

# Using filtration as a technology to remove pollutants in domestic wastewater

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**Abstract.** Most of the wastewater produced comes from household activities. Household wastewater currently tends to be directly disposed into water bodies without prior treatment. As a result, the concentration of pollutants, especially TSS and COD in the waters became high. It is necessary to manage household wastewater, so that the disposed waste is still within safe limits that do not pollute the environment. Filtration is one of treatment methods which is generally used in the processing of clean water, but the materials used in the filtration process also have the ability to reduce pollutant levels in wastewater. This study aims to find out that filtration can be used as a method of household wastewater treatment. The method in this study is to conduct a trial using a simple filtration method to analyse the decrease in household waste levels. The result shows that the percentage of TSS and COD removal are 79.01% and 77.84%. The conclusion in this study is that filtration can be used as a method of household wastewater treatment because the material used can reduce the concentration of TSS and COD to below the specified quality standard.

## 1. Introduction

The availability of water worldwide per person per year decreases due to the increase in population and the decrease of the quality of water sources [1]. Indonesia currently ranked 4th as the country with the highest population in the world after China, India and America [2]. Based on the data from the Central Bureau of Statistics (BPS), the total population in Indonesia until 2016 reached 258,705,000 people. The population in DKI Jakarta, as the capital city of Indonesia itself reached 10,277,628 in 2017. The population has a large influence on the amount of clean water use. The reduction in clean water resources has made water resources increasingly scarce, so it is important to concern to the utilization and treatment of wastewater [3]. One of the reasons is the decrease in the quality of clean water because the residue of the use of clean water flown towards the water source and mixed with clean water [4]. It causes a decrease in water quality so that the water becomes polluted. The population also affect the amount of wastewater produced.

Human activities is one of the causes of an increase in the amount of wastewater, it affects the environment, such as a decrease in water quality [3]. Most of the wastewater discharged by the population comes from household activities, which is equal to 60% of domestic wastewater [5]. Household activities such as bath and showers are activities that consume about 40% of total water consumption, depending on the way of life of the inhabitants [6]. Household wastewater was immediately disposed of into rivers or other water bodies without prior treatments. The source of household wastewater is water that comes from all household appliances that consume water, including baths, showers, hand basins, washing machines,

dishwashers, and kitchen sinks, etc. [7]. Therefore, in planning a wastewater treatment system, it is important to consider to wastewater characterization so that the design and operation of the wastewater treatment system become more optimal [8].

Wastewater treatment, especially household wastewater, is still difficult to do. Current studies mentioned that public awareness to manage waste is still very lacking, even though community environmental awareness is very effective in developing new policies and improving household waste management [9]. One of the reasons is the lack of knowledge that is owned by the community, and from the environmental, social, and economic aspects, as well as technical aspects that are still inadequate, so that community participation in waste management is still low [10]. Community knowledge and behaviour is also needed so that sustainable waste management can be achieved [11]. In addition, even though there is currently a wastewater treatment plant (WWTP), previous study mentioned that increasing pollution occurred due to the knowledge gap between users of domestic wastewater treatment systems [12]. Another problem is, there are still many locations that are not affordable, so people prefer to dispose of their waste into the river. Therefore, there is a need for water treatment that can be applied by the wider community.

The successful application of a technology is determined by cost and the understanding of the community in the location where the technology will be applied, so it will ease the social acceptance of the technology [13]. Alternatively, a decentralized approach or a combination of onsite systems and/or clusters for wastewater treatment makes it easier for management, costs, technology and land needed [14]. One of the methods of water treatment offered and can be applied by the community is by filtration. Thus, this paper aims to analyse the removal of household wastewater before and after the treatment (filtration), so that the treated wastewater can be flowed without contaminate the water body or can be reused for non-consumption needs.

Filtration processing is carried out by filtering wastewater, which uses various types of materials, such as gravel, charcoal, zeolite, and sand. Filtration using sand had the poorest performance with the lowest infiltration rates [15], so that, this study will use silica sand, zeolite sand, and activated carbon, which can be purchased at aquarium stores. Besides, the combination of these materials will optimize the filtration process It also easier for the public to obtain materials for filtration process.

