International Journal of Innovation, Creativity and Change. www.ijicc.net
Special Edition: Safe Communities, 2020

Level of Electro Flocculation Technology as A Treatment of Household Industry Waste (Design and Building Design)

Rifai Agung Mulyono[a], Wibowo Ady Sapta[b], [a,b]Poltekkes Kemenkes Tanjung Karang, Sumatera, Indonesia

At present most of the tempeh/tofu industry is a small-scale household industry that is not equipped with wastewater treatment units. One method that has been used for waste treatment is electro flocculation, which has the advantage of being a simple, efficient method, both used to remove organic compounds without the addition of chemicals, thereby reducing the formation of residues (sludge), and good for removing suspended solids. The purpose of this study was to determine the effectiveness of tofu wastewater treatment using stratified electro flocculation in current-voltage variations (4.5; 6.0; 7.5; 9.0 and 12 volts) to reduce levels of TSS and BOD, COD and pH in tofu wastewater. This research is experimental research. The results showed a decrease in TSS, BOD, COD and pH levels. The most effective reduction of TSS is at a current-voltage of 7.5 volts with an average of 96.80 g/L, the most effective decrease in BOD is at a 12-volt current voltage with an average of 298.18 g/L, the most effective COD reduction is at a current-voltage of 12 volts with an average of 1701.20 g/L and an average pH of 6. The statistical test results show that there is a difference in the level of decline in tofu wastewater contaminants in the home industry of TSS, BOD, COD, and pH with a value (p = 0.000).

Keywords: *Level Electro Flocculation, Tofu Liquid Waste, Processing.*

Introduction

Most tofu industries do not have waste treatment units, where currently liquid waste is directly discharged into sewers, rivers or water bodies without prior processing (Pamungkas and Slamet, 2017; Widayat and Hadiyanto, 2016). This will cause oxygen levels in the water to decrease

sharply. Tofu liquid industrial waste contains suspended substances, causing water to become dirty or turbid (Subekti, 2011).

Liquid waste produced from the tofu and tempeh industry before being discharged into the environment must be treated first so as not to pollute the environment and healthy environmental quality is maintained (Coniwanti, Mertha, and Eprianie, 2013). Most of the tempeh tofu industry is still a small-scale household industry that is not equipped with a wastewater treatment unit (Ridhuan, 2016). This liquid waste contains high Total Suspended Solid (TSS), Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD). With so many pollutants, oxygen levels will decrease, thereby causing life in the waters that need oxygen to be disrupted (Pradana, Suharno, and Apriansyah, 2018).

Characteristics of tofu industrial wastewater include two things, namely physical and chemical characteristics. Physical characteristics include total solids, suspended solids, temperature, colour, and odour. Chemical characteristics include organic matter, inorganic material, and gas (Subekti, 2011).

Environmental pollution is caused by large volumes of waste and direct disposal into the environment without adequate treatment. The level of the entrepreneur's awareness and financial capability is an obstacle in handling tofu industry waste (Djayanti, 2015). In an effort to overcome the problems caused by liquid waste, the waste processing must be carried out before the waste is discharged to the water body (Setyawati et al. 2018); (Alimsyah, Alimsyah, and Damayanti, 2013).

One method that has been used for waste treatment is electroflocking, which has the advantage of being a simple, efficient method, both used to remove organic compounds, without the addition of chemicals so as to reduce the formation of residues (sludge), and good for removing suspended solids. The electrocoagulation/electro flocculation method is effective for treating wastes containing heavy metals (Yilmaz et al. 2005). The principle of treating wastewater using electro flocculation is that the coagulant or flocculant is produced from the electro-oxidation process of anodes, which are generally made from iron or aluminium (Ofir, Oren, and Adin, 2007).

Methods

This research is an experimental study and uses samples of industrial liquid waste. The scale of the household has been measured previously on the parameters TSS, BOD, COD, and PH. Then the processing is carried out by continuously flowing the waste into the processor with a multilevel electroflocking technology with an electric current of 4.5 volts, 6 volts, 7.5 Volts, 9 volts and 12 volts by using a control without jetting current. Gravel (0.5 - 1.5 cm) and fibres are used in the

process of filtering wastewater that has been treated by electro flocculation. The final result that comes out from the fibres and gravel filter media is measured again the parameters TSS, BOD, COD and pH.

The experimental design used in this study is a pretest-posttest with control group design, (Ifadiana and Soemirat, 2016).

