Conference Paper

An Approach to Conductivity Hydraulic Value for Known Soil Types as Pre Eliminate for Water Pre Treatment

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Abstract

Water treatment in Indonesia still used coagulant to reduce contaminant. So that, needing pre-treatment before conventional water treatment, use infiltration gallery. Infiltration gallery is the one of natural technology for absorbing or filtration contaminant. The main role in filtration of contaminate in soil is conductivity hydraulic. There are many kind of soil type with different conductivity hydraulic. In infiltration gallery method we need to know conductivity hydraulic value as preliminary analysis. Because its ability is make movement water from one side to other side, while filtrate the contaminant. Slower conductivity, it is mean that the quality water will be good. The methods used is constant head each *permeameter*. The result we get, was soil type in same type have different conductivity hydraulic.

Keywords: conductivity hydraulic, soil, water treatment

INTRODUCTION

Infiltration gallery is one of the technology for processing water by natural soil mechanism processing. This tools consists of perforated pipe that is covered by the gravel for collecting from water infiltration resulting (Barbiero et al., 2008; Jurel *et al.*, 2013; Bekele *et al.*, 2013; Jones, 2008). Water processing mechanism that occurs in the soil are adsorption, filtration, degradation and recovery, or they so-called purification (Bekele *et al.*, 2013). Infiltration gallery is able to remove physical and chemical parameters. Infiltration gallery abble to reduce 68%, nitric and phosphate respectively 28% and 28.5%. (Asare & Bosque-Hamilton, 2003). Filtering process in the soil depend on porosity, water velocity, pore size distribution, pore of its homogeneity, adsorption, filtration and sedimentation, as well as the movement of bacteria in soil. In principle, infiltration gallery and riverbank the same as slow sand filter. Both water treatment is affected by raw water quality, filtration rate, media, and soil type (Henzler *et al.*, 2014; Hoffman & Gunkel, 2011; Jones, 2008; Bekele *et al.*, 2013). The difference is that on the SSF the media used has been determined (homogeneous), for infiltration gallery and river bank using soil around the heterogeneous river the particle size distribution. Therefore, soil that is passed by water using infiltration gallery has a heterogeneous structure. Previous research indicates about the ability of the soil absorbs the pollutants and their applications (Barbiero *et al.*, 2008; Jones, 2008; Dalai & Ramakarjha, 2014). Modeling has been done before, among others, the model of pollutant distribution caused by infiltration from the river bank in Berlin, Germany (Henzler, 2014). Physical modeling with two types of infiltration gallery with gravel media and atlantic leach system to determine hydraulic speed (Bekele *et al.*, 2013). Atlantis leach system is a filtration

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system using a thick modular polypropylene material. Filtration modeling purpose to determine the penetration power of water to the soil containing bentonite slurry (Yoon & Mochtar, 2015). Given that, then the selection of these factors can be used as a starting point for system engineering to get the best performance behavior pattern of infiltration gallery. This approach looks at system performance behavior patterns to get quality TSS and total coli close to zero so that IPAM can save coagulant. This method analyzes behavioral patterns of infiltration gallery with approach using dynamic system. Factors affecting the performance of infiltration gallery are the distribution of soil particle, specific gravity, porosity, degree of saturation, hydraulic conductivity and soil type.

METHODS

The tool used 60 cm shelby tube. This tool help researcher to taken undisturbed soil. Undisturbed soil was needed for got soil without disturbed the natural structure, because we want to know its ability to flow water or called permeable. Soil sampling located in Surabaya, Sidoarjo, Lumajang, Mojokerto, Bangkalan, and Gresik. The next research we conduct to do constant head *Permeameter* ASTM D 2434-68 SNI 03 - 6871 2002 (figure 1).

