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Faeces Waste Treatment Design in Household with Narrow Land Area

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ABSTRACT

Recently, the distance of wastewater infiltration from septic tank and clean water source is not suitable because developers build houses with narrow land area so that the house price is affordable. This research aimed at analyzing faeces waste treatment design in household with narrow land area, using experimental design. The variables were Coliform bacteria and turbidity of wastewater that passed the treatment design in the distance of 0, 5, 7, 9, 11, and 13 meters. The obtained data was analyzed using Anova. Domestic wastewater treatment design with narrow land area needed at least 3 m². It could reduce Coliform bacteria until 13 meters in 74 colony/100 ml, meanwhile, the turbidity in the distance of 0 meter was qualified into the determined requirement with the average of 19.49 NTU. It could reduce either Coliform bacteria or turbidity significantly in every distance and in the distance of 13 meters, the percentage of decrease was 88.42% for Coliform bacteria, meanwhile, 98.14% was for turbidity.

Keywords: *Septic tank, Coliform, Turbidity*

INTRODUCTION

Residence is one of primary human needs after food and clothing needs. That is why Decree of the State Minister of Agrarian Affairs, guaranteed the homeowner for Indonesian citizen in establishing the rights for the land where his / her residence is and this is assigned for either the residence with narrow land area or the residence with large land area.⁽¹⁾

The residence with narrow land area had a specialty and looked after by Indonesian government. Based on Regulation of Indonesian Minister of Finance, the requirement of simple residence and very simple residence is having exemption for value-added tax. In this case, the regulation of Indonesian Minister of Finance has criteria regarding what is meant by simple residence and very simple residence, where the building area did not exceed from 36 m², the selling price does

not exceed limit of selling price with a certainty that the limit of selling price is based on zone combination and year in accordance with what has been stated in Indonesian Minister ter's regulation where the area is not less than 60 m².⁽²⁾

However, residence needs are really correlated with population growth which is more dense and the development of technology is also more advanced, particularly in urban area, where the land price is more expensive, hence, many urban people only has narrow land for their residence. The requirement of healthy house is not acceptable in a big city. One of the problems is the placement of septic tank in narrow land. According to Decree of Indonesian Minister of Settlement and Regional Infrastructure, one of the requirements of healthy house is that it must have healthy lavatory, which the main characteristic of healthy lavatory is that it does not incur smell, it makes beautiful view, and it does not cause a danger against health caused by faeces.⁽³⁾

The faeces reservoir is a hole in the ground. The shape could be varied and its depth is depended on the condition of the ground. Moreover, twin double model (*cubluk kembar*) is the most model used by the people and its advantages could be used forever, it is suitable

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for all kinds of ground and high groundwater surface. However, its weakness is it needs larger land area. The faeces reservoir that is often used is septic tank shape because its advantages are cleaner, healthy, it does not cause pollution, it is not full too quickly, and it could be drained. Meanwhile, the weakness is it needs larger land area and it is more expensive.

Septic tank is a reservoir for wastewater and faeces. Some of people used conventional septic tank and the impact is the distance between the hole of infiltration reservoir and the groundwater is closer, which caused the pollution of groundwater. This pollution causes the several diseases such as diarrhea. Human faeces which contained Coliform bacteria could contaminate in 4-6 meters from the contamination source.⁽⁴⁾ Dug well construction also influenced the quality of microbiology in water.⁽⁵⁾ This is caused by the construction of dug well itself that does not qualify one of the improper requirements, which is the distance between dug well and septic tank is less than 10 meters and it is seen from septic tank construction and its infiltration really influences the content of Coliform bacteria.

The pollution of groundwater as the effect of disposed conventional septic tank could be prevented by the distance between septic tank infiltration and clean water source, hence, it needs large land so that it could reach the distance between clean water source and septic tank infiltration.

There has been a new innovation of disposed wastewater from septic tank with basic requirement that it does not pollute groundwater if it is minimal in 10 meters. Therefore, it is made a breakthrough in which it still implement basic principle that bacteria would be lost after passing or being in minimal 10 meters. Changing the bacteria which in the first time, bacteria ran horizontally in 10 meters, the researcher would change bacteria to run horizontally only in less than 2.5 m². Thus, it would minimize the size of land area for making lavatory and its wastewater treatment.

