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Material and Life Service of the Septic Tank Have an Influence on the Biological Pollution of Groundwater (Case Study Kelurahan Pademangan Barat, North Jakarta)

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Abstract. The type of septic tank material used can vary but must be impermeable to water. Septic tanks made of cast concrete but at the bottom are not cast and deliberately made seepage should not be used because they pollute from its seepage. The use of this particular material also directly impacts the service life and affects the performance of the septic tank even though there is no standard regarding its usage time limit. This research aims to identify the use of material and life service of the septic tank in Kelurahan Pademangan Barat, which is the area with the highest biological pollution of groundwater in the study conducted by BPLHD in 2015. The results of this research identified more than half of the respondents, as many as 65.99%, used septic tanks with partially cast concrete, 33.31% usefully cast material, and the rest from other types of materials. The highest yield was 29.60% had septic tanks that were more than ten years old. The rest is as much 22.66% not knowing the service life, 19.16% with service life 5 - 10 years of use, 11.53% with 3 - 5 years of use, and 17.06%, which are less than three years old.

1. Introduction

The Jakarta city government prepares significant facilities and infrastructure to meet the target of universal access for the community, one of which is to provide an on-site domestic wastewater treatment system starting from feces compartment, namely a system such as cubluk or septic tank then the sludge is sucked up and transported to further processed at the Fecal Sludge Treatment Plant. One advantage of septic systems is that they are simple in design and generally less expensive to install and maintain [1]. In 2012, the Jakarta Sewerage System (JSS) master plan states that the use of septic tanks in Jakarta is still relatively high, namely 64% so that services will continue to be transferred to a centralized system until it reaches 80% in 2050 [2]. Facing the fact that most Jakarta people still use septic tank technology, appealing to build or design according to predetermined standards is one of the Jakarta city government's efforts to reduce domestic waste pollution in the community. Pollution reduction also depends on downstream processing in the form of Fecal Sludge Treatment Plant (IPLT) with acceptable operational standards and on local processing, draining, or desludging, and transportation [3].

The definition of proper sanitation service management in the community is under the concept of a flow chart where sewage waste from various sanitation facilities can be traced, starting from the container, draining, transportation, maintenance, and final disposal or reuse. As described in the Onsite Wastewater Treatment Systems Manual issued by the U.S. EPA (2002), septic tanks emerged as primary treatment units in the late 1800s. The practice of channeling effluent into the infiltration area using gravel media began in the mid-20th century. Septic tanks with wells or infiltration areas can treat



domestic waste and are almost completely capable of removing parameters such as suspended solids, organic matter, and fecal bacteria if they have the right design, site planning, construction, operation, and maintenance [4].

The presence of the fecal bacteria *Escherichia coli* (*E. coli*) has an impact on groundwater quality in the city of Jakarta [5]–[7]. The case of a septic tank that seeps into the ground is a factor in groundwater contamination. Through the total coliform parameter, which is an indication that pathogenic bacteria contaminate the water or not, the pollution rate in Jakarta, in this case, is represented by the Kelurahan Pademangan Barat has exceeded the 370,000 MPN/100 ml sample (BPLHD, 2015) from the maximum allowed level of 0 MPN/100 ml according to the Minister of Health Regulation No. 492/Menkes/Per/IV/2010 concerning Requirements for Drinking Water Quality. There are no definite rules regarding septic tank systems' useful life, but the design's materials can affect the strength and control of infiltration into the soil.

Ministry of Public Works and Public Housing noted that in 2018 the percentage of domestic wastewater services with a centralized pipe system (off-site system) in Jakarta only reached 11% of the total population. The rest used the local system or did not even have access to sanitation at all. Even though the percentage of access to sanitation is 95% [8], there are concerns that many Jakartans still use cubluk or septic tanks that are not up to standard, also considering the definition of community-based total sanitation imposed by the Ministry of Health. Given the high population density in, i.e., 158.04 people/hectare in 2018 [9] and limited land in Jakarta, this can create new problems, and the relevance of using septic tanks for Jakarta residents needs to be questioned again.

A previous study has conducted that used drum materials can be used as tidal septic tanks in some geographic regions or an emergency even though they still contain high TSS and BOD in effluent discharge [10] and also been carried out on the possibility of designing a septic tank which is not connected to some other treatment facilities to treat wastewater partially but has other benefits such as biogas production during decomposition and fertilizer production from accumulated sludge after decomposition [11]. This research aims to identify the use of the septic tank's material and life in Kelurahan Pademangan Barat, the area with the highest biological pollution of groundwater in the study conducted by BPLHD in 2015.

