Physiochemical property of wastewater discharged from smoked fish industry around fishponds area in Penatarsewu Village, Sidoardjo, East Java

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Abstract. One form of fishery product diversification is in the form of smoked fish product, favored by the community because it has a delicious aroma and distinctive taste. Most fish smoked processes in Indonesia are traditionally carried out on a small scale (household) using simple tools that do not pay attention to sanitation and hygienic aspects. The huge potential for smoked fish is often seen as a source of pollutants that the local community complains about because its activities are considered to have an impact on health and environmental changes. This research objective aims to identify the physicochemical parameter of wastewater contained in smoked fish processing activities at Alo River, Penatarsewu Village, Sidoardjo Regency, East Java. Research conducts from September-November 2020, with direct sampling method of wastewater, a disposal site for fish smoking waste by determining the wastewater sample stations along the river, guided by the direction of the flow. Physicochemical properties including pH, TSS, TDS, BOD, and COD were analyzed by Standard Method for the Examination of Water and Wastewater. The result showed pH effluent was within the intolerance limit of 6-9. The highest TDS and TSS are showing by sample 9 were higher than the threshold limit value. The value TDS in sampling point 6 to 9 shows the TDS value was higher than the threshold limit value. The concentration of BOD and COD in the effluent sampling points 8 and 9 were higher with permission limit value Government Regulation, The Republic of Indonesia (PPRI) No. 82, 2001. It is caused by the presence of heavy equipment used as dredging activity along the river carried out by the local government. This indicates that pollution from fish smoking activities in Penatarsewu Village can be said to be insignificant when compared to activities outside fisheries.

Keywords: Penatarsewu village; physicochemical; smoked fish; wastewater
1. Introduction

Commodities produced from aquaculture have increased the amount of production in Indonesia, reaching 6,772,543 tons of fishery production. If it is taken from the data of per capita fish consumption from year to year, which continues to increase, there is a change in the trend of world consumption to shift from animal protein to fish protein [1, 2]. One of the options developed for fishery products is fish processing. Fish processing operations cannot be separated from the handling process, which typically produces waste from liquid to solid waste. It can also be a source of air pollution. The resulting liquid wastes contain dissolved organic matter in water, such as blood, mucus, and non-dissolved (fat) matter [3, 4]. Meanwhile, organic solid waste is generally in the form of stomach contents, scales, gills, bones, skin, and fish fins.

Java Island is one of the central ponds with a promising level of fishery products. One of how fish products are diversified is by smoked fish. Smoked fish is a product preferred by the community as it possesses a delicious aroma and distinctive taste. The majority of fish smoking processes in Indonesia are traditionally carried out on a small scale (household) using simple tools that do not pay attention to sanitation and hygienic aspects so that it has an impact on health and environmental changes.

Penatarsewu Village, which is located in Sidoardjo Regency, East Java, has potential in the field of fish processing that comes from the aquaculture of the surrounding community. Tilapia is turned into smoked fish as a form of value-added that helps improve the community's economy. Approximately 90% of the population relies on the sale of tilapia smoke, making Penatarsewu Village known as the smoke village. Fish smoking activities are mostly carried out in people's homes so that household activities and production activities are mixed and cause various environmental problems. The huge potential for smoking fish is often seen as a source of pollutants that the local community complains about because their activities are considered to have an impact on environmental quality degradation. Given the possibility that waste may be disposed of without special treatment or treatment, this is very hazardous to health and has an impact on the reduction of ecological function. Thus, this research aims to identify the physicochemical parameter of the wastes contained in the transformation activities of smoked fish in Alo River, Penatarsewu Village, Sidoardjo Regency, East Java.

2. Methodology

2.1. Time and study area

The study was conducted from September to November 2020 in Penatarsewu Village, Sidoardjo Regency, East Java (figure 1). The direct sampling method of wastewaters is used along with a disposal site for fish smoking waste by determining the wastewater sample stations along the river by ten sampling locations along the main River called Alo River.

2.2. Water sample collection

Water samples were collected from ten sampling stations along the river by following the current flowing towards the sea. From each sampling station, water samples were collected by plastic jerry cans with volume 5L. Those ten samples were then transported to the laboratory to be analyzed by standard methods 23rd Edition 2017 and tested by standard Government Regulation, The Republic of Indonesia [5].

