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Analysis of The Impact of Handwashing with Soap Policy on Water Quality in Public Facilities: A Case Study in Palangka Raya, Indonesia

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Abstract— Coronavirus disease 2019 (Covid-19) has changed lifestyles. One of the new habits practiced by the community is washing hands. The government had issued a policy stipulated in the decree of the Minister of Health of the Republic of Indonesia number HK.01.07/Menkes/382/2020 concerning Health Protocols for Communities in Public Places and Facilities in the Context of Prevention and Control of Covid-19. Washing hands with soap is an effective step to break the chain of transmission of Covid-19. This research obtained samples of handwashing disposal and the surface water at three public facilities in Palangka Raya city, i.e. G. Obos XX market, Pasar Besar, and KPD Supermarket that examined for the parameter of BOD, COD, TSS, and detergent content in the area. The result was the handwashing disposal and the surface water of three public facilities had BOD, COD, TSS, and detergent levels exceeding the surface water quality standard. Disposal of handwashing with soap waste directly into surface water causes a decrease in surface water quality.

Keywords— Alkylbenzene sulfonates, Covid-19; Handwashing disposal; Health protocol; Surface water quality.

1. INTRODUCTION

A pandemic is the spread of an epidemic or disease that spreads to every country and on a large scale. The following are some cases due to viruses, such as Black Death, Spanish Flu, Asian Flu, Hong Kong Flu, HIV/AIDS, Smallpox, Cholera, Dengue Fever, Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), Bird Flu (H7N9), Swine Flu (H1N1), Ebola, and Zika. In 2020, more than 160 countries have been devastated by the Covid-19 pandemic impact, significantly affecting economic, educational, and social activities [1].

A policy issued by the government is contained in the Decree of the Minister of Health of the Republic of Indonesia number HK.01.07/Menkes/382/2020 concerning Health Protocols for Communities in Public Places and Facilities in the Context of Prevention and Control of Corona Virus Disease 2019 (Covid-19) [2]. The policy considers that in facing the adaptation of new habits towards a society that is productive and safe from Covid-19, it is necessary to regulate the implementation of various activities with public health priorities. Public places and facilities that are a forum for community activities in supporting economic sustainability but instead have the potential to become a vessel for the spread of Covid-19, health protocols are needed in carrying out activities in these public places and facilities. Therefore, the wheels of the economy will continue to proceed. It is necessary to mitigate the impact of the Covid-19 pandemic, especially in public places and facilities. The community must change their lifestyle with the order and adaptation of new habits (new normal era). Thus, they can live productively and avoid transmission of Covid-19. Discipline in applying the principles of a cleaner and healthier lifestyle is the key to suppressing Covid-19 in the community.

The health protocol has policies, one of which is to provide adequate handwashing facilities for public facility managers. According to the 2009 Indonesian Ministry of Health, the behavior of washing hands with soap is part of the Clean and Healthy Behavior (PHBS) program in households. The PHBS program empowers household members to be aware of their willingness to perform clean and healthy living habits. Washing hands with soap effectively breaks the chain of transmission of Covid-19. However, please note that handwashing soap contains a detergent. In Indonesia, the need for

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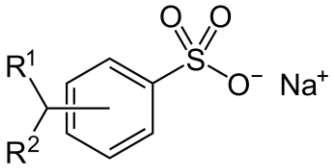
detergents increases every year. This condition is due to the increase in population each year. With the population increasing, the need for detergent also increases. Likewise, with the increasing people's awareness level in maintaining cleanliness, one of which is washing hands with soap, the results of using detergents (hand washing soap) will produce residues in the form of liquid waste, then discharged into the environment. The chemical active agent of soap commonly known as Alkylbenzene sulfonates (**Fig. 1**) is substance that biodegraded rapidly under aerobic conditions with a half-life of approximately 1–3 weeks. Under anaerobic conditions it degrades very slowly or not at all, causing it to exist in high concentrations in sewage sludge. This result can directly disrupt the natural balance, i.e. soil pollution, which can change soil pH [3] and mineral content [4], disrupt nutrients from the soil to plant life and water sources, and pollute the land [5-6].



$$R^1 + R^2 = C_{11}H_{24}$$

Fig. 1. Chemical structure of alkylbenzene sulfonates

The research of the effect of handwashing with soap policy to the water quality is rarely conducted. This research work on the effect of handwashing with soap policy to the parameter of handwashing disposal and the surface water quality. The sample was took from three location in Palangka Raya city, Indonesia: G. Obos XX market, Pasar Besar, and KPD Supermarkets.

