Science, Engineering and Social Science Series
ISSN/e-ISSN: 2541 – 0369/2613 – 988X
Vol. 2, No. 1, 2018, Printed in the Indonesia

Education and Innovative Septic Tank: The Answer of Coastal Area Sanitation Problem

Chairunnisa[1,*], Yuni Lisafitri[2]
[1]*Department of Chemistry, Institut Teknologi Sumatera*
[2]*Department of Environmental Engineering, Institut Teknologi Sumatera*

Development of innovative septic tank for Sebesi Island has been conducted followed by education the danger of defecation improperly. The reactor was made by using the concept of anaerobic baffled reactor with polyethylene based materials. In the other hand, the education project was successfully conducted that can be seen from the public enthusiasm built the sanitation system followed by the change of community behavior

Keywords: sanitation, septic tank, waste water treatment

1. INTRODUCTION

Cleanliness is one of the basic necessities of human life. Awareness of the importance of environmental hygiene has actually been attached to the understanding of every individual. However, the desire and hope to create a clean and healthy environment had not being reality, because of economic factor. Disposal of untreated waste at all would be detrimental to biological communities near the discharge pipe, because it contains large amounts of organic material, unsightly, extinguish the seabed locally and deplete oxygen from the water, and pathogens contained within the outflow can infect commercial fish or shellfish and some marine wildlife. Furthermore, feces and urine are discharged directly into the ground will permeated and contaminate the groundwater. In general, domestic waste water treatment technology is using individual septic tank. The primary functions of septic tank are solids removal from wastewater accumulation and storage of sludge and scum also breakdown of solid material in an anaerobic digestion process and finally discharge the partially treated effluent to soak away soil for further treatment [1]. Effluent from septic tanks still required further processing because of the high organic content therein. Therefore, the infiltration field is used for further waste treatment [2]. Treatment of domestic wastewater using conventional septic tank also found to be inefficient leading to increased soil and ground water contamination. So, there is a need for improving conventional septic tank [3, 4]. Furthermore, septic tanks are recognized as significant contributors to streams' pathogen and nutrient loadings [5, 6].

The Habits of residents charge urine and feces in the environment is caused by lack of sanitation systems, especially latrines and septic tanks. Sanitation is very difficult to be built in coastal areas due to very shallow groundwater especially in the rainy seasons, and sandy soils so it is very difficult to build an underground structure in such a situation. Therefore, residents need to do casting for building a septic tank and requires huge

[*]*Email Address: chairun.nisa@ki.itera.ac.id*

funds to build it. The inadequate economic conditions of coastal resident make it difficult to build such system, so they just charge waste directly to the environment. From these conditions, it could not be denied that coastal society needs the safe, simple and affordable disposal system to maintain public health and protect the environment. One solution that has been developed is using anaerobic baffled reactor constructed from used water reservoir that made from HDPE (High Density Poly Ethylene) that has excellent durability, affordable and suitable for coastal soil conditions. Therefore, the project of innovative septic tank development for coastal area was conducted.

2. MATERIALS AND METHODS

A. Location

Sebesi Island is an island with a fairly dense population sanitation system is far from adequate.

Figure 1. Map of Sebesi Island

From the results of the survey showed more than 80% of homes do not have septic tanks to collect human waste. As a result, local residents dump sludge on land, or at sea, while urine discharged with discharge of water from the bath, and washing. This is certainly harmful to the health of local residents, given the results of the waste can remove phosphates and nitrates into the soil and transmit virus, bacteria and worms that will enter the food chain and ultimately exposed humans lead to various diseases such as diarrhea, typhoid and hepatitis.

B. Materials

The materials for building this innovative septic tank were 1100 ml, and 200 ml water container, PVC pipe 3 and 2 inch, PVC Fittings-Faucet Socket (AW) 3 and 2 inch, Pipe Fitting PVC-Elbow (D-DL) 3 and 2 inch, gravel, squat toilets, gravel, hoes, shovels, gloves, masks, drill, pipe glue, metersand, coconut fiber, gravel

C. Development of Innovative Septic Tank

The design of innovative septic tank was modified from [7]. The septic tank contained several tanks for multi-level wáste wáter treatment. In the end, there are adsorption field to adsorb several containation which remained in the waste water.