Results

The results of research conducted on test parameters TSS, BOD, COD, and pH are as follows:

TSS Content

Table 2 shows the TSS water tofu waste before and after treatment using multilevel electroflocking obtained the average value of the TSS before the treatment was ah 963.20 g/L, treatment at an average control of 784.20 g/L, treatment with the electroflocking process in the variation of the current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) on average there is a decrease in the value of TSS. The most effective TSS reduction capability is at a current-voltage of 7.5 volts with an average of 96.80 g/L.

Changes in the value of TSS in tofu wastewater after processing based on laboratory test results are as follows. Table 3 shows that the change in the value of TSS in tofu wastewater after treatment averaged a change in value, wherein the average control the change in value was 179.00 g/L, the current-voltage of 4.5 volts averaged a change in value of 377.20 g/L, the current-voltage of 6 volts on average changes in value of 688.40 g/L, the current-voltage of 7.5 volts on average changes in value of 866.40 g/L and at the current-voltage of 12 volts the average change in value is h 821.80 g/L. In series the pattern of changes in TSS values can be seen in the following graph. Figure 2 shows that the most effective change in TSS values is at a current-voltage of 7.5 volts with an average change in TSS value of 866.40 g/L

BOD Content

Results of BOD content research before and after processing can be seen in the following table. Table 4 shows the BOD value of tofu wastewater tofu before and after treatment using stratified electro flocculation obtained an average BOD value before treatment was 769.46 g/L, treatment at an average control of 666.850 g/L, treatment with the electro flocculation process in the variation of current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) on average there is a decrease in BOD value.

The most effective BOD reduction capability is at 12-volt current with an average of 298.18 g/L. Changes in the value of BOD in tofu wastewater after treatment are as follows.

Table 5 shows that changes in the BOD value in tofu wastewater after treatment on average experience a change in value, wherein the control average changes in the value of 102.62 g/L, current-voltage 4.5 volts changes in the value of 455.29 g/L, current-voltage 6.0 the average change in value is 379.88 g/L, the current-voltage is 7.5 volts the average value changes are 430.62 g/L, and at a current-voltage of 12 volts, the average value changes are 471.29 g/L. In series the pattern of changes in BOD values can be seen in the following Graph 3. Figure 3 shows that the most effective BOD value change is at 12-volt current, with an average change in BOD value of 471.29 g/L.

The COD content

Results of the COD content research before and after processing can be seen in Table 6 as follows. Table 6 shows the COD value of tofu wastewater before and after treatment using graded electro flocculation for 5 repetitions. Based on laboratory test results, the average COD value before treatment was 7201.20 g/L, treatment at an average control of 6861.40 g/L, treatment with the electro flocculation process in the variation of current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) on average decreased COD value. The most effective ability to reduce COD is at 12-volt current voltage with an average of 1701.20 g/L.

Changes in COD value in tofu wastewater after processing based on laboratory test results are as follows. Table 7 shows that changes in the value of COD in tofu wastewater after the average treatment changes in value, where the average control value changes 339.80 g/L, current voltage of 4.5 volts on average change in value of 2400.20 g/L, current voltage of 6 volts on average change in value of 3600.40 g/L, the current-voltage of 7.5 volts with an average change in value of 4200.20 g/L, and at a current-voltage of 12 volts the average change in value is 5500.00 g/L. In series the pattern of changes in COD values can be seen in Figure 4 below. Figure 4 shows that the most effective change in COD value is at 12-volt current with an average change in BOD value of 5500.00 g/L

pH

The results of the study of pH parameters before and after processing as many as 5 repetitions can be seen in Table 4.7 as follows: table 8 shows the pH in the wastewater tofu before and after treatment based on laboratory test results – the average pH before is 4 and the average pH after

treatment with the electroflocking process in the variation of current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) is 6.

The Statistical Test Results

The test in this study uses the paired t-test. Statistical test results are presented in the table below. Table 9 shows that the statistical test results using paired t-Test on the variables TSS, BOD, and COD Wastewater Tofu obtained p-value = 0.000. This means that there is a difference in the level of reduction in the content of tofu wastewater pollutants in the TSS, BOD, COD and pH industries in the electroflocking process in the variation of the planned current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts)

Discussion

Tofu is one of the sources of food that comes from soybeans containing high protein, wherein 100 gr tofu contains 68 grams of calories, 7.8 grams of protein, 4.6 grams of fat, 1.6 grams of charcoal hydrate, 124 grams of calcium, 63 mg of phosphorus, 0.8 mg of iron, vitamin B 0.06 mg, water 84.8 gm (Widiyanto, Yuniarno, and Kuswanto, 2015).

