

SANITA Performance For Phyto-Assisted Sanitation System In Bandung, Indonesia

Nana Terangna Ginting

Reseach Centre for Water Resources, Jl.Ir.H.Juanda 193, Bandung 40135, Indonesia

Abstract: This paper reports the performance of phyto-assisted sanitation system that exists in Bandung, West Java, Indonesia. SANITA was a name for the installed and operated on-site sanitation facilities in which septic tank effluent was treated by submerged aquatic plants. Organic matter contents measured as BOD and COD and Faecal coliforms bacteria were reduced 80%, 70% and 99% respectively. Compare to control tank without plants, the reduction of 10-20 times were achieved. In addition, SANITA was able to stabilize organic matter containing wastewater. Physical dimension of long-shallow tank and square-deep tank and flow variability did not affect significantly the treatment performance. These suggest SANITA is a flexible small-scale phytotreatment plant that can be applied in a wide range of housing settlement conditions in urban area of Indonesia.

Key words: Septic tank effluent % Phytotreatment % Organic matter % Coliforms bacteria

INTRODUCTION

The on-site system is used as a means of human wastes management in urban area in Indonesia. The system allows that the wastewater flows to septic tanks and the effluent is disposed through the soil absorption system [1]. Construction of septic tank should follow the Indonesian Standard for Septic Tank Design [2], stating the base area of absorption chamber is 4.5 m² and the minimum distance from shallow well is 10 m. More than 73% of urban household have been practicing the system [3], however, this specification can not be applied in dense urban settlement due to limited available land of their house. Therefore most of shallow well are contaminated with domestic waste. A study in the residential areas in Java showed that the groundwater is contaminated by coli bacteria and detergent that contains of higher than 5 times allowable quality standard [4]. Further investigation indicated that domestic wastewater has high potential to contaminate the groundwater and surface water in Java due to poor sanitation facilities [5]. Inevitably, Indonesia has a high waterborne diseases and typhoid incidents in Asia [6].

The conventional approach to environmental sanitation was attributable by a linear waste management system. However, the linear waste management potentially created pollution problems in receiving waters, spreading to wider area, in addition to wasting valuable nutrients [7]. Recycling the nutrient flow by

means of phytotechnology following waste treatment or source disposal is one of the main objectives of a more ecological approach to environmental sanitation [8]. Phytotechnology describes the application of science and engineering to examine problems and provide solutions involving plants [8,9]. An innovative solution on loop-sanitation concept namely SANITA has been applied to treat effluent from septic tanks in Bandung, West Java, Indonesia since 2004. SANITA uses aquatic plants that planted on a chamber receiving septic tank effluent. SANITA is easily constructed and maintained yet economically affordable. The present research reports the performance of SANITA facilities that are well operated in metropolitan city of Bandung for four years application (2004-2007). The objective is to improve the existing facilities and to propose the replicates to other urban areas as well as improving Indonesian Standard for Septic Tank Design.

MATERIALS AND METHODS

Two groups of SANITA tanks were made as replicate of the existing facilities in addition to their control tanks that were without plants. SANITA(L) has a long dimension with shallow water, whereas SANITA(S) has a square dimension with deep water (Fig. 1). The effective volume of SANITA(L) is 40% of SANITA(S). They made from water proofed plastered bricks. Inside the tank, granular media such as sand and gravel are placed.

