Decreasing Level Of Total Suspanded Solid (TSS) And Nitrate In Alcohol Traditional Wastewater Using Multi Soil Layering Electrolysis (MSLE) Method

Nanda Pratiwi Mahardika[1], Siti Fatimah [2]

[1]Chemical Engineering Departement, Muhammadiyah Surakarta University

[2]Chemical Engineering Departement, Muhammadiyah Surakarta University

E-mail: nandapratiwi203@gmail.com , sf120@ums.ac.id

Abstract. Home industry for making alcohol traditional in Bekonang Village, Sukoharjo produces large volumes of liquid waste which is discharged into the river without going through any waste treatment. One of the wastewater treatment methods is Multi Soil Layering Electrolysis (MSLE) which is a combination of Multi Soil Layering (MSL) and Electrolysis methods used to reduce levels of Total Suspanded Solid (TSS) and Nitrate in Alcohol waste. The purpose of this experiment was to determine the effect of time and voltage variations and the effectiveness of using the Multi Soil Layering Electrolysis (MSLE) method to reduce traditional alcohol waste. The results showed that MSLE method is quite effective to reduce Nitrate levels by 82.06% with an effective voltage of 10 volts in 40 minutes. Meanwhile, for TSS levels increase until 164 mg/L with the voltage is 10 volts in 30 minutes.

Keywords: *Alcohol, Electrolysis, Multi Soil Layering, Nitrate, TSS, Wastewater*

1. INTRODUCTION

The development of the industrial sector in Indonesia is accompanied by various problems. The problem that is always associated with industry is waste. One of the industries reported as having problems with waste is the alcohol industry located in Bekonang village, Mojolaban, Sukoharjo. In the village of Bekonang almost every home of its residents becomes ethanolic craftsmen. The production of alcohol produced is as much as 1000-1500 liters/day with waste as much as 7000-10,000 liters / day. Based on this number, it can be seen that every day the alcohol production process produces a large volume of liquid waste (Nurcahyani et al, 2015).

The increasing level of productivity of the alcohol industry will have an impact on the environment both positive and negative impacts. The industrial sector is able to open jobs and improve community income. On the other hand the development of industry also provides negative impact on the environment, namely a decrease in environmental

quality. Some industries, especially those still on the scale of home industries, do not has a wastewater management installation (WWTP). The waste produced is not managed properly, and disposed of into river bodies without management. Thing this can cause river pollution and affect river ecosystems and the surrounding environment. Waste from the industry can pollute the water river, if there is damage to one of the environmental components in the river then will affect other components. Pollution and contamination of water the river does not only harm the people who inhabit the riverbanks only But it is like a river that flows from upstream to downstream means to bring negative impacts to other communities (Safitri, 2018).

1.1 TSS

Total Suspended Solid affects the light intensity of water; suspended solids are the cause of suspended particles inside the water body influencing turbidity and transparency (Poddar and Sahu , 2015).

TSS was measured by using filtration method. To determine total suspended solids, a piece of filter paper was weighed out as accurately as possible. Then, the water sample was allowed to pass through the conical flask where the filter water was placed in the conical flask. The filter paper was allowed to dry completely and was put in incubator for 24 hours. The change in the weight was the weight of the total suspended solids (Wong et al , 2013).

1.2 Nitrate

Nitrate (NO3-) is the main hydrogen form in natural waters. Nitrate comes from ammonium which enters the waters through waste. Nitrate levels can decrease due to the activity of microorganisms in water. Microorganisms will oxidize ammonium to nitrite and by bacteria will convert to nitrate. The oxidation process will cause reduced oxygen concentration. Nitrates are very easily dissolved in water and are stable (Patricia et al,2018).

Nitrate is an important nutrient for plants, but if it is at excessive levels it can cause significant water quality and ecological problems, such as blooms of toxic algae, eutrophication eutrophication of lakes and reservoirs and extinction of species in the river ecosystem (Su Liuhua et al , 2017 ; Xue Ying et al, 2016).

The traditional method for identifying nitrate pollution sources in water bodies combines investigation of land use type of pollution area with analyses of concentrations of nitrogen compounds in water. However, it is difficult to identify the actual sources of nitrate pollution effectively using the traditional method, since the nitrogen compounds are affected by physical, chemical and biological processes simultaneously (Xue Ying et al, 2016).

1.3 Multi Soil Layering Electrolysis (MSLE)

Seeing the level of organic liquid waste is quite high at the disposal of industrial activities, this study was conducted to reduce the levels of TSS and Nitrate that occurred in alcohol liquid waste using combine treatment that are Multi Soil Layering (MSL) and Electrolysis method.

