22. RESEARCH OF WATER QUALITY IMPROVEMENT BY FLOODPLAIN FILTRATION SYSTEM IN KOREA

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This thesis presents a case study to investigate the floodplain by filtration Korea, the floodplain was verified for filtration, filtration Nakdong River floodplain soils collected in Gimhae daedongmyeon sandbox experiments carried out by soil depth were identified according to the degree of water quality improvement . To assess the possibility of treating secondary effluents of municipal wastewater with floodplain soil, a computer code for the analysis of unsaturated flow in soil was employed along with searches conducted in the literature.Based on the data generated, an estimate of total floodplain filtration capacity in Korea was obtained. he results of our study reveal that Korean floodplains have surface soil that is adequate for treating water. Moreover, the distributions of floodplains are substantial over the entire reaches of the rivers, indicating that the conditions are favorable for floodplain filtration as additional treatment of secondary effluent.

Key Words : *Floodplain filtration,Rrecovery system, Sand-Box experiment, Head distribution*

1. INTRODUCTION

In the case of Korea, it has large regime coefficient and the broad floodplain formed near the river. Also many meter of alluvium layer has been developed. The process is aerobic condition by keeping the entire soil contaminants, high processing efficiency can be achieved through the operation, as well as it can solve the disadvantages of the aquifer treatment because through the operation of floodplain filtration system we can keep high recharge rate.

Divided into three parts floodplain filtration, the first is the supply system of floodplain in surface of soil, the second is the behavior of contaminants within the soil, and the third is a horizontal collector pipe at a certain depth of soil including recovery system, which is using the equipment. For the efficient floodplain filtration experimental data is needed to understand how to establish the proper design, operation and conditions meet in Korea. So for this research, a case study to investigate floodplain filtration system in Korea, the floodplain was verified, the Nakdong River floodplain, Gimhae daedongmyeon in Korea sand filtration through the soil sampling depth on soil tests performed to determine the degree of water quality improvement were.

2. CASE OF FLOODPLAIN FILTRATION SYSTEM IN KOREA

Chung(2003) had laboratory experiments inclufing the column filled with soil and unsaturated flow of polluted river water passed through and he has reported the soil layer about 50cm in the passing flow rate of organic contaminants have been removed in accordance with a well- significantly higher denitrification. Chung installed in such a column similar to outdoor experiments in the case of vegetation indicators of organic pollutants and nitrogen removal efficiency was more

higher. Kim has reported through the pilot-scale experiment of outdoor column the water quality of secondary treatmented sewage can be g reatly improved in 40cm soil layer.

In Choi and Kim (2008, no papers arc) suggested floodplain filrtration to obtain clean water from contaminated river water through soil fileration with using the characters in Korea that are larger floodplain and soil permeability. (**Fig.1** typical schematization of floodplain filtration system)

3. EXPERIMENTAL APPARATUS

(1) Experimental Method

The soil taken from downstream of Kim- hae Daedongmyeon were filled with soil immediately after the test in tank No.2 and tank No.3 10 days trial like water supply, open the lid to stabilize the soil was caused by soil subsidence is 5 – 15 cm depth of soil on the surface of the test tank was supplemented. After stabilization of soil saturated hydraulic conductivity was measured. To measure the saturated hydraulic conductivity test in first tank No.1 to fill tank without draining at the bottom of the tank and make the bottom of head equal to the surface of water. Thereafter the continued flooding the soil surface, soil surface while maintaining constant the level of the filtered water is discharged by opening drain part was one hour and the level of the soil surface from the bottom of the test tank with the water head difference between the flow rate and the law of Darcy by substituting the determined. A head of the tank bottom in both converged to a constant value was within 10 minutes, in the case of the another one waited longer there are no more bubbles and not mixed in order to check that was completely removed.

In order to make the raw water tank flood surface of discharge of sewage (secondary treatment) were fed intermittently, soil surface is about 3 ~ 5 cm depth to maintain the water level sensor in conjunction with a device that was attached to the pump. The timer is attached to the pump to control the flood time and stop time , and installed the flow meter to measure water flowing into the pump outlet. According to the study of Kim and Kim test tank (2009), to obtain the largest infiltration rate we applied 30 minutes/15 minutes of the flood/drying and from the tank outlet to measure the water quality we connected 8 mm of diameter and 1mm of thick vinyl tube. (Schematic diagram of the apparatus used in the experiment is shown in **Fig.2** The changes of infilrtration rate in Kim-hae is shown in **Fig.3** and water quality datas of wastewater treatment plant used in experiment in Gyeung-san Nam-cheon are shown in **Table 1**.)