From the process of making tofu there can be seen the generation of waste produced, among others, solid waste in the form of tofu waste and liquid waste. Most of the sources of liquid waste produced by the tofu making industry are thick liquids that are separated from the tofu lumps called whey, while other sources of liquid waste come from washing soybeans, washing process equipment, cooking and soaking solution of soybeans. The solid tofu content contains about 20.93% protein, 10.31 raw fat, 0.72% calcium, 0.55% phosphorus, and 36.69% of other compounds (Faisal et al., 2016).

Tofu industry liquid waste characteristics includes two factors, namely physical and chemical characteristics. Physical characteristics include total solids, suspended solids, temperature, colour, and odour. Chemical characteristics include organic matter, inorganic material, and gas (Damayanti, Hermana, and Masduqi, 2004). From the research report, it was revealed that the average content of pollutants in tofu wastewater from one of the tofu industries in Surabaya was BOD: 5389.5 mg/L, COD: 7050 mg/L, N Total: 161.5 mg/L, P Total: 81.6 grams/L, and pH 4.11 (Siswoyo and Hermana, 2017).

To get quality tofu wastewater that meets applicable standards, especially TSS, BOD, COD and pH parameters, a "multilevel electroflocking" tool can be used which has advantages including a simple, efficient method, both used for eliminating organic compounds, without the addition of

chemicals thereby reducing the formation of residues (sludge), and good for removing suspended solids (Thompson et al., 2001) (Koren and Syversen, 1995).

The content of TSS

Total Suspended Solids (TSS) are substances that are suspended solids that remain as residues in a vessel if the water sample in the vessel is dried at a certain temperature (Breu et al., 2008); (Kurniawan, 2014). Total Suspended Solids (TSS) that settle at the bottom of the river, will form mud which can disrupt river water flow and cause river siltation (Yuliyanti, 2019). The results of the TSS content before and after processing obtained an average TSS value before treatment of 963.20 g/L, treatment at an average control of 784.20 g/L, treatment with the electro flocculation process in the variation of the current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) on average decreased the value of the TSS. The most effective TSS reduction capability is at a current-voltage of 7.5 volts with an average of 96.80 g/L.

These results are in line with research conducted by (Widayatno T and Sriyani, 2008), the results of the study show that electro flocculators are effective in reducing TSS in tapioca liquid waste.

Statistical test results using paired t-Test on the TSS variable in tofu wastewater showed p-value = 0.000. This means that there is a difference in the level of decline in the content of tofu wastewater contaminants in the TSS home industry in the electro flocculation process in the variation of the planned current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts).

The electro flocculation process is a process that simultaneously removes heavy metals, suspended solids, emulsified organic matter and other contaminants from water by using direct electric current (DC) from the anode to the cathode (De Aquino Neto et al., 2011; Koren and Syversen, 1995; Robinson, 1999). This system causes the release of ions on the electrodes to move into the electrolyte solution. Contaminants contained in wastewater are removed by chemical reactions and precipitation processes or by causing colloidal materials to coalesce (Pokhrel and Viraraghavan, 2004).

BOD content

Biological Oxygen Demand (biological oxygen demand) is the amount of oxygen needed by bacteria to decompose or oxidise almost all dissolved organic substances and some organic substances that are suspended in water (Kurnianto, 2017). Basically, the purpose of wastewater treatment is to reduce BOD and dissolved solids (Hendartini, 2013). Based on laboratory test results, the average BOD value before treatment was 769.46 g/L, treatment at an average control

of 666.850 g/L, treatment with the electroflocking process in the variation of the current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) on average decreased the BOD value. The most effective BOD reduction capability is at 12-volt current with an average of 298.18 g/L. The results showed that the greater the electrical voltage and electrolysis time, the greater the decrease in BOD and the more neutral the pH. The results showed that electro flocculators have the ability to reduce BOD content.

These results are in line with research conducted by Widayanto T, 2008 which concluded that electro flocculators are effective in reducing BOD in tapioca liquid waste (Widayatno T and Sriyani, 2008). Paired t-Test results on the BOD variable in Tofu Wastewater showed a p-value = 0.000. This means that there is a difference in the level of decline in the content of tofu wastewater contaminants in the BOD home industry in the electro flocculation process in the planned current-voltage variations (4.5; 6.0; 7.5; 9.0 and 12 volts).