Figure 1. Soil Sampling

Table 1. Conductivity Hydraulic in many Soil Sample

Soil sample	Conductivity hidraulic	Soil type	Source
Lumajang	0,001767599 (cm/s)	sand clay loamy	Analysis
Mojokerto	0,000291684 (cm/s)	sand clay loamy	
Madura	0,000087 (cm/s)	clay	
Sidoarjo	0,000165626 (cm/s)	sand loamy	
Gresik	0,000342206 (cm/s)	clay	
Surabaya	0,000177234 (cm/s)	sand loamy	
	1 -5 m/day	fine sand	Hofkes & Visscher (1986)
	20 – 100 m/day	coarse sand	

100 – 1000 m/day	gravel	
50- 100 m/day	gravel mix sand	
0,1 – 1,0 m/day	sand rocky	
0,01 -0,05 m/day	clay	
0 - 30 m/day	rock	
5,18 x 10^{-7} cm/s		
4,34 x 10^{-7} cm/s	clay	Yoon & Mohtar (2015)
1,38 x 10^{-4} cm/s		
6 x 10^{-3} cm/s	sand	
1,4 x 10^{-3}cm/s	silt	Bughici & Wallach (2016)
1,1 x 10^{-3}cm/s	clay	
2,544 cm/hari - 2,617 cm/hari	sand	Wang *et al.* (2015)
2,275 cm/hari - 2,374 cm/har	sand loamy	

RESULT AND DISCUSSION

Conductivity hydraulic related with porosity, we can conclude Madura has lower conductivity, because any clay or loamy inside the soil content. It will make low flowing water. At sand and clay infiltrate rate respectively in 5cm/hour and 0,05 cm/hour (Dalai & Ramakarjha, 2014). Contaminant transport depend on distance and conductivity hydraulic, biological process and physiochemical process (Mustafa *et al.*, 2016; Nham *et al.*, 2015). Conductivity in each site or region is different (Shwetha & Varija, 2015) that why research taken 6 soil sample in 6 site. Permeability is ability of water through the porous media. Soil mechanism have process they are physic and biology (Kedziorek & Bourg, 2009).

Table 1 shown many different conductivity that we got from research. In lower conductivity we can get good water quality but less quantity. This method used to preliminary analysis on applied infiltration gallery. Figure 2 shown the illustrated of infiltration gallery process. Infiltration gallery is one of the technology in processing water naturally in the soil. This tool consists of perforated pipe covered by gravel that serves as a container and infiltration water filter (Jurel et al., 2013; Jones, 2008). Water treatment mechanisms that occur in the soil are adsorption, filtration, degradation and recovery, or so-called purification. There is a picture showing that the gallery (perforated pipe/gallery) installed under the river (river bed) with a depth of 6 meters and with a length of 50 meters. The river water is infiltrated through the soil, then it is collected in a hollow pipe. Water from the pipe gallery comes into the pre-filter containing the sand and then into the fine sand filter as a post filter. The results of treated water into the collecting wells are then pumped for the consumption of surrounding communities.

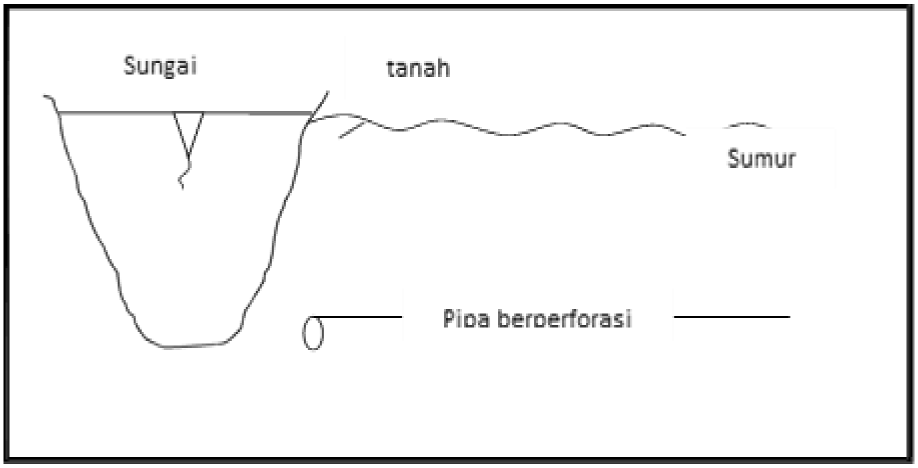

Figure 2. Infiltration Gallery

CONCLUSION

Researcher found that same soil type have different conductivity, so before we applied infiltration gallery we have to know conductivity hydraulic in that site. Infiltration gallery can produce good water quality if can get lower conductivity.