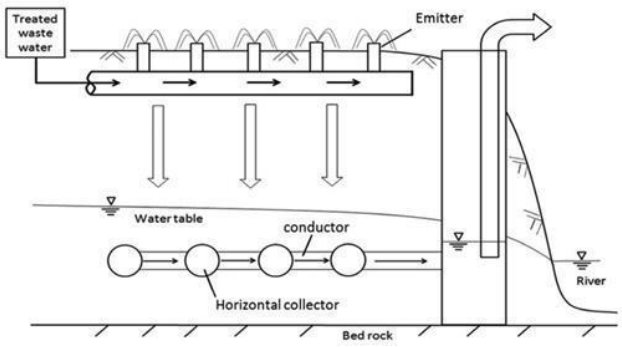

Fig.1 Schematization of floodplain filtration

Table 1 Water quality datas of wastewater treatment plant in Gyeung-san Nam-cheon

	Temperature (℃)	pH	BOD_5 mg/l	CODcr mg/l	T-N mg/l	T-P mg/l	Turbidity (NTU)
Range	11.4~19.8	6.5 ~ 7.1	0.6 ~ 5.8	11.5 ~ 26.3	12.0 ~ 20.7	0.4 ~ 3.4	0.5 ~ 4.2

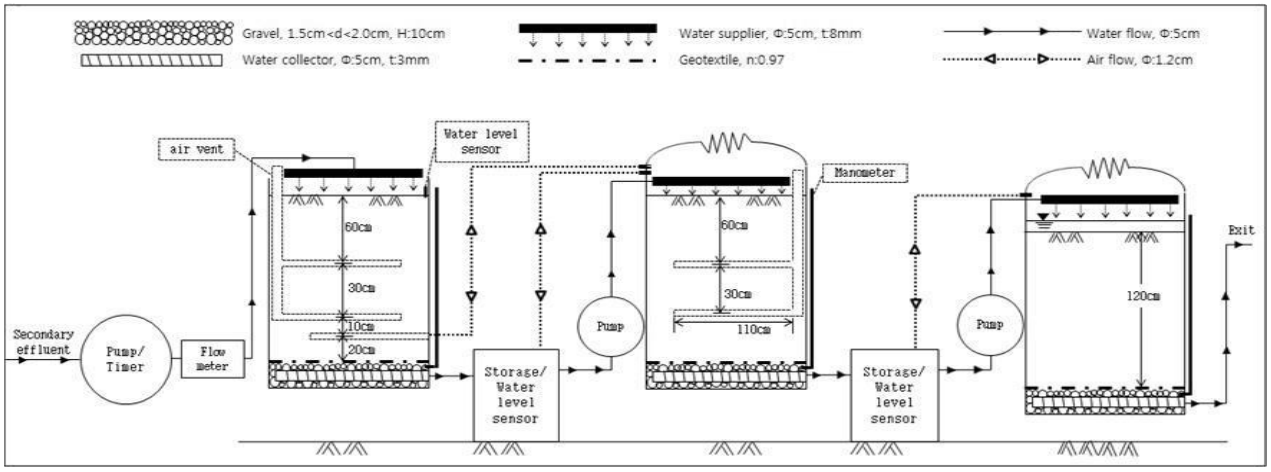

Fig.2 Schematization of experimental apparatus

4. THE RESULT OF EXPERIMENT

(1) Penetration rate of change

a) Permeability compared to the initial infiltration rate is approximately 1/4.(**Fig.3** The changes of infiltration rate in Kim-hae)

b) After drying the foils sludge cake are formed to soil surface, there is 5mm hardened layer is formed in other area.

c) After removal of the foils and hardened layer, infiltration rate was recovered. (A surface blockage make infiltration rate reduced than internal blockage. And it does not recover to 100% recharge rate because the internal blockage.

d) The sample was collected from the start of operation at 1, 5, 15 day where the infiltration rate is respectively 8.1 m/day, 2.4 m/day, 1.7 m/day. (The infiltration rate is not significant effect on the removal rate)

(2) Discussion

BOD was mostly removed from the initial 1.2 m. The concentration of NO3-N is slightly higher than in different soils, but the overall nitrogen curve is similar to that in other soil types.. However most of the phosphorus was removed in initial 1.2 m point and at the 3.6 m point removal rate is almost 100%.(**Fig.4** Changes in the depth of the filtration of water quality indicator). The turbidity gradually stabilized as the operation continues. After drying the sludge cake to the soil surface only a portion of the foils are formed, the foils was not formed at the surface area about 5mm deep and hardening phenomenon is exhibited.

phosphorus almost completely.

