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RESEARCH ARTICLE

TRIPIKON MODIFICATION AS AN INFILTRATION DITCH OF DOMESTIC WASTE AT NARROW FIELD

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ABSTRACT

Tripikon is a pipe usage model as a means of modified infiltration ditch as an effort of water pollution minimization. The purpose of this research was to analyze the decrease of Biological Oxygen Demand (BOD) and Most Probable Number (MPN) Coliform level of domestic waste in tripikon infiltration ditch at narrow field. This research was an experimental research with a group of pre and posttest design. The result of this research was it indicated a decrease of BOD level in tripikon, thus, it was in accordance with Minister of Environment and Forestry Regulation Number 68 in 2016 concerning with domestic waste quality standards, which the maximum was 30 mg/ L. Likewise MPN Coliform level in infiltration ditch was still below the maximum level of waste water (3000 per 100 ml). The decrease of BOD level was 36.8%.

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INTRODUCTION

Septic tank and infiltration ditch were a series of fecal waste management processes which were essential to keep environment from pollution. Environmental pollution, especially on groundwater due to septic tank infiltration could be prevented by giving a minimum distance between septic tank infiltration and clean water source of 10 m, thus, it was needed a large area to achieve the distance as it was required. This condition was in contrast with land ownership in urban areas that most of them had narrow land. New innovation of fecal effluent infiltration from septic tank based on the other research who stated that minimizing the area of infiltration land to be 2.5 m2 by using bending method could reduce E. coli level as well as an infiltration ditch with horizontal distance of 10 m from groundwater sources (Marlik et all, 2018). This brought up an idea to re-innovate and modify the bending infiltration ditch by using tripikon method. Tripikon was an alternative domestic waste processing equipment which was originally a Tripikon-S type (Tri=Tiga (Three), Pi=Pipa (Pipe), Kon= Konsentris (Concentric), S= Septik (Septic)) which was developed at Civil Engineering Laboratory of Gajah Mada University Yogyakarta to answer challenges of environmental issues of tidal affected areas in coastal areas, estuaries, rivers and swamps (Malamassam et all, 2011). The use of tripikon model on septic tank infiltration land was expected to reduce land use as infiltration land in urban areas. Biological Oxygen Demand (BOD) and total coliform were parameters to measure the quality of domestic waste. Regulation of Ministry of Environment and Forestry Number 68 in 2016 concerning with domestic liquid waste quality standards explained the maximum level of BOD was 30 mg/ l, while, total coliform was 3000/100 ml of waste with 100 liters/ person/ day of waste discharge. Modification of infiltration ditch was done because Tripikon was initially used as a septic tank media. However, because the results of Tripikon had not been effective enough in reducing BOD and coliform parameters (Noor, 2011), modifications were made by converting Tripikon model into an infiltration ditch to filter fecal waste of septic tank. Moreover, the purpose of this study was to analyze the decrease of BOD and Coliform level in modified Tripikon infiltration ditch of domestic waste in urban area.

MATERIALS AND METHODS

This research was an experimental research with one group of pre and posttest design because it aimed to know the decrease of BOD and Coliform levels in modified Tripikon infiltration design of urban area rather than the research results by using Tripikon as a septic tank.

Tool installation procedure

- Perforating the end of the pipe 1.5; 4; 6 inches (3 meters)
- Filling the pipe with silica sand
- Connecting the pipe from septic tank with a sequence of 1.5 inch infiltration pipes inside the 4 inch pipe and the 4 inch pipe inside 6 inch pipe.
- Connecting the infiltration pipe to the septic tank
- The level of BOD and coliform at tripikon infiltration ditch were tested by using statistical methods, namely Annova and presented in the form of graphic and tables.

RESULTS

The procedure carried out to assemble infiltration equipment that was began by preparing 3 types of pipes with different diameters, those were 1.5, 4, and 6 inches with 3 meters long. 1.5 and 4 inch pipes were perforated as waste water outlet. The next step was to assemble 1.5 inch pipe inside 4 inch pipe, 4 inch pipe inside 6 inch pipe. At the end of the 6 inch pipe, it was given water tap as waste water outlet.

The next step was filling the pipes with sand. In this research, the sand that was used was silica sand with diameter of 5 meshes. Two sets of infiltration pipes that had been filled by sand were then, placed around the septic tank. Waste water from septic tanks was flowed through pipes by using a pump. BOD and MPN Coliform samples were taken for 5 consecutive days in septic tank and infiltration pipe outlets. BOD parameters were taken from septic tank and infiltration pipe outlet as much as 1,500 ml. While, the MPN Coliform parameters were taken in the septic tank and infiltration pipe outlet as much as 100 ml with 3 replications.