3. DISCUSSION

Building Septic systems in the coastal area are always challenging. The pollution and public health concern due to the release of untreated waste into adjacent coastal and marine environment, resulting in contaminated bottom sediments, shellfish beds and beaches. Therefore, the location, construction and maintenance should be properly planned and designed.

A. Construction

The location of septic tank was in the middle of village, near the only mosque of Teluk Baru village. The location has been decided with geologist considering the water streams, well position and other aspects. Before building this simple septic tank, the society had been given socialization about the danger of defecation. Therefore, they can understand why this thing important. The process of development this system involved the local community due to increasing the sense of belonging this sanitation system. The soil horizon of Sebesi island like other coastal area, sandy, affected by sea water intrusion, and has low water surface. It is difficult to building permanent septic tank using cement and such materials, not only because of soil character, but also the cost of transportation from Sumatera to Sebesi island. Sebesi island has sandy soil characteristic. Sites with sandy textured soils generally are assigned high hydraulic loadings. Moreover, sandy soil allow moderately high organic loadings onto these soils, but limit the potential for these soils to attenuate soluble pollutants such as nitrogen and phosphorus [12]. Therefore, in this project, the septic tank based on polyethylene material was developed due to the excellent durability and affordability. The design of this septic tank is showed in the figure 1. The septic tank has multiple chambers which is anaerobic process will conducted and the end pipe coupled with adsorption field. Inlet point is B with the 3 inch pipe come into C tank. In this tank, the three processes was happened that are separation between solid and liquid gravitationally, degradation of organic matter in the sewage, and accumulation of sludge (EPA, 1980). Supernatant will flow to D tank and the sludge will settled gravitationally in the bottom of the tank. In the tank 1, the solid waste which did not separated in C tank will be separated and the cleaner water will flow into tank 2 and so on. Finally, after the black water has been treated in the tank 1 C and D, the water will come out to the nature by passing the infiltration pipe that has been buried in the adsorption field (Figure 1).

The Teluk Baru orchard, Sebesi Island has 40 families, with 90% of them does not have sanitation system. The total usage of this public sanitation is 10 people/day. Therefore, the retention time for sludge in the tank 1 will be 17 days. The retention time in the tank 2-4 will be 3.5 day for each. Therefore, the total sludge retention time will be 27.5 days which is more than the minimum

retention time which is 5-6 days for anaerobic reaction [8]. Sludge and scum container volume calculation [2]

$$A = P \times N \times S$$

where, A is Sludge container (L) P is Total user (person) N : Desludging Time (min 2 years) S : Total Sludge (L/person/year) 25 liter for dark water treatment system.

B. Adsorption Field

This area was constructed for adsorbing the remaining bacteria and other organic compound in supernatant after being treated anaerobically in tank 1 – 4. After passing over adsorption field the total suspended soil will decreased, some organic compounds will be adsorbed, and the growth of bacteria are inhibited that needs to be proved by next test. The adsorption field was made by coral, coconut shell and sand due to their high adsorption ability.

Information:

A. Toilet
B. Inlet
C. Water container
D. Water container
E. Infiltration pipe
F. Desludging knop

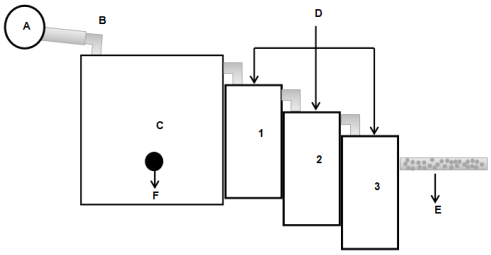

Figure 1. Design of simple anaerobic baffled reactor

Table I. Distance form septic tank.

Distance from	Septic tank	Infiltration field
Toilet	1 m	6 m
Well	5 m	9 m
Clean Water Pipe	4 m	7 m

Table II. Specification of Septic Tank Construction

Parts	Capacity (L)	Height (m)	Length (m)
Tank 1	1100	1.14	1.16
Tank 2	200	0.92	0.587
Tank 3	200	0.92	0.587
Tank 4	200	0.92	0.587
Infiltration pipe	-	-	1

Table 3. The estimated usage per person per day for black water

Type	Volume (L)
Urine (per person per day)	1.1
Feces (per person per day)	0.2
Water (per flush)	4.28
Total	5.58