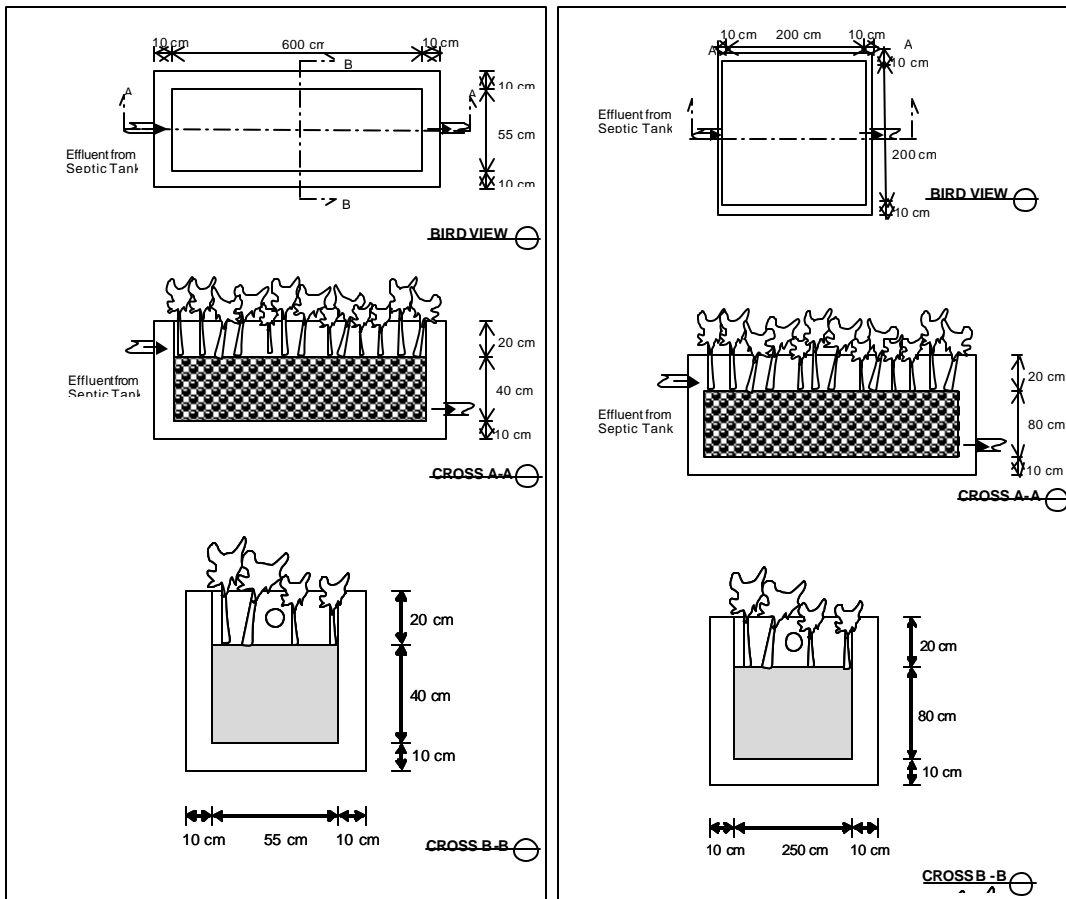


Fig. 1: Physical dimension of SANITA(L) left and SANITA(S) right

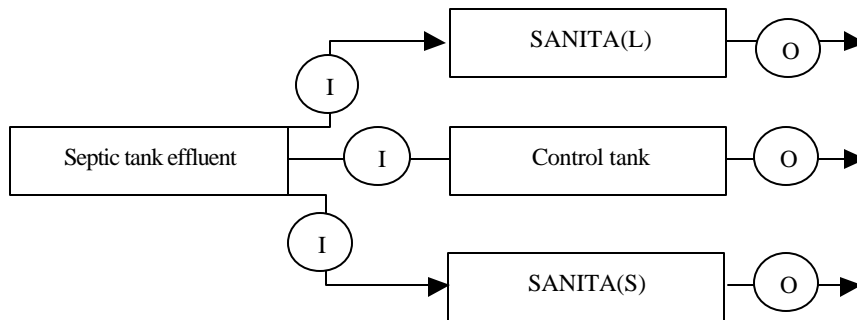


Fig. 2: Observation points for input (I) and output (O)

Table 1: BOD, COD and *F. coli* at the inlet and outlet of SANITA

Parameter	Replicates	SANITA(L)			SANITA(S)			Control		
		Inlet	Outlet	Removal (%)	Inlet	Outlet	Removal (%)	Inlet	Outlet	Removal (%)
BOD (mg/L)	1	68.2	13.1		57.7	12.3				
	2	71.5	13.5		62.1	12.8				
	3	64.1	13.4		46.2	12.1				
	Average	67.9	13.3	80.4	55.3	12.4	77.6	67.9	63.7	6.2
COD (mg/L)	1	89.6	25.9		87.0	25.4				
	2	86.9	25.3		99.6	25.7				
	3	81.2	25.1		69.7	24.6				
	Average	85.9	25.4	70.4	85.4	25.2	70.5	85.9.0	83.0	3.4
<i>Faecal coli</i> (CFU/100 mL)	1	800.0	14.0		600.0	2.0				
	2	4000.0	12.0		300.0	8.0				
	3	600.0	26.0		800.0	6.0				
	Average	1800.0	17.0	99.0	567.0	5.0	99.1	1800.0	1820.0	0.0

Table 2: Organic matter stability index

	Inlet/septic tank effluent	Outlet/SANITA(L) effluent	Outlet/SANITA(S) effluent	Control
BOD/COD	0.65 - 0.79	0.52	0.49	0.77

The media are intended to be growth media for the submerged plants by which roots are attached. The submerged plants were identified as *Typha Sp*, *Cyperus arternifolius*, *Pontederia cordata* and *Echinodorus palaeifolius*.