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REFERENCES

Asare, E. B. & Bosque-Hamilton, E. K. (2004). The performance of an infiltration gallery used as a simple water treatment option for a small rural community – Goviefe-Agodome in the Volta Region, Ghana. *Water SA, 30(2)*, 283-286.

Barbiero, L., Rezende-Filho, A., Furquim, S. A. C., Furian, S., Sakamoto, A. Y., Valles, V., Graham, R. C., Fort, M., Ferreira, R. P. D., Queiroz-Neto, J. P. (2008). Soil morphological control on saline and freshwater lake hydrogeochemical in the Pantanal of Nhecolandia, Brazil. *Geoderma, 148(1)*, 91-106.

Bekele, E., Toze, S., Patterson, B., Fegg, W., Shackleton, M., Higginson, S. (2013). *Journal of Environmental Management, 117*, 115-20.

Bugichi, T., Wallach, R. (2016). Formation of soil-water repellency in olive orchards and its influence on infiltration patterns. *Geoderma, 262*, 1-11.

Dalai, C., Ramakarjha. (2014). A preliminary experimental analysis of infiltration capacity through disturbed river bank soil sample. *International Journal of Engineering Research and Applications (IJERA)*, ISSN: 2248-9622.

Henzler, A. F., Greskowiak, J., Massman, G. (2014). Modellling the fate of organic micropollutant during river bank filtration (Berlin, Germany). *Journal of Cotaminant Hidrology, 156*, 78-92.

Hoffman, A. & Gunkel, G. (2011). Bank filtration in the sandy littoral zone of Lake Tegel (Berlin): Stucture and dynamics of the biological active filter zone and clogging processes. *Limnologica – Ecology and Management of Inland Waters, 41(1)*, 10-19.

Hofkes, E. H. & Visscher, J. T. (1986). *Renewable energy sources for rural water supply*. Hague: International Reference Centre for Community Water Supply and Sanitation.

Jones, A. T. (2008) Can we reposition the preferred geological conditions necessary for an infiltration gallery? The development of a synthetic infiltration gallery. *Desalination, 221(1-3)*, 598-601.

Jurel, E. R. S., Singh, E. R. B., Jurel, S. K., Singh, R. D. (2013). Infiltration galleries: A solution to drinking water supply for urban areas near rivers. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), 5(3)*, 29-33.

Kedziorek, M. A. M. & Bourg, A. C. M. (2009). Electron trapping capacity of dissolved oxygen and nitrate to evaluate Mn and Fe reduction dissolution in alluvial aquifers during riverbank filtration. *Journal of Hydrology, 365(1)*, 74-78.

Mustafa, S., Bahar, A., Aziz, Z. A., Suratman, S. (2016). Modelling contaminant transport for pumping well. *Journal of Environmental Management, 165*, 159-166.

Nham, H. T. T., Greskowiak, J., Nodler, K., Rahman, M. A., Spachos, T., Rusteberg, B., Massman, G., Sauter, M., Licha, T. (2015). Modeling the transport behavior of 16 emerging organic contaminants during soil aquifer treatment. *Science of the Total Environment, 514*, 450-458.

Shwetha, P. & Varija, K. (2015). Soil water retention curve from saturated hydraulic conductivity for sandy loam and loamy sand textured soils. *Aquatic Procedia, 4*, 1142-1149.

Yoon, J. & El Mohtar, C. S. (2015). A filtration model for evaluating maximum penetration distance of bentonite grout through granular soils. *Computers and Geotechnics, 65*, 291-301.