

Designing rainwater drainage structure for pre-treatment of non-point source pollution

D.Y.L.W (Do you love water?)
Donghoon JANG, Yunsu KANG, Hyunwoo SONG
Republic of Korea

Introduction

We studied rainwater drainage structures, addressing **on-site pre-treatment of non-point source pollution**.

Four types of solutions were devised, and tested to verify the performance in the pollutant elimination and the drainage control.

Materials and Methods

We compared four types of models in terms of pollutant removal efficiency through a series of experiments.

- < Experimental Procedure >
STEP 1 : Inflow of water & pollutant mixture (soil 20%)
STEP 2 : Collect sediments
STEP 3 : Dry and measure the weight of sediments
STEP 4 : Analyze the results

Models

<Delta model>



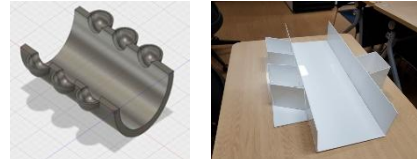
This model was inspired by a **river delta** where decreased flow speed brings about deposition.

<Gyre model>



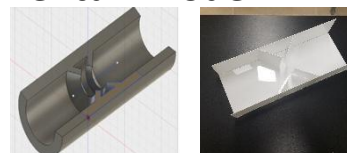
We can **control speed of flowing water** by changing slope to deposit pollutants.

<Vortex model>



Vortex is formed, so that pollutants are deposited **between side spaces**.

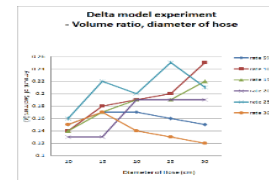
<Venturi model>



Vortex is formed at baffle, so that pollutants are deposited **between baffles**.

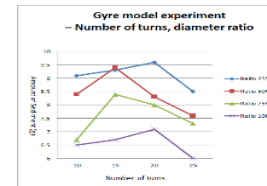
Results

<Delta model>



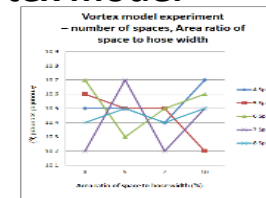
Hose diameter (D) ↑, sediment ↑. (when D < 20cm)

<Gyre model>



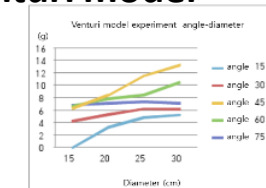
Diameter ratio (d/D) ↓, deposition ↑.

<Vortex model>



The amount of sediment fluctuated around approximately 10g.

<Venturi model>



Hose diameter ↑, sediment ↑.

Discussion

- The most efficient system turned out to be Venturi model. Vortex model showed similar efficiency to Venturi type.

- Venturi model had advantages in making a prototype. At the stage of mass-production, it will imply the cost reduction.

Conclusion

Pollutant removal efficiency:
Venturi (13.0g) > Vortex (10.7g) > Gyre > Delta

- The main cause of high pollutant deposition in Venturi and Vortex models was **swirl inside structures**.

- They can remove pollutants **without any external power** supply and can be applied to **various drainage** situations, such as bridges and slopes.

References

- [1] Guidelines for design and management of road drainage facilities_16-178Pg
- [2] Facility damage and repair reinforcement example collection_172-178Pg
- [3] Principle of CDI (capacitive deionization) (<https://m.blog.naver.com>)
- [4] 'Pipecare' Principle and method of piping washing(<http://pipecare.tistory.com>)