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THE EFFECT OF *BOD* CONCENTRATE INFLUET TO REMOVE POLLUTANT LOAD IN WASTEWATER OF A CHICKEN SLAUGHTERHOUSE

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ABSTRACT

The wastewater of a chicken slaughterhouse in the form of rumen contents or gastric contents, excess blood, flesh, fat, and the rinsed water has become a source of environmental pollution. Characteristics of liquid waste generated from industrial activities slaughterhouse varies greatly, filled with relatively high organic matter content and fat solids concentration. The objective of the research is to determine the ability of the anaerobic bio-filter in minimizing total biological oxygen demand (BOD_5), chemical oxygen demand (COD) in wastewater slaughterhouse. Samples were taken directly to the tub washing after chicken feathers were plucked. Application of the influent BOD concentration is in milligrams per liter (mg / L) with a value range of 420 mg / L; 400 mg / L; and 380 mg / L. Media used in this research is bio-ball to reduce pollutant loads in soluble BOD_5, and COD in wastewater slaughterhouse with anaerobic biofilter dipped in up flow. It can be concluded that it is efficient to remove soluble BOD_5, and COD. The least BOD concentrate influent is capable of removing the greatest amount of soluble BOD, and COD. At a concentration of 380mg BOD influent / L, the content of 98.08% dissolved BOD_5 and content of 96.21% COD is successfully removed.

Keywords: BOD_5 dissolved, COD, concentration BOD influent, liquid waste slaughterhouse.

1. INTRODUCTION

Industrial wastewater of a chicken slaughterhouse is one of the sources of environmental pollution. Slaughterhouse industry runs on slaughtering live chicken and processing them into carcass which is ready for consumption (Singgih and Kariana, 2008). Slaughterhouse industries produce waste either in the process itself as well as in the washing equipment and facilities. It is characterized by high concentrations of organic matter and suspended solids (Amorim *et al*., 2007). Poultry slaughterhouse generate wastewater, both in the process itself and in the washing of equipment and facilities, characterized by high organic rates and suspended solids concentrations. However, the characteristics of the wastewater vary from plant to plant, depending on the industrial process and the water consumed per slaughterhouse bird (Del Nery *et al*., 2001a). Slaughterhouse waste water in the form of rumen content sorgastric contents, excess blood, meat or fat, and its rinsed water, might work as a medium for microbial growth and development so that the waste decomposes. The negative impact of this industry is that it produces solid and liquid waste. Poultry slaughterhouse produce large amounts of wastewater containing high amounts of biodegradable organic matter, suspended and colloidal matter such as fats, proteins and cellulose (C.E.T. Caixeta*et al.,* 2002; D. Masse, and. Masse, 2001; L.A. Nunez, and B. Martinez, 1999). The chicken slaughterhouse liquid waste contains chemical-physical waste and microbiology. Microbes contained in wastewater slaughterhouse include *Bacillussubtilis, Bacillusthuringiensis,* and *Lysinibacillusfusiform* (Tarntip and Thungkao, 2011).

Other pollutant sources such as the content of BOD (Biological Oxygen Demand), and COD (Chemical Oxygen Demand) in the wastewater of RPA industry is also very high. It is beyond the threshold of BOD, and COD content that is regulated. Initial sampling results obtained BOD content of 1.684 mg / L, and COD of 2.573 mg / L. slaughterhouse activities will result in waste with high organic matter content, with the relatively high concentration of solids and fat. To prevent that, it is necessary to reduce the composition of the suspended organic solids. (Laksono and Kirana, 2010).

The main types of waste produced by slaughterhouse industry generally consists of blood, feathers, offal (remnants of the intestine and cloaca pieces), bones and dead chickens. From the measurement results it is figured that the waste in the form of blood is approximately 3.5%, 5% intestinal waste, and dead chickens of 0.5% out of the number of slaughtered chickens per day (Voslarova *et al.,* 2007; Bolu and Adakeja, 2008). Most of this type of waste which includes fat, intestines, heads, remaining bones from processing boneless meat (*boneless*), skin, liver, gizzard and talon/chicken legs still are till valuable and needed by particular consumers. To handle the waste resulted from the slaughterhouse activities, there are three possible activities need to bed one. It is waste identification, characterization and waste processing. (Ross *et al*., 1992).

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Trace elements essential for microbes in anaerobic digestion process may have other impacts. At high concentrations trace elements can inhibit the microbiological process. They can also react chemically in the process e.g. iron reacts with H_2S to form FeS. Therefore, the addition of iron can be used to control H_2S concentration in the biogas, which is needed as H_2S in biogas can cause corrosion in compressors, gas storage tank and engines and it is toxic in concentrations of >5 ppm (Ryckebosch *et al*., 2011). The goal in this experiment is to obtain an effective way of handling slaughterhouse waste by applying an aerobic bio-filter treatment system. The problem stated is how efficient it is to remove BOD_5, and COD in the wastewater of slaughterhouse industry if it is processed with submerged anaerobic bio-filter system. The overall removal of the content of pollutants in the slaughterhouse waste load such as BOD_5, and COD is more than 90% after treatment with an aerobic submerged bio-filter system. The greatest removal occurred in all parameters of the analysed pollutant load with influent BOD concentration of380mg/L.

2. METHODS

2.1. Chicken Slaughterhouse wastewater sampling and characterization

The sample used in this experiment was slaughterhouse liquid waste after the feather plucking process is complete. The slaughterhouse wastewater taken for the samples were the results from the second rinsing process to drain the blood. The wastewater from the first washing was not taken as a sample because it is classified a shot waste and chicken feathers have not been plucked yet because the chicken are still being soaked in hot water.