2. EXPERIMENTAL SECTION

The data obtained in this research was parameter of Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Substance (TSS), and detergent parameters.

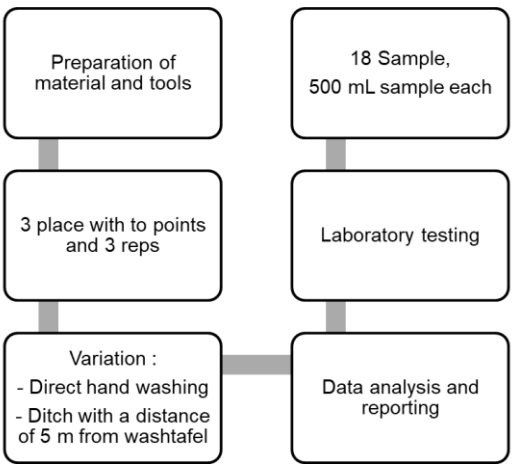


Fig. 2. Flowchart of the research process

The research was conducted from August to December 2020. The samples were obtained at 3 points at each facility. The first sampling point was water from handwashing directly without falling to the ground, and the second sampling point was 5 m from the sink. Each sampling point was three-times repeated. The tests in this study included pH, temperature, TSS, BOD, COD, and detergents. This research was performed in stages so that the experimental results were very rigorous. The research flow process is shown in **Fig. 2**.

3. RESULT AND DISCUSSION

3.1. Parameter of Handwashing Disposal

Handwashing disposal parameter was collected from the 3 points at G. Obos XX market (coordinate: 2°13'58.7"S 113°53'15.8"E), Pasar Besar complex Palangka Raya (coordinate: 2°12'23.1"S 113°56'14.5"E), and KPD Supermarket (coordinates: 2°13'34.8"S 113°54'16.1"E). Sampling was carried out on September 17, 2020. The standard of the domestic wastewater quality is based on the Indonesian Minister of Environment Regulation Number P.68/Menlhk/Setjen/Kum.1/8/2016 [7] that are listed in **Table 1**.

The parameter of handwashing disposal can be known from the COD, BOD, TSS, and detergent parameters at the 3 public facilities displayed in **Table 2**. Compared to the wastewater quality standards (**Table 1**), the total COD parameter in handwashing disposal at the G. Obos XX market was 1668.67 mg/L which exceeded the domestic waste quality standard with a maximum of 100 mg/L. The amount of BOD parameter from hand washing waste at the G. Obos XX market also exceeded the quality standard, 338.00 mg/L, which should be a maximum of 30.00 mg/L. The TSS parameter of hand washing waste at the G. Obos XX market was 213.00 mg/L, exceeding the maximum quality standard parameter of 30.00 mg/L. Based on the results of field observations during sampling, much foam is left over from soap and non-flowing water, which reduces the detergent content to 7478.33 mg/L. The locations around the water sampling are residential areas and shops that directly dispose of their waste without treatment.

The highest parameter of hand washing waste at the Pasar Besar was detergent, 2022.67 mg/L. Based on the domestic wastewater quality standards, the parameter

Table 1. Domestic wastewater quality standards

Parameter	Unit	Maximum Level Parameters
pH	-	6.00 – 9.00
BOD	mg/L	30.00
COD	mg/L	100.00
TSS	mg/L	30.00
Oils & Fats	mg/L	5.00
Ammonia	mg/L	10.00
Total Coliforms	Amount/100 ml	3000.00
Discharge	Liters/person/day	100.00

Table 2. Parameter of handwashing disposal in G. Obos XX market, Pasar Besar, and KPD Supermarket.