The content of COD

Chemical Oxygen Demand, or chemical oxygen demand, is a measure for water pollution by organic substances which can naturally be oxidised through microbiological processes (Irfan et al. 2017; Pisarevsky, Polozova, and Hockridge 2005). The COD content of tofu / tempeh waste is around 30000 mg/L - 60000 mg/L. (Dasmita, 2014). Based on laboratory test results, the average COD value before treatment was 7201.20 g/L, treatment at an average control of 6861.40 g/L, treatment with electro flocculation process in the variation of current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) caused an average decrease in COD. The most effective COD reduction capability is at 12-volt current with an average of 1701.20 g/L. The results showed that the greater the voltage and electrolysis time, the greater the decrease in COD and the more neutral the pH. The results showed that the electro flocculator had the ability to reduce the COD content. These results are in line with research conducted by Widayanto, 2016 which concluded that electro flocculators are effective in reducing COD in tapioca wastewater (Widayatno T and Sriyani, 2008). Research by Melchiors, 2016 also concluded that electro flocculation is a very good alternative for milk wastewater treatment compared to conventional treatment methods (Melchiors et al., 2016).

The results of paired t-Test on the COD variable in Tofu Wastewater showed a p-value = 0.000. This means that there is a difference in the level of reduction in the content of tofu wastewater contaminants in the COD home industry in the electro flocculation process in the planned current-voltage variations (4.5; 6.0; 7.5; 9.0 and 12 volts).

pH

The results showed that the pH in wastewater tofu before treatment averaged pH 4 and after treatment with the electro flocculation process in the variation of current-voltage (4.5; 6.0; 7.5; 9.0 and 12 volts) the average was 6. These results indicate that tofu's pH in wastewater before and after treatment is still within normal limits.

Conclusion

Tofu wastewater treatment using stratified electro flocculation as an alternative technology is able to reduce the pollutant content in household tofu wastewater including TSS, BOD, COD and pH parameters. There is a difference in the level of reduction in the content of tofu wastewater pollutants in the home industry TSS, BOD, COD, and pH in the electroflocking process in the planned current-voltage variations (4.5; 6.0; 7.5; 9.0 and 12 volts) with a value of p = 0.00.