MSL (Multi Soil Layering) is a system using soil, zeolite, and charcoal as carbon sources which are arranged in patterns such as bricks and using aeration pipes as a source of oxygen. This method has been carried out in Japan and Thailand to process organic wastes. MSL (Multi Soil Layering) method, this method is effectively used to remove

organic wastewater components. The availability of abundant materials at affordable costs, and not yet widely developed, allows the MSL method to be utilized and developed for liquid waste treatment processes. As MSL systems are mainly composed of local materials such as soil, charcoal, sawdust and iron, the cost of construction is comparatively low. (Irmanto et al,2012)

MSL system has been verified to be efficient for the elimination of organic matter, nitrogen (N) and phosphorus (P) in wastewater, there is a lack of studies that have investigated bacteria removal by the MSL system. As water consumption is very limited in the rural areas of Morocco, domestic wastewater is generally very concentrated in organic matter, N and P. the performance of the MSL system in the removal of fecal contamination bacteria indicators and pathogens, and to compare this performance with that of other natural technologies commonly used for small community wastewater treatment (Latrach et al., 2015).

Electrolysis offers prospective advantages of relatively simple equipment, oxidative or reductive chemistry, and operation at ambient temperature and pressure (Sharma et al,2016).

The Electrolysis literally means to break substances apart by using electricity. The process occurs in an electrolyte, a watery or a salt melting solution that gives a possibility to transfer the ions between two electrodes. When an electrical current is applied, the positive ions move to the cathode while the negative ions move to the anode. At the electrodes, the cations are reduced and the anions will be oxidized. Environmentally oriented electrochemistry is more and more asked for pollution abatement of wastewater and reclaiming the requirement of discharge or permissible limit of wastewater. Under these circumstances an electrochemical treatment is an emerging technology with many applications in which a variety of unwanted dissolved toxic chemicals and microorganisms can be effectively removed from wastewater (Sharma et al,2016).

2. MATERIALS AND METHODS

In this reserach used *Multi Soil Layering Elektrolysis* (MSLE) method where the method combined from two method that is Multi Soil Layering (MSL) and Electrolysis with using two variation factor. First factor is variation of voltage with three variation (5, 15, 25, volt) to find the effective voltage and second factor is variation of time there are five variation (10,15, 20, 30, 40 minute), to find the effective time using effective voltage from first factor.

2.1 Materials

The design of Multi Soil Layering system using 1.5 L bottle, at the bottom bottle was cut by 2 cm, with composition absorbent of MSL instrument from top are gravel, charcoal, zeolite sand, coarse cotton, soil + active carbon, and fine cotton.

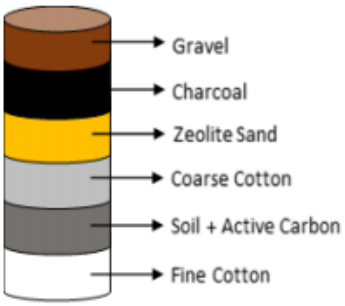

Figure 1. Design of MSL system

The electrolysis process is carried out with a batch system. The waste used is alcohol wastewater which has gone through a multi-soil layering process. A total of 350 mL was put into beaker glass. Then brass electrodes are installed as anodes at the poles (-) and copper electrodes as cathodes installed at the poles (+). Both electrodes are inserted 5 cm in beaker glass that contain a sample.

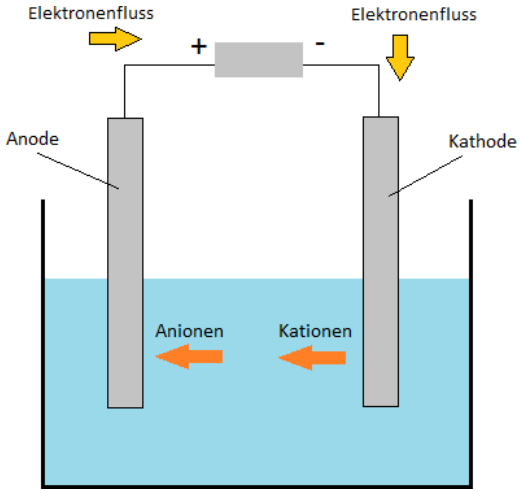

Figure 2. Design of Electrolysis system

2.2 Procedure

Alcohol liquid waste taken directly fom temporary reservoir as musch as 2 ml and diluted in 1L of water. The sample that was diluted is directly analyzed for TSS and nitrate parameter as sample 0 without anytreatment. As same procedure dilute 2 ml sample in 1L water, poured into MSL system until the liquid comes out, then treat with electrolysis process with using variation voltage that are 5, 10, 15 V, analyze TSS and Nitrate parameter to find the effective voltage that is used.