The experiment scheme and observation were carried out as follows (Fig. 2). SANITA tanks were constructed close to the existing Wastewater Treatment Plant receiving septic tank effluent. The acclimatized plants were grown on the SANITA tanks. The septic tank effluent flows continuously by gravity to the inlet of SANITA tanks and control tanks. The outlets flow were discharged safely to well absorption system. Quality parameters of inlet and outlet flows were BOD, COD and Faecal coliforms bacteria that were measured weekly during 6 months. Laboratory analysis for the parameters were carried out using Standard Methods [10].

RESULTS AND DISCUSSION

Weekly observation for BOD, COD and *F.coli* during 6 months were summarised in Table 1. The results were on an average value since the fluctuation was not more than 10%. Table 2 presents the organic matter stability index that is the ratio of BOD/COD that contains BOD of less than 100 mg/L dan COD of less than 500 mg/L [11].

Quality Assessment: The BOD of septic tank effluent ranged from 64.1-71.5 mg/L that could be reduced to

46.2-62.1 mg/L following SANITA treatments. The COD reduction was lower than the BOD reduction, leading to decrease BOD/COD ratio (Table 2). Since the concentrations of BOD and COD were less than 100 mg/L, meaning that organic matter was stabilized [11]. Therefore, SANITA treatment could reduce organic matter as well as stabilize it. The final quality SANITA effluents confirmed to the Minister Environment Decree No.112/2003 regarding the Domestic Waste Water Standard. However, the content of *F. coli* was higher than the Decree, even SANITA was able to eliminate them significantly high of about 99%. In these conditions, for practical purposes, the effluent discharge could be discharged to receiving water bodies that are not intended for drinking water sources.

Physical Assessment: The capacity of SANITA(L) is 2.0 m³ with long and shallow dimension, whereas SANITA(S) is 4.0 m³ with short and deep profile. The experiment was not controlling flowrate to meet acceptable hydraulic load with an intention to approach practical conditions. However, the effluents quality of both facilities were not differ significantly. This suggests that physical dimension of SANITA did not affect the wastewater treatment performance. The results were comparable to phytotreatment treatment for small scale wastewater treatment [12] and evapotranspiration bed in treating septic tank effluent using terrestrial plants [13].

CONCLUSION

The present experiment demonstrated the ability of phytotreatment in improving septic tank effluent quality. SANITA performed well in reducing and stabilizing organic matters containing wastewater. The results suggest the existing facilities could be maintained for their sustainability. Moreover, replicates of SANITA could be applied to urban area due to their physical flexibility on land conditions.

REFERENCES

1. Mangkoedihardjo, S. 2005. The Limiting Factors of Sand Bed Reactor for Heterotrophic Denitrification Process in Tropical Conditions. *Malaysian Journal of Soil Science*, 9: 65-74.
2. Badan Standarisasi Nasional, 2002. *Tata Cara Perencanaan Tanki Septik dengan Sistem Resapan*, SNI 03-2398-2002, Jakarta.
3. Badan Pusat Statistik, 2009. *Data Sumber Air Minum & Sanitasi dalam SUSENAS*, Water and Sanitation Monitoring Conference 2009, Jakarta 13-14 April 2009.
4. Nana Terangna, *Kualitas Sumber-Sumber Air pada Daerah Perkotaan*, Prosiding Diskusi panel Hari Air Sedunia, Jakarta 22 Maret 2001, ISBN 979-3197-09-9.
5. Kementerian Lingkungan Hidup, 2007. *Status Lingkungan Hidup Indonesia 2006*, Jakarta.
6. World Bank, 2007. *Water and sanitation Program-East Asia and the Pacific (WSP-EAP)*, 2007, *Economic Impacts of sanitation in South East Asia Summary*, World Bank East Asia and the Pacific Region.
7. Mangkoedihardjo, S. 2006. Phyto-assisted Sanitation System. *Journal of Applied Sciences in Environmental Sanitation*, 1: 9-16.
8. UNEP, 2004. *Integrated Watershed Management Ecohydrology & Phytotechnology - Manual* - Available at <http://www.unep.or.jp>
9. ITRC (Interstate Technology Regulatory Council), 2001. *Technical and Regulatory Guidance Document, Phytotechnology*. Available at <http://www.itrcweb.org>
10. Standard Methods, 1995. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association/American Water Works Association/Water Environmental Federation, Washington DC, 19th Edition.
11. Mangkoedihardjo, S. 2006. Revaluation of Maturity and Stability Indices for Compost. *Journal of Applied Sciences and Environmental Management*, 10 (3): 83-85.
12. Mangkoedihardjo, S. 2007. Leaf Area for Phytopumping of Wastewater. *Applied Ecology and Environmental Research*, 5 (1): 37-42.
13. Mangkoedihardjo, S. 2007. Phytopumping Indices for Evapotranspiration Bed. *Trends in Applied Sciences Research*, 2 (3): 237-240.