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SCENARIOS MODIFICATION OF HYDRAULIC CONDUCTIVITY TO TIME PERIOD OF CLOGGING IN INFILTRATION GALLERY

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ABSTRACT

Clean Water availability is a serious problem in Indonesia. A lot of water has been treated by coagulation and flocculation process. It might be the rate of high water rates and not all citizen can being it. So researcher tried to analyze how to make pre treatment to reduce contaminant, such as TSS, used soil purification method so could reduce coagulant, TSS and total coli close to drinking water standards. The technology of soil purification method is Infiltration gallery. Infiltration gallery is method that replicate soil mechanism absorption or filtration in daily process. This research tried to find the optimal soil composition used as an approach to dynamic system modelling. System dynamic modelling was used to input all of variable that influence soil filtration procces such as weather, conductivity hydraulic, TSS influent, percentage soil removal to TSS, capacity water, evaporation and catchment area. All variables could be changed until got TSS close to zero. It could be one of policy to the government to making decision in reducing production cost, if used infiltration gallery as pre treatment in IPAM and could save coagulant consumption the result is sand loamy could reduce 63.50% of TSS with conductivity 0.000217 and sand loamy have composition 85% sand and 15% clay.

KEY WORDS *:* TSS, Infiltrattion gallery, Dynamic system modelling.

INTRODUCTION

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 and Gunkel, 2011; Jones, 2008; Paterson, 2011; 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). 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 atlantis leach system to determine hydraulic speed (Bekele *et al*., 2013). *Atlantis leach system is a filtration system using a thick modular polypropylene material.* Filtration modeling purpose to determine the penetration power of water to the soil containing bentonite slurry (Yoon and Mochtar, 2015). Modeling water for disaster prone areas by using maximum ground water. 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 water treatment 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. However, to gain clean water close to drinking water standart with cheap and high quality, we have to add pretreament using infiltration gallery, with modification in the soil composition.

METHODS

This study emphasizes the behavioral pattern of infiltration gallery system obtained from the real of TSS absorption and total coli by soil in a model. This model contains some related entities in the reduction of TSS and total coli. For example, in Figure 1 illustrated that TSS increases then the total number of coli increases. TSS is influenced by porosity, permeability and composition between clay and sand. If porosity and permeability are big then the value of TSS is also big, but if the percentage of clay is higher then TSS will be small because there is filtration process. A soil type has a sand, silt and clay component. If the amount of sand is high then the quantity of clay is low and vice versa. The ratio of clay and sand affect the size of the particle of soil. If the particle soil has a large size then the TSS becomes high because there is no effective screening process. Water content affects the porosity of the soil easily passed by water. The filtration rate is also affected by the permeability. If the permeability value is high, then the filtration rate is fast, so the TSS removal is reduced.

RESULTS AND DISCUSSION

Scenario Simulation Results in 0.03 cm/s

Based on the following scenario it can be concluded that the filter media with a hydraulic conductivity value of 0.03 cm / s has the ability to reduce TSS and total coli by an average of 72.79% and 85%. The simulation results can be seen in Table 1.

Table 1 above shows that the type of sand with a diameter of 0.63-0.2 mm with a hydraulic conductivity of 0.0003 m/s produces a water capacity of 10.41 m^3 with an area of 200 m^2 for seven days of operation. TSS filtration ability is able to reach zero on the first day and rise the next day in a row by 68.5 mg/L, 90 mg/L, 128.9 mg/L, 427.8 mg/L and 566.6 mg/L, therefor it can be recommended to use pre-screening to increase the decrease in TSS and total coli. The total coli filtration yield reached zero on days 1 to 2 and further increased by