Figure 1. Electro flocculation Experimental Process Design

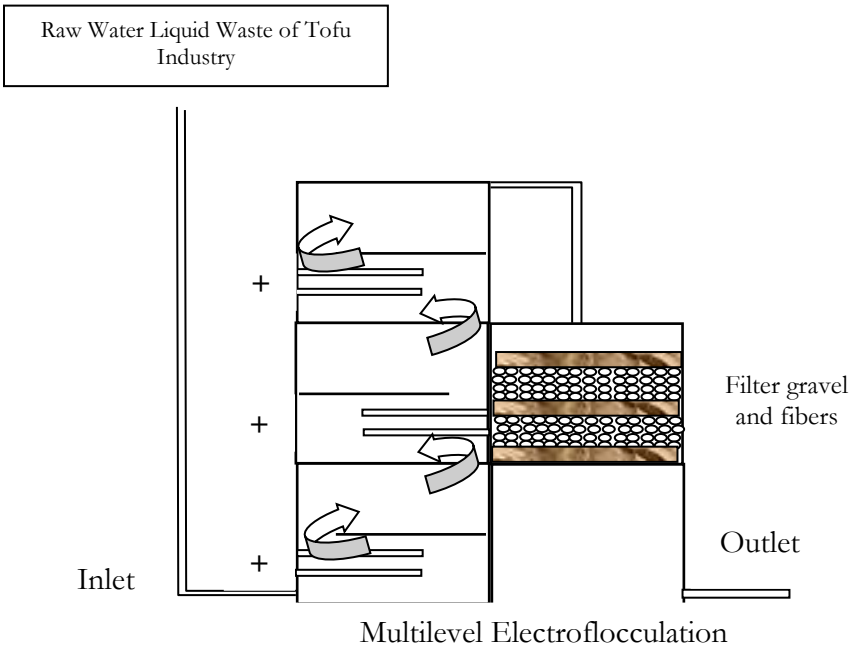

Figure 2. Graph of Changes in TSS Values of Tofu Wastewater After Treatment

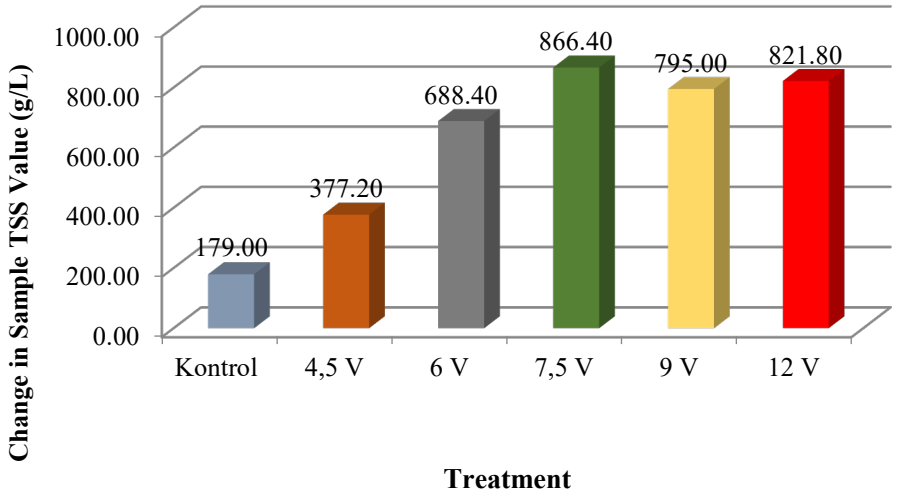

Figure 3. Changes in BOD Values of Tofu Wastewater After Treatment

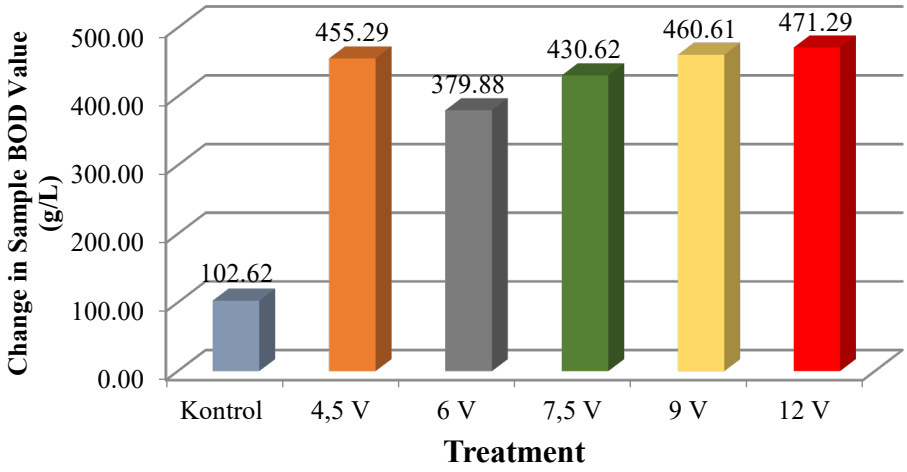

Figure 4. Changes in COD Value of Wastewater Tofu After Treatment

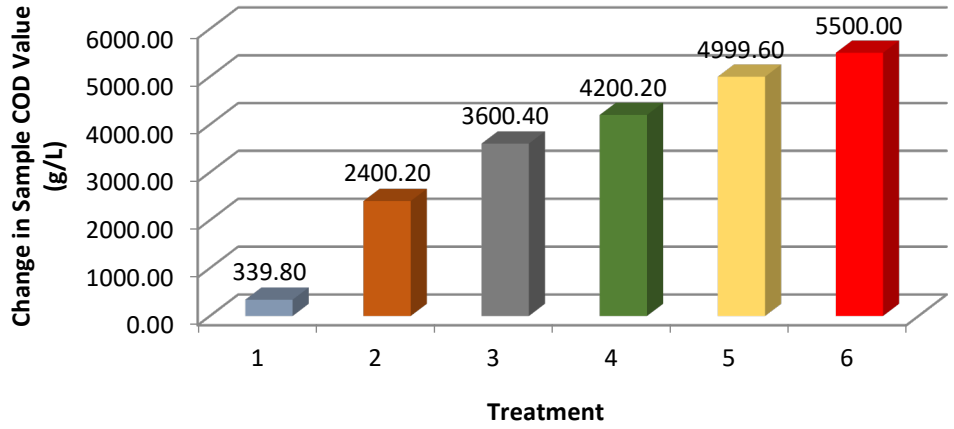

Table 1. Value TSS in wastewater Know Before and After Treatment Based on Laboratory Test Results

