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INTEGRATION OF ATTACHED GROWTH AND SUSPENDED GROWTH METHODS FOR PROCESSING THE LIQUID WASTE OF PATHOLOGY LABORATORY OF SURABAYAE-LAB CLINIC

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ABSTRACT

Laboratory waste is all solid and liquid waste produced by laboratory activities and other supporting activities. Laboratory waste can harm the surrounding environment if it is not managed or treated with liquid waste before it is put into a water channel or body. Laboratory waste is not only dangerous but also infectious. This study aims to treat the waste produced by the Surabaya E-Lab Clinic Pathology Laboratory using the integration of attached growth and suspended growth methods which were arranged in series using laboratory scale reactors to reduce pollution load of BOD, COD, TSS. The attached growth reactor is an anaerobic reactor equipped with green sand and activated charcoal. The suspended growth reactor is an aerobic reactor equipped with a rotor which functions to mix and increase dissolved oxygen needed by microorganisms. Wastewater was put into an anaerobic reactor which was directly filtered by greensand and activated charcoal, then entered the aerobic reactor rotated by the rotor with variations in the rotation speed of 50,100 and 150 RPM with processing time in these two reactors for 15, 27 and 31 hours.The lowest outlet concentration results for BOD, COD, TSS was 45 mg/L, 77 mg/L, 60 mg/L, respectively, which occurred at 50 RPM rotation and 31 hour rotation time, where only TSS parameters did not meet applicable wastewater quality standards in Indonesia. The highest removal efficiency for BOD, COD, and TSS at reactor outlets was 92%, 93%, 88%, respectively, at the 50 RPM rotation and 31 hour rotation times.

KEY WORDS : BOD, COD, TSS, Suspended-growth, Attached growth,

INTRODUCTION

Laboratory waste is a mixture of various chemical reactions and the rest of the lab samples which have a negative impact. The main types of chemicals commonly used include chemicals, acids, bases, and chemicals as well as chemicals that are organic and inorganic (Raimon, 2011). Laboratory wastes can allow environmental pollution or disease transmission (Ahmad, 2011). Laboratory pathology clinical waste is produced during routine patient care and comes from pure samples of patients which include urine, feces, blood, sputum and other body fluids, the rest of the test specimens and chemicals used for analysis (Adli, 2012). Chemical pollutants contained in laboratory waste are chemical compounds including detergent, phosphate, and other chemicals so that this waste is considered to havehigh risk if it is wasted directly in the environment (Sitepu, 2015). If liquid waste can be treated, river pollution can be prevented (Razif *et al.,* 2014). A pollution-free river will be beneficial for the sustainability of raw water for drinking water in big cities like Surabaya (Razif and Persada, 2015a). In addition to the discharge factor of wastewater discharged into the river, the river water discharge factor also has a significant effect on river water quality parameters (Razif and Persada, 2015b). If the river has been heavily polluted, it is very difficult to restore it in the short term, because the water quality of the river in the future still shows severe polluted conditions (Razif *et al.*, 2018). This river water pollution is inseparable from the non-functioning of the Wastewater Treatment Plant (Razif *et al*., 2015c) because it cannot overcome the fluctuations of treated wastewater quality (Razif *et al.*, 2015d). Another concern is about the amount of operating and maintenance costs (Razif *et al*., 2015e). If the Wastewater Treatment Plant can be implemented properly, river pollution can be reduced (Razif et al., 2014). The negative impact that comes with the increase of activity is always a threat to the continuity of individual life on earth (Amien, 2015). Waste is the residual of the production process that is no longer used and will be immediately discarded; if it is not treated appropriately, itcan harm humans and the surrounding environment (Kulkarni and Kherde, 2015). Therefore, the handling steps are needed before the waste is discharged into the environment or reused as water to support activities such as watering plants (Arif and Ikbal, 2013). Various wastewater treatment techniques to set aside water from contamination materials are usually carried out using three methods, namely physical processing, chemical processing, and biological processing (Zeng, 2014). Biological processing uses microorganisms that can convert components that can be broken down by microorganisms into microbial biomass, which can be separated by separation processes such as sedimentation and flotation (Dabi, 2015). Based on the growth process of microorganisms, this biological processing can be divided into three processing methods, namely suspended growth, attached growth, and a combination of suspended and attached growth (Azizi, 2018). Comparison of attached growth and suspended growth has been examined in previous studies (Hamid and Razif, 2014). Suspended growth uses an activated sludge system, which is a mixture of heterogeneous microorganisms that are mixed continuously using a motor or rotator installed in the process (Gulhane and Sahare, 2014). In addition to functioning as attached growth, anaerobic reactors can also function as suspended growth in the form of Anaerobic Baffled Reactor (Mahatyanta and Razif, 2016).