2.3. Physicochemical analysis

During the sampling activity, the water temperature was measured by using a digital thermometer. In this research, physicochemical analysis is divided into two, namely the physical and chemical tests. The physical test involved Total Suspended Solid (TSS), Total Dissolved Solid (TDS), while the chemical test such as Chemical Oxygen Demand (COD), and Biochemical Oxygen Demand (BOD) measured by using the Standard Method for the Examination of Water and Wastewater [5], by following the parameter tested.
2.3.1. **Total Suspended Solid (TSS)**. Transfer a measured volume onto a glass fiber filter with the applied vacuum. Wash filter with at least three successive volumes ≥10 ml reagent grade water. Allow complete drainage between washing and continue suction until all traces of water are removed. When filtering samples with high dissolved solid concentrations, additional washings may be required to ensure that dissolve material is removed from all exploded filter surfaces. Remove the filter from the filtration apparatus and transfer it to an inert weighing dish. Dry for 1 h in an oven 103-105°C oven, cool in a desiccator to ambient temperature and weight, repeat the cycle (drying, cooling, desiccating, and weighing) until the weight change is ≤ 0.5mg.

2.3.2. **Total Dissolved Solid (TDS)**. To measure the TDS, using Standard Method for the Examination of Water and wastewater by transfer a measured volume onto a glass fiber filter with the applied vacuum. Then, continue by wash the entire exposed surface of the filter with successive of ≥10 ml reagent grade water. Allow complete drainage between washing and continue suction until all traces of water are removed. Transfer total filtrate to a pre-weight evaporating dish and evaporate dryness. Dry evaporated sample for 1 h in an oven 180 °C.

2.3.3. **Chemical Oxygen Demand (COD)**. Pipette 50 ml sample into a 500 ml refluxing flask. Add 1 g HgSO₄, several glass bead, and very slowly add 5.0ml sulfuric acid reagent with mixing to dissolve HgSO₄. Cool while mixing to avoid possible loss of volatile materials. Add 25 ml 0.04167M K₂Cr₂O₇ solution and mix. Attach the flask to condense and turn on cooling water. Add remaining sulfuric acid reagent (70ml) through the open-end condenser. Continue swirling and mixing while adding sulfuric acid reagent. Cover
the open end of the condenser with a small beaker to prevent foreign material from entering the refluxing mixture and reflux for 2h. Cool and wash down the condenser with distilled water. Disconnect the reflux condenser and dilute the mixture to about twice its volume with distilled water. Cool to room temperature and titrate excess K2Cr2O7 with FAS, using 0.10 to 0.15ml (2 to 3 drops) ferroin indicator. Take as the endpoint of the titration the first sharp color change from blue-green to reddish-brown that persists for 1 min or longer. In the same manner, reflux and titrate a blank containing the reagent and a volume of distilled water equal to that sample.

2.3.4. **Biochemical Oxygen Demand (BOD)**. Add desired sample volume to BOD bottles (300 ml) approximately two-thirds full of dilution water. Without entraining air. Add an appropriate amount of seed suspension and nitrification inhibitor. (3 mg TCMP). Add nutrient, mineral, and buffer solution directly to diluted sample at a rate of 1mL/L (MgSO4, CaCl2, and FeCl3). Use membrane electrode method to determine initial DO on all sample dilutions, dilution water blank, seed control. Incubate samples at 20 ± 1°C the stoppered and sealed BOD bottles containing desired dilution, seed control, dilution water blank. Exclude light avoid algae growth in bottles during incubation. After 5d of incubation determine to DO in all sample dilutions, blank using a membrane electrode method.

2.4. **Data analysis**

Data collection is carried out by tested ten sampling sides and compare the test results with the water quality classification (I, II, III, IV) from the Government Regulation, The Republic of Indonesia (PPRI) No. 82, 2001 [6]. Besides, qualitative descriptively data were observed by interviews from the local communities in the study area.

3. **Results**

3.1. **pH**

Determination of pH is very important because it influences the other physicochemical parameters and the availability of metal ions in the water and wastewater (effluent). pH is the measure of acidity and alkalinity of water. Figure 2 showed the pH of all sampling points from 1 to 10 are between 7.37-7.67. The pH of the sample is normal. The activities of the hydrogen and hydroxyl ion are equal, and each corresponds to an approximate activity of 10^-7 moles/L. It’s meant the pH of effluent was within intolerance limit of 6-9 by Environmental Government regulation of Republic Indonesia [6].