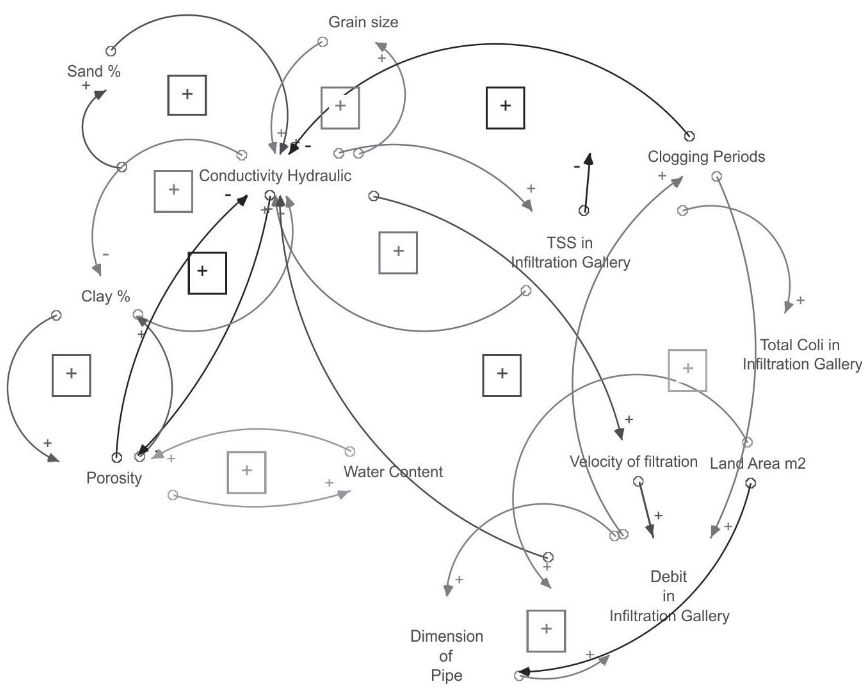

Fig. 1. Illustration of linkage corelation between influencing variables in TSS reduction in infiltration gallery system

Table 1. Scenario Simulation Results in 0.03 cm/s

Day	River flow (m^3)	Infiltration Gallery flow (m^3)	TSS in River (mg/L)	TSS in Infiltration Gallery (mg/L)	Total coli in River (MPN/mL)	Total *coli* in Infiltration Gallery (MPN/100 mL)
0	1.56	0,00	0.0	0.0	0.00	0.00
1	1.56	1.17	189.0	0.0	7,200,000.00	0.00
2	1.56	2.64	326.0	68.5	9,960,000.00	0.00
3	1.56	4.17	381.7	90.0	3,840,000.00	1,127,911.10
4	1.56	5.73	183.6	128.9	1,440,000.00	3,639,407.10
5	1.56	7.29	96.0	427.8	900,000.00	6,359,019.00
6	1.56	8.85	92.0	496.1	414,000.00	8,878,174.20
7	1.56	10.41	186.5	566.6	87,000.00	11,143,681.70

Table 2. Scenario Simulation Results in 0.0000176 cm/s

Hari	Debit in river (m^3)	Debit in Infiltration Gallery (m^3)	TSS In River (mg/L)	TSS in Infiltration Gallery (mg/L)	Total coli di River (MPN/mL)	Total coli in Infiltration Gallery (MPN/100 mL)
0	1.5	0.00	0.00	0.0	0.00	0.00
1	1.5	0.00	189.00	0.0	7,200,000.00	0.00
2	1.5	1.13	326.00	0.0	9,960,000.00	0.00
3	1.5	2.53	381.70	62.1	3,840,000.00	2,399,200.00
4	1.5	4.01	183.60	210.9	1,440,000.00	7,317,826.60
5	1.5	5.50	96.00	436.2	900,000.00	11,877,030.80
6	1.5	7.00	92.00	647.8	414,000.00	15,396,846.90
7	1.5	8.50	186.50	821.4	87,000.00	18,043,682.00

1,127,911.10 MPN/100 mL; 3,639,407.10 MPN/100 mL; 6,359,019.00 MPN/100 mL; 8,878,174.20 MPN/100 mL; 11,143,681.70 MPN/100 mL.

Scenario Simulation Results in 0.0000176 cm/s

This scenario contains data that the filter media with a hydraulic conductivity value of 0.0000176 cm / s has the average ability to reduce TSS and total coli by 60.00% and 66.67%. Simulation results can be seen in Table 2.

Table 2 above shows that the filter media with hydraulic conductivity of 0.0000176 cm / s with the composition of clay (35%) and sand (65%) produces a water capacity of 8.5 m^3 with a land area of 200 m^2 for seven days of operation. TSS filtration ability reaches zero on the first day to the second day. That number increased on the following day in a row by 62.1 mg / L, 210.9 mg / L, 436.2 mg / L, 647.8 mg / L and 821.4 mg / L. The total number of coli became zero on days 1 and 2, then increased by 2,399,200.00 MPN / 100mL; 7,317,826.60 MPN / 100mL; 11,877,030.80 MPN / 100mL; 15,396,846.90 MPN / 100mL; and 18,043,682.00 MPN / 100mL. Thus, it can be recommended the use of pre-screening to increase the occurrence of a decrease in TSS and total coli.

CONCLUSION

It could be one of policy to the goverment to making decision in reducing production cost, if used infiltration gallery as pre tretment in IPAM and could save coagulant consumption. The result is soil composition with 85% sand and 15% clay could reduce 63.50% of TSS and total coli 99.67%.

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