Location	Unit	Parameter			
		COD	BOD	TSS	Detergent
G. Obos XX market	mg/L	1668.67	338.00	213.00	7478.33
Pasar Besar	mg/L	117.57	29.60	10.33	2022.67
KPD Supermarket	mg/L	131.00	44.50	37.67	1846.67

that does not exceed is BOD 29.60 mg/L and TSS 10.33 mg/L, with a maximum BOD parameter of 30.00 mg/L and TSS 30.00 mg/L. The COD parameter of handwashing disposal at Pasar Besar is higher than the standard, 117.57 mg/L, which should not exceed 100 mg/L. Based on the results of field observations around sampling, much domestic waste from housing and shops around the market are the biggest waste generators, not just handwashing disposal.

The highest parameter of handwashing disposal at KPD Supermarkets was detergent at 1846.67 mg/L. Based on the quality standards for domestic wastewater and handwashing disposal at the KPD Supermarkets, the parameters that exceed the quality standards include COD, BOD, and TSS. Based on the field observations, all KPD Supermarkets visitors are required to wash their hands with soap which results in an increase in detergent levels which is in accordance with laboratory results that the detergent content is the largest of the other parameters.

3.2. Surface Water Parameters

Surface water samples were taken 5 m from the handwashing disposal sampling area. **Table 3** shows the reference for quality standards from Government Regulation No. 82 Year 2001 concerning Water Quality Management and Water Pollution Control [8] and the results of laboratory tests of obtained sample are displayed in **Table 4**.

The COD parameter of surface water parameter in the G. Obos XX market was 605.67 mg/L, with the quality standard for maximum water parameter for COD Class IV of 100 mg/L, which exceed the quality standard. The BOD parameter of 165.00 mg/L exceeds the quality standard, which should have a maximum BOD parameter of 12 mg/L. The TSS parameter was still good at 85.67 mg/L, included in class III. The highest parameter of detergent from the other parameter was 1237.00 mg/L, while in the quality standard, the highest level of detergent was 0.20 mg/L. Based on field observations around the water sampling location,

Table 3. Standards for water quality

Parameter	Unit	Class			
		I	II	III	IV
BOD	mg/L	2.00	3.00	6.00	12.00
COD	mg/L	10.00	25.00	50.00	100.00
TSS	mg/L	50.00	50.00	400.00	400.00
Detergent	mg/L	0.20	0.20	0.20	0.20

Table 4. Parameter of surface water in G. Obos XX market, Pasar Besar, and KPD Supermarket

Location	Unit	Parameter			
		COD	BOD	TSS	Detergent
G. Obos XX market	mg/L	605.67	165.00	85.67	1237.00
Pasar Besar	mg/L	101.23	24.03	8.33	2353.33
KPD Supermarket	mg/L	91.40	41.60	11.67	1986.67

several residents' housing and shops disposed of their waste directly without treatment, resulting in high COD, BOD, and detergent levels exceeding the quality standard. TSS levels were categorized as class III water according to quality standards in terms of water clarity.

The comparison of handwashing disposal and the water surface in G. Obos XX market is presented in **Fig. 3.** All of the parameter of handwashing disposal was higher than the parameter of surface water. The COD in handwashing disposal was 1668.67 mg/L, exceeding the maximum COD wastewater quality standard limit of 100 mg/L. Meanwhile, the COD surface water parameter was 605.57 mg/L exceeding the class IV surface water quality standard.

The BOD from handwashing disposal was 338.00 mg/L, and surface water was 165.00 mg/L. The BOD from hand washing waste was higher than the domestic wastewater quality standard. Thus it affects the BOD levels in surface water, which exceeds the surface water quality standard levels.

The TSS from handwashing disposal was 213.00 mg/L, exceeding the quality standard for domestic waste, which polluted the environment, and the TSS of surface water was 85.67, classified as class III. If TSS from hand washing waste accumulates continuously without any treatment, it can cause surface water pollution, even though the TSS content in surface water is classified as class III.