3.2. **Total Dissolved Solid (TDS)**

The concentration of TDS in the effluent of the smoked fish industry has a variety of values. Sample from 1-5 and 10 ranged from 1042-1130 mg/L (figure 3). It means that samples 1-5 and was below the permissible limit of within 2000 mg/L by Government Regulation, The Republic of Indonesia (PPRI) No. 82, 2001 for effluents for wastewater of fish processing to be discharged into the water body. While the value TDS in sampling point 6 to 9 shows the TDS value was higher than the threshold limit value (over 2000 mg/L). The highest TDS is showed by Sample 9 (15687 mg/L). TDS composition may include salt, metal, metalloids, and dissolved organic matter. The formation of inorganic TDS by dissolution and desorption depends on many parameters associated with a biological and chemical process, such as pH, ionic strength, temperature, and concentration of dissolved oxygen and organic carbon [7]. The value of TDS in sampling point 9 was higher than the discharge of tannery effluent, it 9370 mg/L [8].
3.3. Total Suspended Solid (TSS)

The concentration of TSS in the effluent of smoked fish ranged from 4.7-149 mg/L (figure 4). The effluent sampling point 2, 5, 7, 8 and 9 showed TSS values were higher than the permissible limit by Government Regulation, The Republic of Indonesia (PPRI) No. 82, 2001 (50 mg/L). The effluent 9 showed the highest value than the others, it’s 149mg/L. The result of this study indicated that effluent 9 should not be discharged into the river and must pass through wastewater treatment. The composition of TSS may include sand, silt, clay, mineral precipitates, and biological matter. TSS formation primarily depends on physical processes driven by fish processing, erosion of adjacent surface soil, colloidal, and clay [7].
Figure 4. Total Suspended Solids (TSS) along the river of effluent smoked fish.

3.4. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

The concentration of BOD and COD in the effluent of smoked fish ranged from 5.1-232 mg/L, while the COD ranged from 20-800 mg/L (figure 5). Government Regulation, The Republic of Indonesia (PPRI) No. 82, 2001 recommended standard limits value of 60 mg/L and 150mg/L. That mean, Sampling point 8 and 9 have the highest permission limit value BOD and COD. The highest BOD was showed by Sample 9. The addition of oxidizable pollutants to streams produces an oxygen sag. An unpolluted stream is relatively free of oxidizable material; the oxygen level is high; and the bacterial population is relatively low. With the addition of oxidizable pollutants, the oxygen level drops because reaeration cannot keep up with oxygen consumption. In the decomposition zone, the bacterial population rises. Organic pollutant caused the decrease of level oxygen are sewage, soap, detergent, pesticides [9].

Figure 5. BOD and COD along the river of effluent smoked fish.
4. Discussion

The processing of smoked fish in Penatarsewu Village is carried out traditionally, from the purchase of materials to the selling process carried out in traditional markets. The following is an overview of the production process:

Raw material -> Cleaning -> Washing -> Cutting -> Fish stick -> Smoking -> Sorting -> Marketing

In terms of Law no. 32 of 2009 [10] concerning Environmental Control and Management, what is meant by the impact is the effect of changes to the environment as a result of a business and/or activity. The environment can be polluted due to human activities themselves, either through industrial activities or household activities that produce waste and garbage. The production process of smoked fish processing businesses and/or activities in Penatarsewu Village produces various wastes in the form of liquid waste, solid waste, or gas, namely in the form of smoke. The following is an overview of the various wastes produced.

| Table 1. Production waste from smoked fish activities. |
|--------------------------------------------------------|
| Production process | Raw material | Waste                                      |
| Purchase of raw materials and supporting materials     | Fish, coconut shell |                                          |
| Fish cleaning                                           | Clean water | Strench, dirty water                       |
| Cutting                                                 | Swallow wood, knife | Strench, dirty water, fish blood,          |
| Washing                                                 | Clean water, sink | Strench, fish blood                        |
| Stick                                                   | Bamboo stick, fish cut | Strench                                 |
| Smoking                                                 | | Smoked                                      |
| Sorting                                                 | Bamboo plate | Strench                                   |

The cleaning process up to immersion of the fish produces liquid and solid waste in the form of dirty, cloudy, and smelly water. This process also produces solid waste in the form of fish waste pieces (offal, head, scales, fish bones). These various wastes are disposed of directly into river flow around industrial activities. The disposal process is carried out directly into the river flow without any prior treatment. Smoked fish business actors and/or processing activities tend to ignore these regulations. this is due to lack of infrastructure and limited budget in providing support such as IPAL (Wastewater Treatment Plant) in the internal environment within the fish smoking industrial area. The availability of this IPAL is necessary so that the environmental conditions are more suitable for a clean industry and do not pollute river water.