Observation to	TSS Value (g/L)						
	Before	After Treatment					
		Control	4,5 Volt	6 Volt	7,5 Volt	9 Volt	12 Volt
1	962.00	784.00	585.00	274.00	96.00	168.00	140.00
2	963.00	785.00	586.00	275.00	98.00	169.00	141.00
3	964.00	783.00	587.00	276.00	97.00	168.00	143.00
4	965.00	784.00	586.00	274.00	96.00	167.00	141.00
5	962.00	785.00	586.00	275.00	97.00	169.00	142.00
Average	963.20	784.20	586.00	274.80	96.80	168.20	141.40

Table 2. Changes in TSS Value in Tofu Wastewater After Processing Based on Laboratory Test Results

Observation to	TSS Value (g/L)					
	Control	4.5 Volt	6 Volt	7.5 Volt	9 Volt	12 Volt
1	178.00	377.00	688.00	866.00	794.00	822.00
2	178.00	377.00	688.00	865.00	794.00	822.00
3	181.00	377.00	688.00	867.00	796.00	821.00
4	181.00	379.00	691.00	869.00	798.00	824.00
5	177.00	376.00	687.00	865.00	793.00	820.00
Average	179.00	377.20	688.40	866.40	795.00	821.80

Table 3. BOD Value in Tofu Wastewater Before and After Processing Based on Laboratory Test Results

Observation to	BOD Value (g/L)						
	Before	After					
		Control	4.5 Volt	6 Volt	7.5 Volt	9 Volt	12 Volt
1	769.46	666.84	314.17	389.50	338.84	308.84	298.17
2	769.47	666.85	314.18	389.60	338.85	308.85	298.18
3	769.48	666.84	314.19	389.70	338.84	308.86	298.17
4	769.45	666.85	314.16	389.50	338.86	308.86	298.18
5	769.46	666.86	314.18	389.60	338.85	308.85	298.19
Average	769.46	666.85	314.18	389.58	338.85	308.85	298.18

Table 4. Changes in BOD value in Tofu Wastewater After Processing Based on Laboratory Test Results

Observation to	BOD Value (g/L)					
	Control	4.5 Volt	6 Volt	7.5 Volt	9 Volt	12 Volt
1	102.62	455.29	379.96	430.62	460.62	471.29
2	102.62	455.29	379.87	430.62	460.62	471.29
3	102.64	455.29	379.78	430.64	460.62	471.31
4	102.60	455.29	379.95	430.59	460.59	471.27
5	102.60	455.28	379.86	430.61	460.61	471.27
Average	102.62	455.29	379.88	430.62	460.61	471.29

Table 5. COD Value in Tofu Wastewater Before and After Processing Based on Laboratory Test Results

Observation to	COD Value (g/L)						
	Before	After Treatment					
		Control	4.5 Volt	6 Volt	7.5 Volt	9 Volt	12 Volt
1	7200.00	6860.00	4800.00	3600.00	3000.00	2200.00	1700.00
2	7201.00	6861.00	4801.00	3601.00	3001.00	2201.00	1701.00
3	7202.00	6861.00	4802.00	3602.00	3002.00	2202.00	1702.00
4	7203.00	6862.00	4801.00	3600.00	3001.00	2204.00	1701.00
5	7200.00	6863.00	4801.00	3601.00	3001.00	2201.00	1702.00
Average	7201.20	6861.40	4801.00	3600.80	3001.00	2201.60	1701.20

Table 6. Changes in COD Value in Tofu Wastewater After Processing Based on Results Laboratory test

Observation	COD Value (g/L)					
to	Control	4.5 Volt	6 Volt	7.5 Volt	9 Volt	12 Volt
1	340.00	2400.00	3600.00	4200.00	5000.00	5500.00
2	340.00	2400.00	3600.00	4200.00	5000.00	5500.00
3	341.00	2400.00	3600.00	4200.00	5000.00	5500.00
4	341.00	2402.00	3603.00	4202.00	4999.00	5502.00
5	337.00	2399.00	3599.00	4199.00	4999.00	5498.00
Average	339.80	2400.20	3600.40	4200.20	4999.60	5500.00

REFERENCES

Alimsyah, Angelica, Angelica Alimsyah, and Alia Damayanti. 2013. "Penggunaan Arang Tempurung Kelapa Dan Eceng Gondok Untuk Pengolahan Air Limbah Tahu Dengan Variasi Konsentrasi." *Jurnal Teknik ITS*.