BOD and MPN Coliform Level in Septic Tank: The measurement result of BOD and MPN Coliform level in septic tank before entering tripikon infiltration pipe could be explained in the following table:

BOD and MPN Coliform Level in Tripikon Infiltration Outlet

The result of BOD in tripikon infiltration outlet could be seen in figure 2 below: If BOD level decrease was compared with Ministry of Environment and Forestry Regulation No. 68 of 2016 concerning with domestic waste quality standards, BOD level in tripikon infiltration outlet had qualified the qualification that was permitted (maximum in of 30 mg/ L).

Decrease of BOD and MPN Coliform Level in Tripikon Infiltration Outlet: Decrease of BOD and MPN Coliform level in tripikon infiltration outlet could be explained as followed: Based on the calculation above, the efficiency of decrease of BOD level by using tripikon infiltration ditch with silica sand in diameter of 5 meshes was 36.8%.

$$Eficiency = \frac{Before - after}{Before} \; x \; 100\%$$
$$= \frac{38 - 34}{38} \; x \; 100\%$$

DISCUSSION

Table 1 explained that BOD level that was measured in septic tank outlet (30 mg/L) qualified maximum level that was permitted for domestic waste itself for activities of flats, inn, dormitories, health services, educational institutions, offices, commerce, markets, restaurants, halls, recreational areas, settlements, industries, regional Waste Water Treatment Plant (WWTP), residential WWTP, urban WWTP, harbors, airports, railway stations, terminals and social institution which were in accordance with Minister of Environment and Forestry Regulation Number 68 in 2016. This was appropriate with the location of sample collection for BOD and MPN Coliform, which were in educational institutions. The measurement result of MPN Coliform that was taken from septic tank were 1,600 per 100 ml of waste water. Table 2 explained that MPN Coliform level in septic tank was still below the maximum permissible level by Minister of Environment and Forestry Regulation Number 68 in 2016 (3,000 per 100 ml).

Based on table 2, it could be explained that MPN Coliform of liquid waste in tripikon infiltration outlet was not changed from day 1 to day 5. According to Minister of Environment and Forestry Regulation Number 68 in 2016 concerning with domestic waste quality standards, the MPN Coliform that was measured in tripikon infiltration outlet was still consistent with the maximum permissible level of MPN Coliform (3000 per 100 ml). The decrease of BOD level was caused by degradation of some organic substances which previously were not decomposed in anaerobic process into new cells which were suspended and separated by precipitation (PH Doraja, 2012). The use of sand as a filtration media in septic tank infiltration ditch could reduce BOD level, total coliform and other parameters. This was in accordance with conducted research which could reduce BOD level by 75%, 65% of Nitrogen, 73% of COD and 2Ulog of total bacteria (S Eturki, 2015). Silica sand that was also used in this research as a septic tank waste filtration media was proven in previous research able to significantly reduce BOD level was up to 72.72% (Pavithra S and Shanthakumar S, 2017).

The difference of BOD level for each sampling (sampling day) was occurred because of the different amount of waste water that entered into septic tank, thus, the liquid waste that flowed into infiltration ditch also changed its BOD level. This was in accordance with conducted research which showed that there was a significant difference in measured BOD levels in hospital every day because of activities which were up and down and were depended on the discharge of liquid waste that entered into waste tank (Kerubun, A Arsad, 2014).

The use of MPN Coliform parameter was conducted in order to determine the level of groundwater pollution. Bacteriological quality changes in this case were indicated by MPN Coliform content that could widen to ± 2 meters at a distance of 5 meters from the source of pollution and narrowed to 11 meters in line with the land flow (Marsono, 2009). Another conducted research on the effect of pollutant source distance on the quality of surrounding groundwater sources stated that the distance between pollutant sources and clean water sources which were less than 11 meters could increase the pollutant content in groundwater sources in South Lampung District (Aminah Siti, S Wahyudi, 2018). From that research, it could be explained that the conclusion of this research was indicating the content of measured MPN Coliform from septic tank that was still in safe condition based on Minister of Environment and Forestry Regulation Number 68 in 2016, which was expected that it would not decrease the prestige of public health which used clean water source in around septic tank.