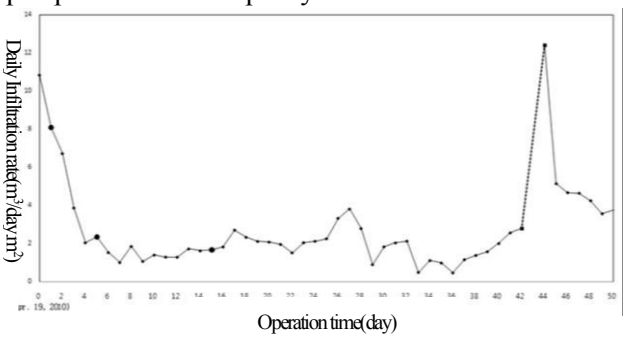

Fig.3 The changes of infiltration rate in Kim-hae

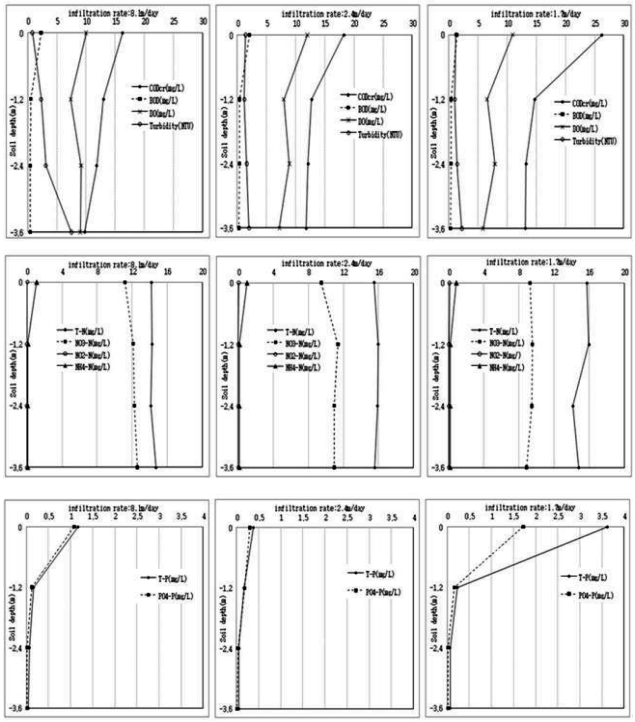

Fig.4 Changes in the depth of the filtration of water quality indicators

5. CONCLUSION

1) Depending on continuing the experiment, the infiltration rate decreased exponentially because of blockage on the surface. But the decreasing rate didn't increase by more than 20 % of initial infiltration rate.

2) Operation cycle was about 2 weeks in cold weather, in the rest of period was more than 3 weeks. In the case of soil in Gim-hae a stable infiltration rate is 1m/day.

3) The contamination depending on the distance of filtration hasn't big relation with infiltration rate.

4) COD removal rate was around 30-35 % , if the filtration distance is increased, it can expect to obtain a higher removal rate.

5) The soil taken in Gim-hae has high phosphorus removal rate. If it has sufficient distance, it can expect to remove

REFERENCE

1) Kim, S-H., Chung, J-B., Jeong, B-R., Lee, Y-D., and Prasher, Shiv O., "Electron Affinity Coefficients of Nitrogen Oxides and Biodegradation Kinetics in Denitrification of Contaminated Stream Water," J. Environmental Quality, 32, pp. 1474-1480, 2003.

2) Simunek, J., Sejna, M., Saito, H., Sakai, M. and van Genuchten, M.Th., "The HYDRUS-1D Software Package for Simulating the One-Dimensional Movement of Water, Heat and Multiple Solutes in Variably Saturated Media," Department of Environmental Sciences, University of California at Riverside, California, U.S.A., 2008.

3) Kim,S-H, "Compairson of Riverbank and Riverbed Filtration in Korea"Journal of Environmental Engineering ,29,pp.1154-1162,2007

4) Linsley, R.K., and Franzini, J.B., "Water-Resources Engineering," 3rd ed., McGraw-Hill, Singapore, 1979

5) Chung, J-B., Kim, S-H., Jeong, B-R., and Lee, Y-D., "Removal of organic matter and nitrogen from river water in a model floodplain filtration,"J. Environmental Quality, 33, pp. 1017-1023, 2004.

6) Chung, J-B., Kim, S-H., Jeong, B-R., Lee, Y-D., and Prasher, Shiv O., "Modeling Floodplain Filtraiton for the Improvement of River Water Quality," Transport in Porous Media, 60, pp. 319-337, 2005.