Education Program Building an innovation without educate is zero. Therefore, this program were also conducted here to inform local people the danger of improper defecation and to promote the septic tank system. The education program was held by playing some videos, and other interactive media so the local people would be understand the aim of this program. The maintenance of this system was doing by everyday by monitoring the number of user, and how to clean it properly so the anaerobic process in the tank will not be disturbed. After got the constant number of user, the drainaged time could be calculated. The drainageprocess was by open the F knop (Figure 1) and then the matured sludge could be used as fertilizer

Information:

A. Infiltration pipe (End pipe)
B. Coral
C. Coconut shell
D. Sand

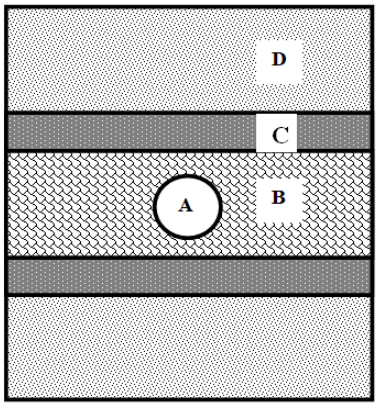

Figure 2. Adsorption Field

4. CONCLUSION

Introducing technology with education were the powerful way to make people aware of changing habits by utilizing technology that has be made. The polyethylene septic tank with total volume number was 1700 L was expected to be enough for sebesi island resident. Therefore, the quality life and soundness level of local people will be better. The recommendation of this program to evaluate the supernatant of last tank, long term society habits change and desludging time prediction.

ACKNOWLEDGMENTS

This work was supported by the JANIS (Jalan-Jalan Inovasi) and Institut Teknologi Sumatera

References

1. V. A. D'Amato, A. Bahe, T. Bounds, B. Comstock, T. Konsler, S.K. Liehr, S.C. Long, K. Ratanaphruks, C.A Rock, and K. Sherman, Factors affecting the performance of primary treatment in decentralized wastewater systems, WERF, Final Report (**2008**)
2. Sudarmadji and Hamdi, Tangki Septik dan Peresapannya Sebagai Sistem Pembuangan Air Kotor di Permukiman Rumah Tinggal Keluarga, PILAR J. Teknik Sipil, 9 (**2013**)
3. R. Anil , and A. L. Neera, Modified septic tank treatment system, Procedia Technology. 24 (**2016**)
4. Y. Tong, X. Bu, C. Chen, X. Yang, Y. Lu, H. Liang, M. Liu, H. Lin, H. Zhang, Y. Lin, F. Zhou, S. Zhao, T. Wu, G. Mao, W. Zhang, and X. Wang, Impacts of sanitation improvement on reduction of nitrogen discharges entering the environment from human excreta in China, Sci Total Environ. 593–594 **(2017**)
5. S. Richards, E. Paterson, P.J. Withers, and M. Stutter, Septic tank discharges as multi-pollutant hotspots in catchments, **Sci** Total Environ. 54 (**2016**)

6. M. A. Michael, Septic Systems in The Coastal Environment: Multiple Water Quality Problems in Many Area, Monitoring Water Quality, (**2013**), http://dx.doi.org/10.1016/B978-0-444-59395-5.00004-2
7. M. A. Mallin, Septic Systems in the Coastal Environment: Multiple Water Quality, University Of North Carolina Wilmington, Center For Marine Science,Wilmington, Nc, Usa, (**2013**)
8. I. W. Wardhana, and W. Karunia, Evaluasi Dan Optimalisasi Instalasi Pengolahan Limbah TinjaKota Pekalongan, Jurnal Presipitasi. 7 (**2009**)
9. F. B. Kraemer, C. I. Chagas, H. J. M. Morras, J. Moertton, M. Paz, and L. A. Garibaldi, Influence Of Physical and Chemical Soil Properties on The Adsorption Of Escherichia coli in Mollisols and Alfisols Of Argentina, Revista internacional de contaminación ambiental. 29 (**2013**)
10. A.C.A. De Lima, R.F. Nascimento, F. F, de Sousa, J. M Filho, and A. C. Oliveira, Modified coconut shell fibers: A green and economical sorbent for the removal anions from aqueous solutions, Chem. Eng. (**2012**)
11. U.S. Environmental Protection Agency, Onsite Wastewater Treatment And Disposal Systems, (**1980**)
12. U.S. Environmental Protection Agency, Decentralized Systems Technology Fact Sheet Septic Tank Systems for Large Flow Applications, (**2000**)

Received: 03 June 2018. Accepted: 24 July 2018