Repeat the same procedure and the treatment to find the effective time using the effective voltage in a process before, combine with various operating time that are 10, 15, 20, 30, 40 minute . Then analyze the levels of TSS and Nitrate.

3. RESULT AND DISCUSSION

The research has been done , the result show there was change level before and after given with MSLE treatment process. The levels of TSS and Nitrate before given MSLE process obtained are as in the table below:

Tabel 1. Result data of TSS and Nitrate without any tretment

Sample	TSS (mg/L)	Nitrate (mg/L)
0 (diluted sample)	56	5.018

As much 2 ml of Alcohol liquid waste that dilute in 1L of water, from the result showing the levels of TSS amounted to 56 mg/L, and 5.018 mg/L for level of Nitrate, before being given MSLE treatment.

Tabel 2. Analysis result variation of voltage concern to TSS levels

Voltage (V)	Time (minute)	TSS (mg/L)
5	10	80
10	10	64
15	10	104

Furthermore, the liquid waste is treated using MSLE method with voltage variations in electrolysis process are (5, 10, 15) volts in 10 minutes. This method is carried out to find the effect of an effective voltage for TSS levels and from the data get an effective voltage is 10 volts of 64 mg/L .

Tabel 3. Analysis result variation of time concern to TSS levels

Voltage (V)	Time (minute)	TSS (mg/L)
10	10	61
10	15	60
10	20	80
10	30	164
10	40	150

For the treatment using the electrolysis method with a variation of time (10, 15, 20, 30, 40) minutes with voltage is 10V, from the data show that the higher level of TSS is 164 mg/L at the time is 30 minute.

TSS levels actually have increased after being given treatment, this is due to the possibility during the process of filtering the electrolysis results there are flocks that are followed and also there is a stirring factor so that the flock clumps are

recombined as well as the deposition of the carbohydrate content contained in the waste. So for testing TSS levels of liquid waste samples after electrolysis need to be deposited by settling for a long time to separate the suspended solids with water.

Tabel 4. Analysis result variation of voltage concern to Nitrate levels

Voltage (V)	Time (minute)	Effectivity (%)
5	10	76,68
10	10	78,48
15	10	77,28

After testing the TSS levels, the next parameter being tested is the Nitrate level. Nitrate levels in ethanol waste are 5,018 mg/L. For the treatment using the electrolysis method with time variations (10, 15, 20, 30, 40) minutes and 10 volt voltage, it was found that the effective time was 10 minutes at 1.08 mg/L with the effectiveness lowering 78.48%.

Tabel 3. Analysis result variation of time concern to Nitrate levels

Voltage (V)	Time (minute)	Effectivity (%)
10	10	78,48
10	15	79,08
10	20	78,88
10	30	80,87
10	40	82,06

For the treatment using the electrolysis method with time variations (10, 30, 45, 60, 75) minutes and 10 volt voltage, the graph shows that the effective time is 40 minutes by 0.9 mg/L with the effectiveness lowering 82.06%.

Judging from Figure 4 and Figure 5, using the highest voltage and time is 15 volts and 40 minutes. In this research the most effective decomposition of nitrate levels is known at 10 volts for 40 minutes, this is because if more than that decomposition will decrease. This is due to the electrodes being blocked by hydroxyl ions and will reduce the nitrate adsorption on the electrode surface. As the voltage increases, it will accelerate not only nitric oxidation, but also other reactions due to far exceeded potential. In this case it can be said that the increase in voltage can accelerate the reaction but reduce selectivity.

4. CONCLUSION AND SUGGESTION

Based on the results of research and discussion, the following conclusion and suggestion are obtained :

4.1 Conclusion

The electrolysis multi soil layering method is effective for reducing nitrate levels, while the method is less effective for reducing TSS levels in the treatment of liquid alcohol waste.

After using the MSLE process, the original TSS level was 56 mg/ L increase to 164 mg/L at a voltage of 10 volts and time is 30 minutes. Meanwhile, the nitrate level, which was originally 5.018 mg/L, decrease to 1.08 mg/L with a voltage of 10 volts and time is 40 minutes, effectively decreasing until 82.06%.

The reduction of nitrate levels using the MSLE method is quite effective as long as the volatage and time given to the sample are still below the limit.

4.2 Suggestion

Alcohol Industry in Bekonang, Sukoharjo may not be disposed of directly into the environment which can damage the water ecosystem and its surroundings, it is necessary to treat the waste first, one of which is the Multi Soil Layering Electrolysis (MSLE) method to reduce TSS and Nitrate levels.

The use of the Multi Soil Layering Electrolysis (MSLE) method with variation of voltage and time can be effective if used below the limit according to the electrodes used during electrolysis.

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