Current literatures largely explain the use of filtration as a method to treat some wastes, but it has not been much discussed especially about its use as a method of household wastewater treatment, which every household be able to do this method. Previous research which aimed to evaluate the effectiveness of filtration method in treating milk processing waste water in laboratory scale, stated that filtration using sand combined with coral or glass beads was found to be the most effective filtering medium with an average of Total Suspended Solid (TSS) reduction of 99%, Chemical Oxygen Demand (COD) 93%, and Total Solid (TS) of 51%, then filtration using charcoal is also able to reduce 85% of TSS, 83%, of COD and 46% of TS [16]. Filtration using more than one material produces better results than using only one material [17-19], as previous study has shown that filtration using sand and gravel had a better COD removal than using gravel only [17]. Another research that has been done in processing of modern olive wastewater using sand filters is able to show a decrease in TSS of 75% to 90% [20]. The treatment of TSS needs to be done because if TSS is too large it can cause delays in the entry of sunlight into the waters [21].

The analysis in this study begins with collecting wastewater from several households as samples, and then measures the parameters of TSS and COD before and after the filtration

process. The test results will be compared with the applicable quality standards to find out whether the filtration process can be used to treat household wastewater. The material used in filtration process is material that is easily obtained by the community. This paper expected to provide benefits for the government in order to be able to disseminate information to the community so that it can be a waste treatment method that can be applied by the entire community.

## **2. Research Method**

### **2.1. Preparations**

Preparations of tools and materials used for the filtration process are PVC pipes 1.5 meters, silica sand, zeolite sand, filters, and activated carbon. While the tools are pH meter and sample bottles. Household wastewater collected from some different locations. The samples are homogenized before processing by filtration.

Filtration process is done by flowing the wastewater into PVC pipes containing silica sand, zeolite sand, filters, and activated carbon. Wastewater previously divided into 2 parts, one as controlled sample, and the rest is processed by filtration. The materials composition of the filtration process are 30 cm of silica sand, 27 cm of zeolite sand, and 30 cm of activated carbon. Each material is separated by a filter, so the material will not be spilled and filter process can be more optimally.

### **2.2. Measurement of Temperature, pH, TSS, and COD**

Temperature measurement is done to determine sample temperature when it taken. The measurement is done by using a thermometer. While pH measurement is carried out as basic test to determine the acidity of the sample tested. pH measurement is done using a digital pH meter. Temperature and pH measurements are carried out directly during sampling process.

Then, TSS measurement will be done in the laboratory by referring to SNI 06-6989.3-2004, using gravimetric method. Measurement of TSS is carried out to determine the suspended residues contained in water samples. The TSS value is obtained by calculating the difference between total dissolved solids and total solids. Measurement of COD also is done in the laboratory by referring to SNI 6989.2:2009 using  $\text{Cr}_2\text{O}_7^{-2}$  reduction method by spectrophotometric. If the range of COD value is 100 mg/L up to 900 mg/L then the test is done by spectrophotometry with a wavelength of 600 nm. If the COD value is smaller or equal to 90 mg/L, the test is done with a wavelength of 420 nm.

The result of the test will be compared with the applicable regional regulation, Republic of Indonesia Minister of Environment and Forestry Regulation Number P.68 concerning Domestic Wastewater Quality Standards. Thus, it will be known whether the concentration of treated water has met environmental quality standards and can be disposed of into water body safely.

## **3. Result and Discussion**

### **3.1. Water Sample Measurement Results before Treatment Process**

Before treatment process, water sample was measured first to determine the concentration of pollutant contained in it. The purpose is to find out the pollutant concentration before filtration process. The result of wastewater sample measured before treatment process shown in Table 1.

**Table 1.** The Result of Water Sample Concentrations before Filtration Process

<b>Parameter(s)</b>	<b>Unit(s)</b>	<b>Quality Standard(s)</b>	<b>Control Sample</b>	<b>Treated Sample</b>
<b>pH</b>	-	6-9	6.6	6.6
<b>Temperature</b>	°C	-	29	29
<b>TSS</b>	mg/L	30	81	81
<b>COD</b>	mg/L	100	102	102

The measurement result between control sample and water sample that will be treated showed the same value because the type of water used was same and has not gotten any treatment. The pH value obtained in the control sample and the water sample before filtration process showed the same value, which is 6.6. If it compared with the quality standard, the Minister of Environment and Forestry of the Republic of Indonesia Regulation Number P.68 of 2016 concerning Domestic Wastewater Quality Standards, the pH value in the sample still meets environmental quality standards.