Fish is the main material used in the smoking process, with the main raw material being obtained from the ponds or ponds around the Penatarsewu village. This fish smoking activity has the potential to increase the production of waste produced, these wastes will greatly affect changes in environmental conditions around the village of Penatarsewu. Common environmental impacts caused by smoking activities are air pollution, solid waste, and liquid waste. If this waste is not treated properly, it will cause pollution to the surrounding environment. The waste generated from fish smoking activities in the Penatarsewu village is rarely treated properly, such as water from washing fish and fish guts that are thrown away carelessly, this results in a bad smell that can disturb the comfort of the community.

The waste management in the Sidoardjo fish smoking industry is not optimal, many of these industries dispose of their waste into sewers or directly into the Alo river in Penatarsewu village. This greatly affects the environmental conditions of the rivers around it, so that the condition of the river will become polluted.
due to careless disposal of waste. The contamination of the Alo river greatly affects the fish farming activities around the village, because the source of water in cultivation activities is taken directly from the river. The results of this research activity state that the physiochemistry parameter include pH, TDS, TSS, COD, and BOD. Determination of pH is very important because it influences the other physicochemical parameters and availability of inorganic chemicals in the water and wastewater. The pH effluent is normal to show the activities of the hydrogen and hydroxyl ion are equal. The effluent sampling point 9 showed the highest physiochemistry parameter which value was above permission limit government regulation Indonesia. It is caused by the presence of heavy equipment used as dredging activity along the river carried out by the local government.

This of course also affects aquaculture activities that use water as a source of aquaculture. So that pollution from fish smoking activities in Penatarsewu Village can be said to be insignificant when compared to activities outside fisheries, such as dredging.

Solid refers to matter suspended or dissolved in the potable, surface, and saline water, as well as domestic and industrial wastewaters. Solid may adversely affect water or effluent quality in several ways. Water with high dissolved solid generally is inferior palatability. TDS (Total Dissolved Solid) is a collection of solids dissolved in water. The solid substances in question can be minerals, metals, salts, and ions. TDS levels that are too high can cause concentrated water, making it look cloudy. The excess ion content also has short-term and toxic effects on cultivated commodities. This shows that water with a high TDS level is very unfavorable for aquaculture. High TDS can also affect the pH of the water. This is because high TDS contains high mineral levels so that it can make water pH increase.

In the fish processing process, clean water infrastructure is needed, because clean water cannot be separated from the fish processing process. The water used in the smoked fish processing process is clean so that it meets the stipulated requirements. Apart from the problems above, the smoke problem is also quite disturbing. The resulting data is based on laboratory results tested based on Government Regulation No. 5 of 2019. Changes in the TDS concentration can be as dangerous as it will because of changes in salinity, change in ion-composition, and their respective toxicity ion. Changes in salinity can disrupt the balance of water biota, biodiversity, cause species that are less tolerant, and cause high toxicity at a life stage organism

The value of TSS is weak and moderate. TSS value is usually taken as an index of contamination potential of water. Literature classified wastewater TSS as follow, if TSS is less than 100 mg/L it is weak, greater than 100 mg/L but less than 220 mg/L is medium, and greater than 220 mg/L is strong wastewater [11].

BOD and COD. The high BOD and COD values indicate toxic state wastewater together with the presence of biologically resistant organic substances [8]. COD is one of the most widely used parameters of indicating organic pollution applied to both wastewater and surface water, it is defined as the oxygen requires for microorganisms to carry out the biological decomposition of dissolved solid or organic matter in wastewater.

5. Conclusion
Smoked fish industry wastewater is considered a problem and is detrimental to every industry player. The highest TDS and TSS are showed by sample 9 were higher than the threshold limit value. The value TDS in sampling point 6 to 9 shows the TDS value was higher than the threshold limit value. The concentration of BOD and COD in the effluent sampling point 8 and 9 were higher with permission limit value Government Regulation, The Republic of Indonesia (PPRI) No. 82, 2001. It is caused by the presence of heavy equipment used as dredging activity along the river carried out by the local government. This indicates that pollution from fish smoking activities in Penatarsewu Village can be said to be insignificant when compared to activities outside fisheries.
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