1 This research aimed at analyzing the design of feces waste treatment in household with narrow land area.

MATERIAL AND METHOD

The variables of this experimental were Coliform bacteria and turbidity of wastewater that passed the treatment design in the distance of 0, 5, 7, 9, 11, and 13

meters. The obtained data was processed, analyzed by using Anova.

FINDINGS

Feces waste treatment design in the household was made from PVC pipe with diameter of 4 Ø with length in 10 meters. PVC pipe was cut into 2 meters for 6 pieces and 1 piece was 1 meter. Connect the pipe as spiral shape and fill the pipe with quartz sand until full. The sand needed was around 200 kg. Length total of PVC pipe needed was 13 meters. Meanwhile, the land area needed in tooling of this wastewater treatment in household as the infiltration replacement by being planted to the ground and it needs area either horizontally or vertically in 3 m². Although the length of the pipe was 13 meters and due to being shaped in spiral, the land area needed by this design was not more than 3 m² horizontally. If it was planted vertically, it would be simpler in placing at home. This design of waste treatment was conditioned in almost similar with the running of bacteria in the ground in which the bacteria would pass the ground with porosity and ground pores depending on the condition of the ground in that area.



Figure 1. Design of Feces Waste Treatment

Design of feces waste treatment in household for narrow land area made by being not to change function from that infiltration itself is in the distance of 11 meters, the Coliform could die by itself. Moreover, this tool design was made as the replacement of infiltration. Only its design was changed into pipe shape with the length in more than 11 meters and was shaped in spiral. This design seems to be more practical although in its production process was quite difficult because it needs quartz sands that must be entered into the pipe that had the function as filter from bacteria and turbidity.

Table 1. Coliform bacteria and Turbidity

Distance (meter)	Coliform Bacteria (colony/100 ml)			Turbidity (NTU)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
0	620	660	641	18.76	20.09	19.49
5	510	540	524	12.56	16.40	14.84
7	460	480	467	7.34	9.67	8.81
9	320	360	337	3.72	5.26	4.71
11	110	150	124	1.28	1.74	1.47
13	70	80	74	0.24	0.52	0.36

Table 2. Reduction Coliform bacteria and Turbidity

Distance (meter)	Coliform Bacteria (%)	Turbidity (%)
	Average	Average
0-5	18.24	23.96
0-7	27.14	54.84
0-9	47.42	75.88
0-11	80.64	92.48
0-13	88.42	98.14

There was minimum one pair of average in reduction percentage either for Coliform bacteria or different turbidity, meanwhile LSD showed that there was a significant difference of reduction between Coliform bacteria and turbidity in domestic feces waste on the comparison of 0-5 with 0-7, 0-9, 0-11, 0-13 meters.

DISCUSSION

The result of examining Coliform bacteria and turbidity after passing simple infiltration design resulted significant data. The longer the distance, the Coliform bacteria and turbidity reduced are more and more. In the infiltration design, there is quartz sand that has the function as filter. The wastewater has high turbidity after passing sand media, then, the particle in it would be retained on the sand. Furthermore, this research is in accordance with the research conducted by Edwin, Satiyadi & Dewilda, who used andesite as a filter for well water that has very high total of Coliform in 1100 MPN/100 ml and turbidity in over 5 NTU.⁽⁶⁾ According

to Indonesian Government's Regulation, Number 82 2001 for class 1 of this well water is very improper for being used.⁽⁷⁾ After the well water is filtered by utilizing bio-sand, its result is bio-sand which is very effective to be used as filter.

In Indonesian Government's Regulation, water resource in this regulation is water container that is on or under the ground surface, which are aquifer, water springs, river, marsh, lake, and estuary.⁽⁷⁾ Everyone is forbidden to dispose either solid waste or gas waste into the water and water resource. Every Indonesian citizens must manage their domestic waste.⁽⁷⁾ Winarni & Puspitasari explained that the pollution of ground water in Yogyakarta is still high. One of the obstacles as to why this pollution is still high is that the citizens have not been aware and understood well how to care septic tank. Second, they did not conduct technical guidance stated in Standar Nasional Indonesia (Indonesian National Standard) 03-2398, (2002) and there is an infiltration system and septic tank constructing that did not qualify.⁽⁹⁾ The ground pollution may also occur based on the ground types in the area and the condition of quite dense population, thus, the construction of infiltration could not be conducted. The other conclusion is the lack of government's role in solving this groundwater pollution because there is no budget to solve this ground water. Besides, it is because there is no budget for chlorine diffuser and lack of control. Septic tank with infiltration system could not be done again recently. Moreover, it is undertaken in urban area that has dense population and narrow land area.⁽⁸⁾ There is a significant correlation between diarrhea and the lavatory owner.⁽¹⁰⁾ Factor of lavatory owner that must be appropriate with either regulation or law is really influenced by the factor of knowledge, education, economic status,