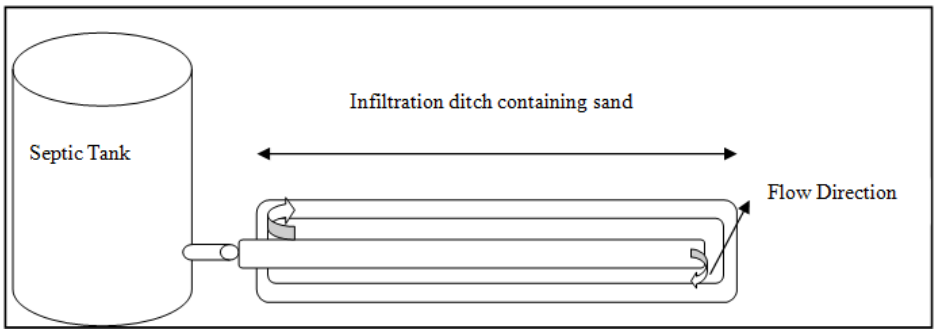

Fig. 1. Tripikon Infiltration Design

Fig. 2. Tripikon Infiltration Model

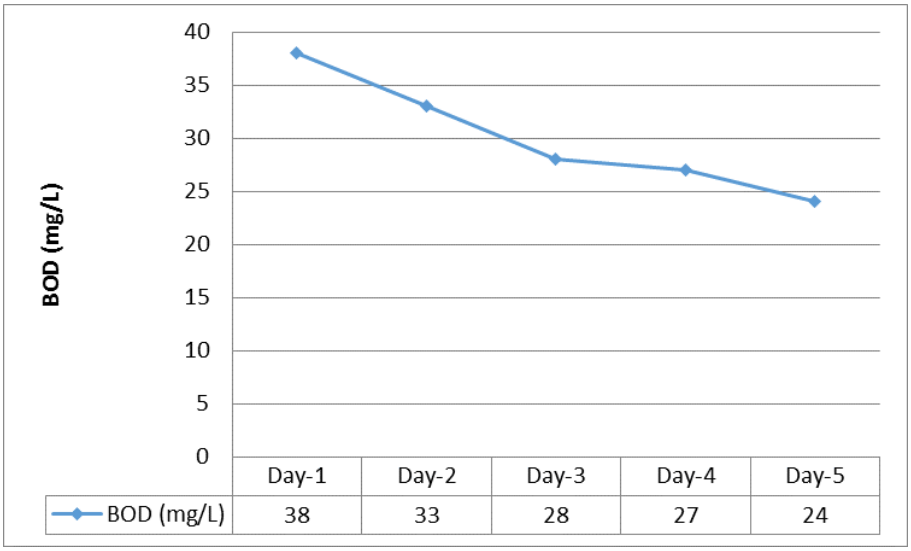

Fig. 3. BOD level decreased

The MPN Coliform in tripikon infiltration outlet was same as the former MPN Coliform before through the infiltration ditch which was 1,600 per 100 ml.

Table 1. Measurement Result of BOD and MPN Coliform in Septic Tank

Variables	**Results**
BOD	30 mg/L
MPN Coliform	1,600/ 100 ml

Table 2. Measurement Result of MPN Coliform in Tripikon Infiltration Outlet

MPN Coliform	Measurement Result (per 100 ml)
Day-1	1,600
Day-2	1,600
Day-3	1,600
Day-4	1,600
Day-5	1,600

This could be possible because the use of sand directly without being cleaned could affect the measured MPN Coliform level. The BOD level that was getting smaller showed that the organic compound in waste was also small because the oxygen that was needed was also less. Organic compounds would be converted into CO_2, H_2O, NH_4 and bacterial mass as energy sources. The smaller the decrease of BOD value in waste process, the smaller the degradation process was occurred (P. G. Smith, J. G. Scott, 2005). Good waste water management could improve human health and protect the environment from pollution. Many waste management system had been analyzed to improve the prestige of public health and one of them was through the use of piping infiltration model (Thakur V, e*t all,* 2015). The use of domestic wastewater management from septic tank in this case was the use of tripikon infiltration model in reducing BOD and MPN Coliform level.

Conclusion

Tripikon infiltration model with silica sand of 5-mesh could reduce BOD level of fecal waste in educational institution or office with decrease efficiency of 36.8%. While, the MPN Coliform level before and after the use of tripikon infiltration model was still in permissible level based on applicable regulations. The level of BOD and MPN coliforms after being through the tripikon infiltration ditch was in accordance with Minister of Environment and Forestry Regulation Number 68 in 2016 concerning with domestic waste quality standards, which maximum was 30 mg/ L and 1,600 total per 100 ml.

Recommendation

Tripikon infiltration model can be used at sub urban or urban area which the land is narrow. This can be used on emergency state after a natural disaster too. So this model can facilitate to waste water treatment on domestic waste for reduce an environment pollution.

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