2. Methodology

This study uses survey data results of respondents by distributing closed questionnaires in Kelurahan Pademangan Barat, North Jakarta, Indonesia, in 2016. As many as 1,273 respondents were given a list of questions about the septic tank's material and life service. The study area selection is based on the high level of biological pollution in groundwater. However, this paper does not test the hypothesis but only describes the state of the area's variables and conditions. This study will be limited regarding the design and service life of the septic tank.

3. Result and Discussion

3.1. Water and Wastewater at Pademangan Barat

The rate of groundwater use in Jakarta shows an increase on average until 2019, and the dependence of residents on groundwater as a source of drinking water is still high [12]. From studies conducted in the field, most houses or buildings at Kelurahan Pademangan Barat are self-owned. As much as 94.94% of respondents use groundwater as their daily source of clean water, only 5% use services from local government-owned drinking water companies (see Figure 1). A house or building with a water source from a local drinking water company can generally be known about the use of clean water for daily activities so that it makes it easier to estimate the generation of wastewater. In contrast, when using water from groundwater or other sources, it is generally difficult to know the use of clean water, so it is difficult to estimate the generation of domestic wastewater.

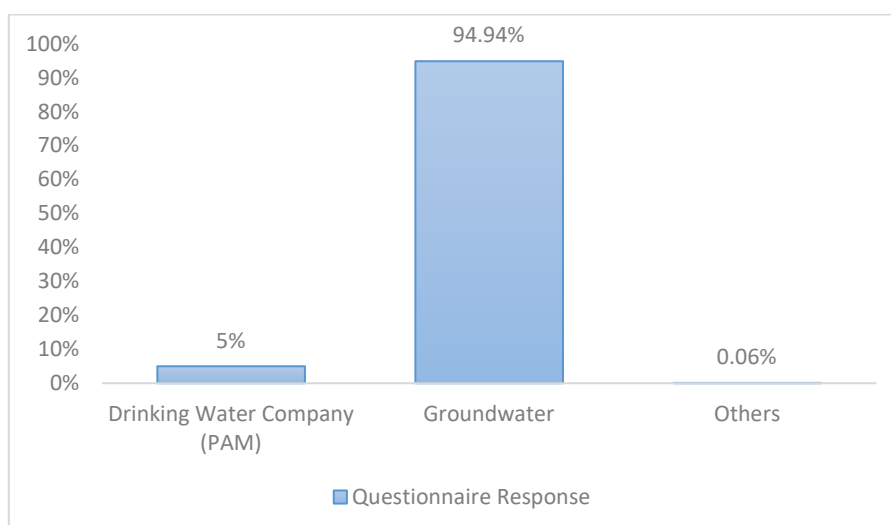


Figure 1. Source of Clean Water at Kelurahan Pademangan Barat

3.2. Survey of Respondents

The most widely used partially cast concrete septic tanks as an on-site wastewater treatment system in a study area. In Indonesia, this system can be referred to as *cubluk*, commonly used by the community. Regulation of the Minister of Public Works and Public Housing No. 04/PRT/M/2017 concerning the Domestic Wastewater Management System's Implementation defines *cubluk* as the most straightforward domestic wastewater treatment unit (on-site system). It consists of a hole dug manually with a water-permeable wall made of hollow masonry—*cubluk* functions as a place for feces to settle and a medium for absorption of incoming fluids.

It can be seen in Table 1, through the type of material, which is an indication that groundwater contaminated with septic tanks, 65.99% of respondents at Kelurahan Pademangan Barat using a septic tank made from partially cast concrete. Only 33.31% usefully cast material. The rest uses fiber/plastic tank, drum/zinc plat/iron, and others. The system is the primary unit for on-site wastewater treatment, mostly not equipped with further treatment. It is merely a feces storage directly impregnated into the ground or disposed of into water bodies and is not impermeable. The septic tank with this material design still requires secondary processing. A study from Nawa Village Qalubiya Governorate, Egypt, mentioned that septic tank served ten houses with volume 10m³ enough for two days retention time, only used simple modified plastic septic tank divided into three compartments one for settling, second for submerged bio gravel filter & third for up-flow bioplastic filter. After three months of operation, the modification improves the septic tank's removal efficiency from 50% become 83.66% for BOD & 60% becomes 86.91% for TSS [13].