Then, the TSS measurement in the sample as a control or sample before treatment process showed the result of 81 mg/L based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.68 of 2016 concerning Domestic Waste Water Quality Standards where the maximum permissible limit for TSS parameter is 30 mg/L, so the TSS value in the control sample and sample before the filtration process still exceeds the standard quality. If the TSS concentration is too high, it will hamper the entry of sunlight into the water, and it has an impact on the reduction of oxygen level in the waters.

The measurement of COD is done to determine the amount of oxygen needed to oxidize organic materials in water, so if the COD value is high, it will concluded that the level of pollution that occurs in waters is getting worse. Based on the result of measurement of sample, the COD values obtained in both water samples were 102 mg/L. If it compared with the quality standard in the Republic of Indonesia Minister of Environment and Forestry Regulation Number P.68 of 2016 concerning Domestic Wastewater Quality Standards where the maximum permissible limit for COD parameter is 100 mg/L, so the COD value in the sample still exceeds the quality standard permitted.

### *3.2. Water Sample Measurement Results after Treatment Process*

Sample measurement after treatment process was done to determine the concentration of water sample after filtration process. Wastewater sample that after processed have shown changes. The result shown in Table 2 below.

**Table 2.** The Result of Water Sample Concentrations after Filtration Process

<b>Parameter(s)</b>	<b>Unit(s)</b>	<b>Quality Standard(s)</b>	<b>Control Sample</b>	<b>Treated Sample</b>
<b>pH</b>	-	6-9	7	6.8
<b>Temperature</b>	°C	-	29	29
<b>TSS</b>	mg/L	30	81	17
<b>COD</b>	mg/L	100	102	22.6

Based on the results shown above, it can be seen that there is no change in the measurement results of the control sample, both before processing and after processing. This is due to the there is no treatment given to the control sample, so that there is no change in sample quality both before and after processing.

The pH value in the control sample and water sample after the filtration process showed values of 7 and 6.8 respectively. If it compared with the pH value before treatment, there is an increase shown in the sample after processing. The increase in the control sample can be caused by precipitation which affects the acid/base level of the sample. While the increase in the pH value shown in the water sample after the filtration process can be caused by the influence given to the materials used in the filtration process, so that the pH value indicates an increase even though it is not high. If it compared with the quality standard in the Republic of Indonesia Minister of Environment and Forestry Regulation Number P.68 of 2016 concerning Domestic Wastewater Quality Standards, the pH value still meets the permitted standard quality requirements. While the temperature value obtained after the processing does not indicate a change in value when compared to the water sample before processing, which is still 29°C. The amount of reduction resulting from the filtration process is shown in Table 3.

**Table 3.** Removal of TSS and COD of Water Sample

<b>Samples</b>		<b>TSS (mg/L)</b>	<b>% Removal</b>	<b>COD (mg/L)</b>	<b>% Removal</b>
<b>Control</b>	Before	81	-	102	-
	After	81	-	102	-
<b>Filtration</b>	Before	81	-	102	-
	After	17	79.01	22.6	77.84

Table 3 has shown the removal percentage of TSS and COD parameters after filtration process. The material that contained in filtration process absorb the organic substances in water sample. Based on the observation and calculation, the result showed a decrease in TSS concentration up to 79.01% in the filtration process. The decrease of TSS level is caused by the use of sand in the filtration process. Silica sand and zeolite sand have a function to absorb organic substances contained in waste water. In addition, sand also functions to separate fine solids in wastewater.

Then, this research also observed the decrease of COD concentration in waste water. Based on the observation, the result showed a decrease in COD concentration up to 77.84%. It happened because the materials used in filtration process had function to absorbed organic material contained in water. In addition, the materials used in the filtration are aimed on reducing organic matter, because the treated wastewater is household wastewater. Household wastewater itself has a fairly high content of organic matters, so the use of filtration methods for processing household wastewater is considered quite effective. The concentration of wastewater produced from the treatment process is also quite low and meets the permitted standard.

#### 4. Conclusion

The household wastewater treatment using the filtration method is considered quite effective to be applied in the household, because the tools and materials are easy to obtain, and the process carried out is also quite easy. The result showed that the filtration method

used silica sand, zeolite sand, and activated carbon were able to reduce the TSS concentration up to 79.01% and COD up to 77.84%. This research is expected to be a recommendation for the government to disseminate to the community, especially those living around the river boundary, to process their wastewater before being discharged into the river, so that river pollution can be reduced and both rivers and treated wastewater can be used for non-consumption needs.

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