The detergent from waste was 7478.33 mg/L, and the detergent content from surface water was 1237.00 mg/L from the maximum quality standard for detergent content of 0.20 mg/L. Handwashing waste pollution is very high. However, the 2016 Minister of Environment and Forestry regulations does not regulate the maximum amount of domestic waste detergent.

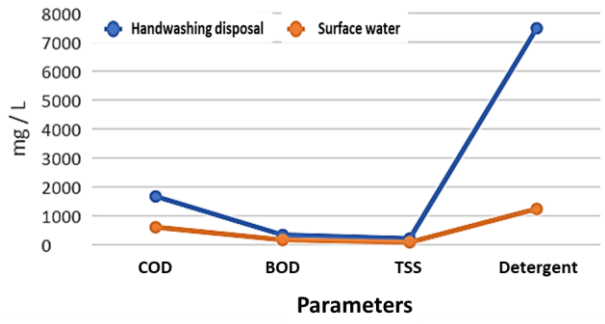


Fig. 3. The comparison of handwashing disposal and the water surface in G. Obos XX market.

The detergent from handwashing waste does not pollute the environment but the surface water, according to Government Regulation No. 82 Year 2001.

The surface water parameter in the Pasar Besar is shown in **Table 4** with a COD parameter of 101.23 mg/L. The COD parameter exceeds the quality standard, which should be 100 mg/L. The BOD parameter of 24.03 mg/L exceeds the quality standard, which should have a maximum BOD parameter of 12.00 mg/L. The TSS parameter of 8.33 mg/L is included in class I. The highest detergent content of other materials was 2353.33 mg/L, while in the quality standard, the highest level of detergent was 0.20 mg/L. Based on observations around sampling, the total domestic waste originates from surrounding housing and shops. The comparison of handwashing disposal parameter with the surface water in Pasar Besar is presented in **Fig. 4**.

The parameter of handwashing disposal was higher than the surface water. The COD of handwashing disposal was 117.57 mg/L, exceeding the maximum COD wastewater quality standard limit of 100 mg/L. While the COD surface water parameter was 101.23 mg/L, exceeding the surface water quality standard. The COD parameter of handwashing disposal exceeds the quality standard of 117.57 mg/L, which becomes a pollutant for the environment, increasing in the COD level of surface water. Thus, the COD level of surface water exceeds the surface water quality standard.

The BOD from handwashing disposal was 29.60 mg/L, and surface water was 24.03 mg/L. The BOD from handwashing disposal does not pollute the environment because it is below the standard for domestic waste BOD standard of 30.00 mg/L. However, the BOD level in the surface water is in accordance with government regulation No. 82 of 2001. The maximum level of BOD in the surface water was 12.00 mg/L, while the BOD level in surface water was 24.03 mg/L in polluted surface water in Pasar Besar.

The TSS from handwashing disposal was 10.33 mg/L in accordance with the domestic waste quality standard, not to exceed the maximum TSS level of 30.00 mg/L, and the TSS of surface water was 8.33 mg/L, classified as class I. The TSS level from handwashing disposal and surface water is still good because it complies with the domestic waste and surface water quality standards.

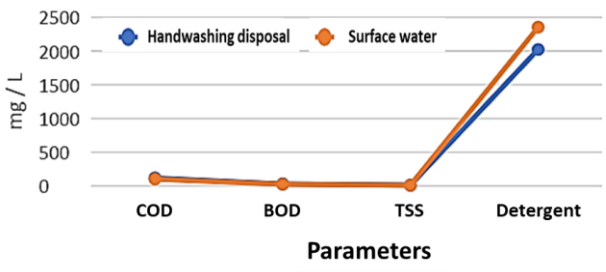


Fig. 4. The comparison of handwashing disposal and the water surface in Pasar Besar.