Table 1. Type of Septic Tanks at Houses and Buildings in Kelurahan Pademangan Barat

Material	Respondents	Percentage (%)
Partially Cast Concrete	424	33.31
Fully Cast Concrete	840	65.99
Fiber/Plastic	5	0.39
Drum/Zinc Plat/Iron	1	0.08
Others	3	0.24
Total	1,273	100.00

Most of the technology only utilizes infiltration, and the ability of the soil to carry out self-purification, wells, or infiltration areas are two secondary processing options. Secondary processing is

needed to reprocess effluent from septic tanks that do not meet quality standards. At the right location and optimal performance, through secondary processing and infiltrating it into the soil, domestic waste is treated and safe for the environment and replenishes the supply of groundwater sources. Either in the media in the well or the infiltration area, the infiltration zone, and the unsaturated soil zone, microorganisms will stick to form biofilms (microorganism layers) to treat effluent from the septic tank by utilizing oxygen that diffuses into the soil. Some of the parameters that are degraded optimally in this process are ammonia, carbon, phosphorus, and pathogens [14].

In practice, the central government has issued a standard for the manufacture of septic tanks on a household scale SNI 2398:2017 concerning Procedures for Septic Tank Planning with Advanced Treatment defines a septic tank as a watertight space, consisting of one or several compartments that function to accommodate and treat household wastewater. The slow flow rate results in anaerobic precipitation and decomposition to form water and gas soluble materials.

3.3. Relation between Type and Service Life

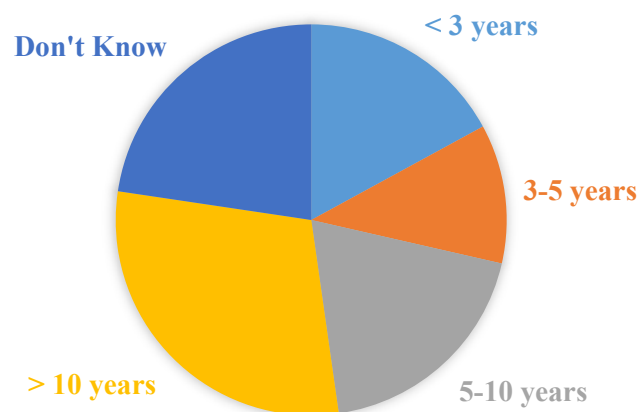


Figure 2. Service Life of Septic Tank at Kelurahan Pademangan Barat

The type of septic tank will affect the septic tank's life and its resistance to collecting wastewater. The type of material for using the septic tank can vary, but it must be ensured that they are waterproof. Cast concrete and plastic fiber tanks are generally able to hold water longer than other materials. Drum material, zinc plate, iron are generally the most easily eroded materials by soil or rust due to water, so the possibility of leakage is greater. Septic tanks made of cast concrete but the bottom part not cast and are made of seepage should not be used because they pollute soil and groundwater with seepage of wastewater.

The type of material used in the design of a septic tank affects the septic tank's life and its resistance to collecting wastewater [1]. Several studies show cast concrete, fiber and plastic are generally able to hold water longer than the drum, zinc, and iron plates that are most easily eroded by soil or rust due to water. However, there is no standard reference regarding the time limit for using a septic tank because the septic tank's durability depends on the material used. However, it is feared that the septic tank, which is a dozen years old with certain materials, has broken or cracked due to soil and water pressure so that it has a great potential to pollute the environment. Based on Figure 2, it can be seen that most of the houses or buildings of residents in Kelurahan Pademangan Barat have septic tanks that are more than ten years old, as much as 29.60%. The second most answer was 22.66% not knowing the service life of their septic tank, 19.16% mentioned that their septic tank has a service life of 5 - 10 years, the rest, i.e., 11.53% with 3 - 5 years of use and 17.06% which are less than three years old.

4. Conclusion

It can be concluded according to the research conducted, from a survey of 1,273 respondents regarding the design and service life of their septic tank at the study area, found that 65.99 % of respondents using a septic tank made from partially cast concrete, 33.31% of respondents using fully cast material and the rest uses others. In contrast, 94.94% of respondents use groundwater as their daily clean water; only 5% use services from local government-owned drinking water companies. For the life of the septic tank, as much as 29,60 % have septic tanks that are more than ten years old, 22.66% not knowing the service life of their septic tank, 19.16% have a septic tank that is 5 - 10 years old, 11.53% with 3 - 5 years of use and 17.06% which are less than three years old.

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