De Aquino Neto, Sidney, Thiago Cavalheiro Magri, Gláucia Maria Da Silva, and Adalgisa Rodrigues De Andrade. 2011. "Tratamento de Resíduos de Corante Por Eletrofloculação: Um Experimento Para Cursos de Graduação Em Química." *Quimica Nova*.

Brahmi, Khaled et al. 2018. "Treatment of Heavy Metal Polluted Industrial Wastewater by a New Water Treatment Process: Ballasted Electroflocculation." *Journal of Hazardous Materials*.

Breu et al. 2008. "Total Suspended Solids." *Vasa*.

Coniwanti, Pamilia, Indah Desfia Mertha, and Diana Eprianie. 2013. "Pengaruh Beberapa Jenis Koagulan Terhadap Pengolahan Limbah Cair Industri Tahu Dalam Tinjauannya Terhadap Turbidity, TSS Dan COD." *Jurnal Teknik Kimia No. 3, Vol. 19, Agustus 2013*.

Damayanti, Alia, Joni Hermana, and Ali Masduqi. 2004. "Analisis Resiko Lingkungan Dari Pengolahan Limbah Pabrik Tahu Dengan Kayu Apu (Pistia Stratiotes L.)." *Jurnal Purifikasi*.

Darmawanti, Titik, Suhartana Suhartana, and Didik Setiyo Widodo. 2010. "Pengolahan Limbah Cair Industri Batik Dengan Metoda Elektrokoagulasi Menggunakan Besi Bekas Sebagai Elektroda." *Jurnal Kimia Sains dan Aplikasi* 13(1): 18. http://dx.doi.org/10.14710/jksa.13.1.18-24.

Dasmita, Eva. 2014. "Penelitian Pengolahan Air Limbah Industri Berkonsentrasi COD Tinggi Secara Anerobik Dan Aerobik." *Jurnal Kimia dan Kemasan*: 16. http://dx.doi.org/10.24817/jkk.v0i0.5188.

Djayanti, Silvy. 2015. "Kajian Penerapan Produksi Bersih Di Industri Tahu Di Desa Jimbaran, Bandungan, Jawa Tengah." *Jurnal Riset Teknologi Pencegahan Pencemaran Industri*.

Faisal, M., Asri Gani, Farid Mulana, and H. Daimon. 2016. "Treatment and Utilisation of Industrial Tofu Waste in Indonesia." *Asian Journal of Chemistry*.

Hendartini, Hendartini. 2013. "Penghilangan Padatan Tersuspensi Pada Pengolahan Air Limbah." *Jurnal Kimia dan Kemasan*: 24. http://dx.doi.org/10.24817/jkk.v0i0.5060.

Ifadiana, Dewi Permata, and Juli Soemirat. 2016. "An Analysis of the Effect of the Implementation of an Integrated Management System (IMS) on Work Ergonomics in an O&M Power Plant Company." *Journal of Engineering and Technological Sciences*.

Irfan, Muhammad et al. 2017. "The Removal of COD, TSS and Colour of Black Liquor by Coagulation–Flocculation Process at Optimised PH, Settling and Dosing Rate." *Arabian Journal of Chemistry*.

Koren, J. P.F., and U. Syversen. 1995. "State-of-the-Art Electroflocculation." *Filtration and Separation*.

Kurnianto, Erwin. 2017. "PENGOLAHAN LIMBAH CAIR TAHU DENGAN PENAMBAHAN KITOSAN PADA REAKTOR ANAEROB DENGAN VARIASI WAKTU TINGGAL." *Jurnal Teknologi Lingkungan Lahan Basah* 5(1). http://dx.doi.org/10.26418/jtllb.v5i1.18405.

Kurniawan, Agung. 2014. "RANCANG BANGUN SISTEM PENGOLAHAN LIMBAH CAIR DOMESTIK TERPADU (COMPACT SYSTEM)." *Jurnal Teknologi Lingkungan Lahan Basah*.

Melchiors, Marina S. et al. 2016. "Treatment of Wastewater from the Dairy Industry Using Electroflocculation and Solid Whey Recovery." *Journal of Environmental Management*.

Ofir, E., Y. Oren, and A. Adin. 2007. "Electroflocculation: The Effect of Zeta-Potential on Particle Sise." *Desalination*.