The detergent from handwashing disposal was 2022.67 mg/L, and the detergent content from surface water was 2353.33 mg/L from the maximum quality standard for detergent content of 0.20 mg/L. Pollution from hand washing waste is very high. However, the 2016 Minister of Environment and Forestry Regulation does not regulate the maximum amount of detergent for domestic waste. The detergent from hand washing waste does not pollute the environment. However, the surface water in the area is contaminated with detergent in accordance with Government Regulation No. 82 of 2001. Pollution does not only occur from hand washing waste because the level of detergent in the surface water is greater than the level of hand washing waste in terms of observations. There are many other sources of pollution.

The surface water parameter in the KPD Supermarket is shown in **Table 4,** with a COD parameter of 91.40 mg/L. The COD parameter is included in the class IV water category. The BOD parameter of 41.60 mg/L exceeds the quality standard, which should have a maximum BOD parameter of 12.00 mg/L. The TSS parameter, 11.67 mg/, was included in the class I water category. The detergent content was the highest of the other contents at 1986.67 mg/L, while in the quality standard, the highest detergent level was 0.20 mg/L. The comparison of handwashing disposal parameter with the surface water in KPD Supermarket is presented in **Fig. 5**.

The COD parameter in hand washing waste was 131.00 mg/L, exceeding the maximum COD domestic wastewater quality standard limit of 100.00 mg/L. Meanwhile, the COD surface water parameter was 91.40 mg/L according to class IV surface water quality standards. The problem is that the COD parameter of polluted water is close to the maximum limit, namely 100.00 mg/L. If handwashing disposal is continuously disposed of on the surface without treatment, it can pollute surface water.

The BOD of handwashing disposal was 44.50 mg/L, and surface water was 41.60 mg/L. The BOD of handwashing disposal exceeds the domestic waste quality standard, which should be a maximum of 30 mg/L. Pollution from hand washing waste affects surface water, thus increasing the surface water BOD levels based on surface water quality standards PP 82 of 2001 maximum BOD content of 12.00 mg/L. Therefore, the BOD of surface water in KPD Supermarkets is polluted beyond the quality standard.

The TSS of handwashing disposal was 37.67 mg/L, in accordance with the quality standards for domestic waste, with a maximum TSS content of 30.00 mg/L. There was contamination from handwashing waste, which exceeded the domestic waste quality standard of 7.67 mg/L. The TSS content of surface water was 11.67 mg/L, classified as Class I. This result means that the TSS parameter in the KPD area at the time of testing is

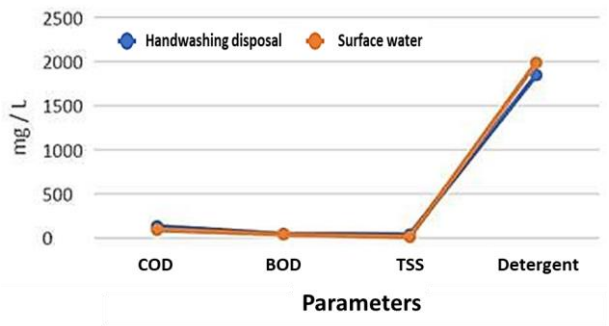


Fig. 5. The comparison of handwashing disposal and the water surface in KPD Supermarket.

still good. However, the problem is continuous pollution from handwashing disposal because it does not comply with domestic waste quality standards.

The detergent content from handwashing disposal was 1846.67 mg/L, and the detergent content from surface water was 1986.67 mg/L from the maximum quality standard for detergent content of 0.20 mg/L. There is very high pollution from hand washing waste. However, the 2016 Minister of Environment and Forestry does not regulate the maximum amount of domestic detergent waste. The detergent from handwashing disposal does not pollute the environment. However, the surface water in the area is contaminated by detergent according to Government Regulation No. 82 of 2001.

3.3. Effect of Health Protocol Policy on Environmental Quality

Based on government policy to reduce the rate of transmission of the Covid-19 disease, the Minister of Health of the Republic of Indonesia issued Decree number HK.01.07/Menkes/382/2020 concerning Health Protocols for Communities in Public Places and Facilities in the Context of Prevention and Control of Covid-19. This policy considers adaptation to new habits toward a productive and safe society from Covid-19. One way to reduce the transmission rate is to maintain cleanliness by washing hands with soap.