attitude, and role of health workers. Education level, knowledge, attitude, economic status, and the role of health workers that really supported someone to do good changes in attitude, behavior for having a healthy lavatory completed by septic tank and infiltration that has distance in accordance with the standard established and the water resource.⁽¹¹⁾⁽¹²⁾ If someone does not have any knowledge, this would not be realized. Lavatory constructing completed by septic tank and infiltration based on standard, is actually really correlated with economic status. Design of feces waste treatment in household for narrow land area as the replacement of infiltration made is quite simple. It only needs land area around 2.5 meter and it could be modeled either vertically or horizontally.

1 The reduction average of turbidity reached 98.14% in the distance of 13 meters, meanwhile, the reduction percentage of Coliform bacteria until it reaches 80.64% in 11 meters and 88.42% in 13 meters. The reduction of Coliform bacteria caused by Coliform bacteria flow together with the stream of incoming waste and passed pipe, which in the inside, there is quartz sand. According to Selintung & Syahrir, the research result at Faculty of Engineering who studied quartz as the filter media obtained that Specific Gravity is in 2.678 and Uniformity Coefficient is in 1.912. The quartz sand that have Specific Gravity in 2.678 is qualified as filter media. However, if it is seen from Uniformity Coefficient, it did not qualify as a filter media based on Selintung & Syahrir.⁽¹³⁾ If Uniformity Coefficient is big, it shows that the size of its grain is also big. Thus, it could be stated that the ground that has big Uniformity Coefficient shows that this ground is coherence with Uniformity Coefficient >6. By looking at Uniformity Coefficient in less than 6 that is not uniform resulted the pores in the sand are not solid/ not tight. Thus, the porosity would be bigger. The speed of the domestic waste flow would be faster because of the magnitude of porosity from the sand.⁽¹⁴⁾

Human sewage is a domestic waste that could cause several diseases, such as cholera, typhus, abdominal, dysentery, basilar, amoeba, and several kinds of worms. Moreover, these diseases are included in disease type caused by bacteria, protozoa, virus, and helmin. These diseases could infect human through water, hand, insects, rats media that touched food and drinks which are not managed well and in healthy manner. Therefore, in order to prevent the disease that could estinguish human, every human who produce domestic waste,

particularly sewage/ human faeces, must be managed well and correctly and one of them is by having lavatory that is completed with septic tank and infiltration.

Liquid which is out from effluent of the septic tank is liquid that is accompanied by enteric microorganism in which mechanism of pollution pattern of wastewater in the ground, bacteriologically that bacteria would thrive and breed together with wastewater, which is as food for the bacteria. Moreover, the bacteria proliferated and could thrive for 5 meters. After 6 until 11 meters, the bacteria would undergo extinction/ death because many bacteria which proliferated are not accompanied by the total of food from the waste. In another words, all food are eaten. Thus, bacteria in the distance of over 11 meters would die. Therefore, the distance of pollution bacteriologically is in 11 meters from the source point of landfill or human sewage. This bacteriological pattern moved in accordance with the condition of normal ground horizontally to the ground flow.⁽¹⁵⁾

The result obtained in 13 meters is the average is 70 colony/100 ml. This result is above standard settled by Minister of Health. In order to obtain the result of Coliform bacteria under 70 colony/100 ml, it is lengthened the flow path of domestic waste. The second step is the people could scours/ pulverize quartz sand to obtain uniformity coefficient. Hence, the pores in the sand are smaller and its porosity is also smaller.

CONCLUSION

1 Wastewater treatment design in household with narrow land area could significantly reduce Coliform bacteria and turbidity.

2 **Conflict of Interest, Funding and Ethical Clearance:** The authors state that there is no conflict of interest about this study. The funding of this study taken from the authors. Ethical clearance taken from Ethics Committee of Health Polytechnic of Ministry of Health in Surabaya.

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