Pamungkas, Agung Wahyu, and Agus Slamet. 2017. "Pengolahan Tipikal Instalasi Pengolahan Air Limbah Industri Tahu Di Kota Surabaya." *Jurnal Teknik ITS* 6(2). http://dx.doi.org/10.12962/j23373539.v6i2.24585.

Pisarevsky, A. M., I. P. Polozova, and P. M. Hockridge. 2005. "Chemical Oxygen Demand." *Russian Journal of Applied Chemistry*.

Pokhrel, D., and T. Viraraghavan. 2004. "Treatment of Pulp and Paper Mill Wastewater - A Review." *Science of the Total Environment*.

Pradana, Tedy Dian, Suharno Suharno, and Apriansyah Apriansyah. 2018. "Pengolahan Limbah Cair Tahu Untuk Menurunkan Kadar TSS Dan BOD." *Jurnal Vokasi Kesehatan* 4(2): 56. http://dx.doi.org/10.30602/jvk.v4i2.9.

Ridhuan, Kemas. 2016. "Pengolahan Limbah Cair Tahu Sebagai Energi Alternatif Biogas Yang Ramah Lingkungan." *Turbo : Jurnal Program Studi Teknik Mesin* 1(1). http://dx.doi.org/10.24127/trb.v1i1.81.

Robinson, Vivian. 1999. "Electroflocculation in the Treatment of Polluted Water." *Australian Water & Wastewater Association Joint NSW ...*.

Setyawati, Harimbi, Erni Junita Sinaga, Luluk Sutri Wulandari, and Faradilla Sandy. 2018. "EFEKTIFITAS BIJI KELOR DAN TAWAS SEBAGAI KOAGULAN PADA PENINGKATAN MUTU LIMBAH CAIR INDUSTRI TAHU." *Jurnal Teknik Kimia* 12(2). http://dx.doi.org/10.33005/tekkim.v12i2.1084.

Siswoyo, Eko, and Joni Hermana. 2017. "PENGARUH AIR LIMBAH INDUSTRI TAHU TERHADAP LAJU PERTUMBUHAN TANAMAN BAYAM CABUT (AMARANTHUS TRICOLOR)." *Jurnal Sains &Teknologi Lingkungan* 9(2): 105–13. http://dx.doi.org/10.20885/jstl.vol9.iss2.art4.

Subekti, Sri. 2011. "Pengolahan Limbah Cair Tahu Menjadi Biogas Sebagai Bahan Bakar Alternatif." *Prosiding Seminar Nasional Sains dan Teknologi ke-2*.

Thompson, G., J. Swain, M. Kay, and C. F. Forster. 2001. "The Treatment of Pulp and Paper Mill Effluent: A Review." *Bioresource Technology*.

Widayat, Widayat, and H Hadiyanto. 2016. "PEMANFAATAN LIMBAH CAIR INDUSTRI TAHU UNTUK PRODUKSI BIOMASSA MIKROALGA Nannochloropsis Sp SEBAGAI BAHAN BAKU BIODIESEL." *Reaktor* 15(4): 253. http://dx.doi.org/10.14710/reaktor.15.4.253-260.

Widayatno T, and Sriyani. 2008. "Pengolahan Limbah Cair Industri Tapioka Dengan Menggunakan Metode Elektroflokulasi." *Prosiding Seminar Nasional Teknoin 2008 Bidang Teknik Kimia dan Tekstil mengandung*.

Widiyanto, Agnes Fitria, Saudin Yuniarno, and Kuswanto Kuswanto. 2015. "POLUSI AIR TANAH AKIBAT LIMBAH INDUSTRI DAN LIMBAH RUMAH TANGGA." *Jurnal Kesehatan Masyarakat* 10(2): 246. http://dx.doi.org/10.15294/kemas.v10i2.3388.

Yilmaz, A. Erdem, Recep Boncukcuoğlu, M. Muhtar Kocakerim, and Bülent Keskinler. 2005. "The Investigation of Parameters Affecting Boron Removal by Electrocoagulation Method." *Journal of Hazardous Materials*.

Yuliyanti, Dewi Arum. 2019. "Perbedaan Kadar Total Suspended Solid Pada Air Sungai Nguneng Sebelum Dan Sesudah Tercemar Limbah Cair Tahu." *Jaringan Laboratorium Medis* 1(1): 16. http://dx.doi.org/10.31983/jlm.v1i1.4937.