The government of Palangka Raya has issued and implemented the health protocol and helps provide hand washing facilities in various public places in the

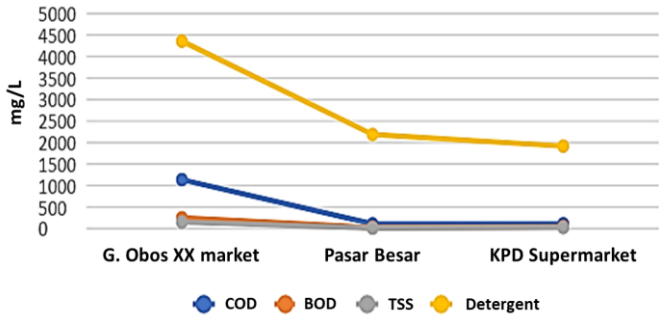


Fig. 6. The comparison of water quality parameter in G. Obos XX market, Pasar Besar, and KPD Supermarket.

Table 5. Comparison of detergent content in G.Obos XX market, Pasar Besar, and KPD Supermarket

No	Location	Detergent Content (mg/L)	Detergent quality standards (mg/L)
1	G. Obos XX market	4357.67	0.20
2	Pasar Besar	2188.00	0.20
3	KPD Supermarket	1916.67	0.20

city of Palangka Raya. In addition, they also appealed to shops by providing handwashing stations in every shop. The increasing number of hand washing stations everywhere has led to an increase in the amount of domestic waste from handwashing activity. Based on the research results, 3 samples of public places were taken from G. Obos XX market, Pasar Besar, and KPD Supermarkets. Laboratory test results of BOD, COD, TSS, and detergent content show that detergent content was the highest of all parameters (**Fig. 6**).

The highest parameter in detergents exceeding 1900.00 mg/L. KPD Supermarkets produced the smallest quantity of detergent compared to the other two places, namely 1916.67 mg/L. In Pasar Besar, the total detergent content was 2188.00 mg/L. This content is the second largest after KPD Supermarkets, and the highest detergent content is in the G. Obos XX market, namely 4357.67 mg/L. The detergent content of each place compared with the quality standards is shown in **Table 5**.

It shows the three locations tested for detergent content exceeding the quality standards set by the government in Government Regulation No. 82 of 2001. Meanwhile, based on the Ministry of Health regulation HK.01.07/Menkes/382/2020, it is mandatory to wash hands with soap. Soap has a high detergent content with the active agent of ABS and it is harmful to the environment. This result is in accordance with a study by Yuliani et al. (2016) stated that the higher the detergent waste concentration, the higher the fish mortality [9]. Therefore, the policy of washing hands with soap can damage the environment.

CONCLUSION

The parameters of handwashing disposal based on the domestic wastewater quality standard at the G. Obos XX market and KPD Supermarkets exceeded the domestic waste quality standard. Pasar Besar contaminated COD content exceeded the domestic waste quality standard. The COD, BOD, and detergent levels in the surface water at the G. Obos XX market and Pasar Besar markets had been polluted, exceeding the quality standards for surface water. Meanwhile, only the levels of BOD and detergent in the polluted surface water at KPD Supermarket exceeded the quality standard for surface water. The Health Protocol Policy regarding handwashing with soap can pollute the environment, especially detergent contamination.

SUPPORTING INFORMATION

There is no supporting information of this paper. The data that support the findings of this study are available on request from the corresponding author (A.I. Santoso).

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CONFLICT OF INTEREST

No potential conflicts of interest were reported by the authors.

AUTHOR CONTRIBUTIONS

A.I. Santoso, the leader of research, conducting the coordination and responsible for all stages of the research implementation, as well as compiling reports and research journal articles. **M. Azhari,** as a research member, conducting to translating articles into english and managing the research budget. **D.S. Putro,** as research member, conducting water sampling in the field and laboratory testing.

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