 10 µm) are closely related to pollutants due to their high surface area, which accounted for more than 70% of all particles surface area in this study (Figure 3). Thus the treatment of stormwater wetland largely depends on how to control these fine particles and resuspension.

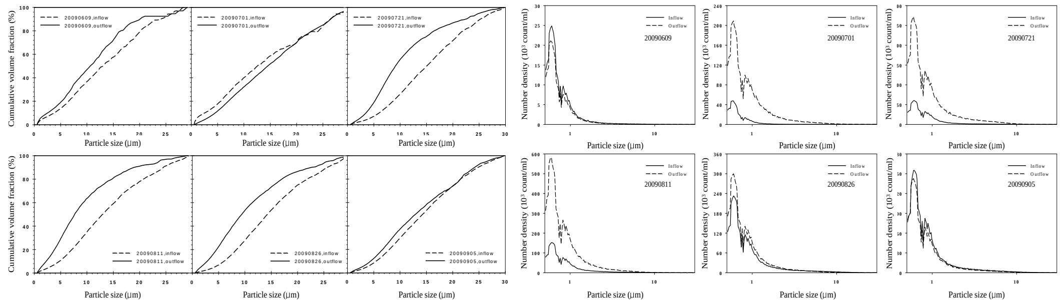

Figure 2. The particle size distribution of inflow and outflow.

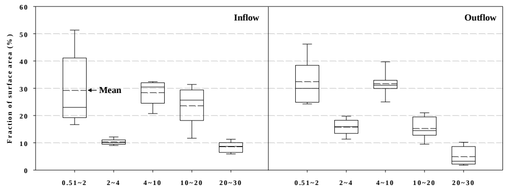

Figure 3. surface area fraction of particles in different size ranges.

In summary, there was a close correlation between the number density of particles in different size ranges and turbidity/TSS. Turbidity was more closely related to particles less than 10 μm, while TSS was more likely affected by particles coarser than 4 μm (r > 0.7). This difference indicates that different treatment mechanisms should be considered in the design of stormwater wetland for the removal of turbidity and TSS.

Parameter	Correlation Coefficient				
	0.51~2μm	2~4μm	4~10μm	10~20μm	20~30μm
Turbidity	0.819	0.921	0.905	0.649	0.407
TSS	0.585	0.691	0.787	0.873	0.722

Table 1. Correlations between the particle density in different size and turbidity/TSS

Conclusions

Particles were finer in outflow than inflow due to sedimentation of coarse particles and resuspension of fine particles as well as algal growth. Particles in different size ranges showed a different contribution to turbidity and TSS. Therefore, the success of stormwater wetland depends on how to control resuspension of highly pollutant-related fine particles and how to treat turbidity and TSS with proper design effort.

Acknowledgement

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References

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