Research Method

This study used a research reactor designed for laboratory scale, which consists of reactors attached to growth and suspended growth operated in series. The attached growth reactor is an anaerobic reactor containing greensand and activated charcoal. Suspended growth rectors are aerobic reactors containing rotors rotated to increase dissolved oxygen levels in anaerobic reactor. A sampling of wastewater was carried out in the inlet before entering the anaerobic reactor and in the outlet after exiting the aerobic reactor. The variables of this study were residence time in both reactors (15 hours, 27 hours, 31 hours) and rotational speed in aerobic reactors (50 RPM, 100 RPM, 150 RPM). Sample water from the inlet and outlet was analyzed in the laboratory, where the BOD content used the Iodometric titration method; the COD content used the Reflux method and the TSS content used the Gravimetric method.

RESULTS AND DISCUSSION

Based on the measurement results of the concentration content in the anaerobic reactor inlet and the aerobic reactor outlet for the BOD, COD, and TSS parameters, the results are shown in Table 1, 2 and 3. According to the Regulation of Minister of Environment of Republic of Indonesia No. 5 of 2014 on wastewater quality standards for businesses and/or activities of health service facilities, the wastewater quality has 50 mg / L of BOD values, 80 mg / L of COD values, and 30 mg / L of TSS values. If it is compared with the value of wastewater quality standard inTable 1, 2, and 3, the TSS quality standard is not fulfilled. The non-fulfillment of TSS quality standards is possible because the attached growth process (aerobic reactor) was not equipped with a clarifier which functions to separate the microbial floc suspended in the aerobic reactor. Based on Table 1, Table 2, Table 3, the amount of removal efficiency for BOD, COD and TSS parameters can be calculated as shown in Table 4, 5 and 6.

Table 1. Concentration results for BOD parameters

Time (hour)	Inlet (mg/L)	Outlet 50 RPM (mg/L)	Outlet 100 RPM (mg/L)	Outlet 150 RPM (mg/L)
15	580	249	269	278
27	580	132	152	164
31	580	45	69	85

Table 2. Concentration results for COD parameters

Time (hour)	Inlet (mg/L)	Outlet 50 RPM (mg/L)	Outlet 100 RPM (mg/L)	Outlet 150 RPM (mg/L)
15	1073	443	496	526
27	1073	236	277	303
31	1073	78	112	147

Table 3. Concentration results for TSS parameters

Time (hour)	Inlet (mg/L)	Outlet 50 RPM (mg/L)	Outlet 100 RPM(mg/L)	Outlet 150 RPM(mg/L)
15	500	308	363	390
27	500	108	163	185
31	500	60	83	90

It can be seen from Table 4, 5 and 6 that the highest removal efficiency reached at 50 RPM and 31 hours. The longer the residence time of wastewater in the reactor, the greater the chance of wastewater degradation by decomposing microbes, whereas the higher the rotational speed of rotation, the lower the removal efficiency results. It is probably due to the difficulty in separating the microbial floc that has been formed from the supernatant.

Table 4. Removal Efficiency of BOD Parameters

Time (hour)	Outlet 50 RPM (%)	Outlet 100 RPM (%)	Outlet 150 RPM (%)
15	57	54	53
27	77	74	72
31	92	77	74

Table 5. Removal Efficiency of COD Parameters

Time (hour)	Outlet 50 RPM (%)	Outlet 100 RPM (%)	Outlet 150 RPM(%)
15	60	54	51
27	78	74	72
31	93	90	86

Table 6. Removal Efficiency of TSS Parameters

Time (hour)	Outlet 50 RPM (%)	Outlet 100 RPM(%)	Outlet 150 RPM(%)
15	39	28	22
27	79	68	63
31	88	84	82

CONCLUSION

1. The results of the best outlet concentration for BOD, COD, TSS are 45 mg/L, 78 mg/L, 60 mg/L, respectively, which occurred at 50 RPM rotation and 31 hours rotation time, where only TSS parameters do not meet the standard of wastewater qualityin Indonesia
2. The highest removal efficiency for BOD, COD, and TSS at reactor outlets is 92%, 93%, 88%, respectively, occurring at the 50 RPM rotation and 31 hour rotation time.

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