Wastewater samples were collected from the small settling tank. Slaughterhouse wastewater is filled in the plastic container which volumetric size 20 L, and it was then transported to the laboratory to be processed in an anaerobic bio-filter system dipped in up flow. Seeding and acclimatization process is done in the laboratory for 10 days for growing microorganisms decomposing waste. Before processing by anaerobic biofilter system, its BOD content of 1,684 mg/L O_2 and its COD content of 2,573 mg/L O_2.

2.2. Design of Experiment

As shown in Fig. 1 anaerobic biofilter reactor that is used has a size that is different. The reactor used in this study is a model of anaerobic biofilter laboratory scale made of acrylic with a thickness of 5 mm. Media used is bio-ball media. Media high bio-ball in the anaerobic biofilter reactor is 50 cm. Anaerobic biofilter reactor consists of three reactors. The size of the reactor 1 is 0,3 m x 0,3 m x 0,5 m with capacity was 45 L liquid volume. The size of the reactor 2 is 0,25 m x 0,25 m x 0,5 m with capacity was 31,25 L liquid volume and the size of the reactor 3 is 0,2 m x 0,2 m x 0,5 m with capacity was 20 L liquid volume. Figure-1 is an example of anaerobic biofilter reactor used in the study.

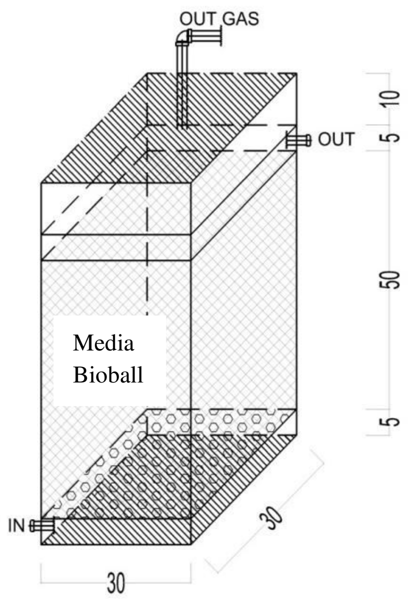

Figure-1. Anaerobic Biofilter Reactor.

2.3. Analytical methods

Waste water of chicken slaughterhouse analyses were carried out according to the Standard Method for the Examination of the Water and Wastewater (APHA, 2005). The removal efficiency of the pollutant was calculated by using the following equation:

$$DO\ (mgO_2/l) = \frac{A\ x\ N\ x\ 8000}{100\ ml}$$

$$BOD_5{}^{20}\ (mg/l) = \frac{\{(DO_0 - DO_5) - (B_0 - B_5)\}\ x\ (1 - P)}{P}$$

$$COD\ (mg/l\ O_2) = \frac{(a - b)\ x\ N\ x\ 8000}{Volume\ Sampel}\ x\ F\ x\ D$$

Where

DO = dissolved oxygen
A = Sodium Thiosulfate titration volume
N = Normality solution of Sodium Thiosulfate
DO_0 = dissolved oxygen samples at time 0
DO_5 = dissolved oxygen samples at time 5
B_0 = dissolved oxygen blank at time 0
B_5 = dissolved oxygen blank at time 5
P = the degree of dilution
a = ml ammonium ferrous sulfate titration blank
b = ml ammonium ferrous sulfate titration sample
F = factor (20: titrant second blank)
D = dilution
N = normality solution of ammonium ferrous sulfate

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Data collected by using the method of observation, is as follows:

a. Waste water quality analysis early, covering dissolved BOD_5, and COD.
b. Biofilter reactor operating procedures are as follows:
1. Set the wastewater influent concentration into the reactor by using a valve in accordance with the desired discharge amounting to 0.045 m^3/day or 31.25 ml/minute Biofilter media used in this study is bio-ball media.
2. Effluent from the biofilter is taken and analyzed in accordance with the parameters measured regularly. Parameters measurement of BOD, and COD is done with the analysis before and after treatment.
c. Dissolved oxygen analysis procedure (OD) and BOD by using Winkler method (APHA, AWWA, 2005).

The observation will be analysed graphically and described to determine how efficient it is to remove slaughterhouse wastewater concentration. Methods charts are incorporated to see the decline of the parameters observed.

3. RESULTS AND DISCUSSIONS

Aerobic treatment processes are considered less suitable for slaughterhouse wastewater due to high energy consumption for aeration, large quantities of sludge production, and oxygen transfer limitations (Gavala *et al*, 1996; Rajeshwari *et al*, 2000; Speece, 1996). Therefore, anaerobic biological process is more suitable and has been used to treat slaughterhouse wastewater with high influent concentrations. A high level of anaerobic reactor has been used as a good and effective alternative because they have more advantages such as low initial and operating costs, smaller space required, high removal efficiency of organic matter content and low sludge production. In addition, this process produces useful clean energy through biogas production. (Banu *et al*, 2007; Behera *et al*, 2007; Juang and Chiou, 2007; Liu *et al*, 2010; Bicheldey and Latushkia 2010; Karapidakis *et al*, 2010). Some processing technologies can be applied to process RPA waste such as Contac anaerobic (AC), up flow anaerobic sludge blanket (UASB), the anaerobic filter (AF), and the sequence of anaerobic batch reactor (ASBR) (US-EPA, 2002; Johns, 1995). WWTP performance biofilter showed excellent results, with excellent processed quality. Application of biofilter in Janti's tertiary clinic WWTP can reduce the content of BOD organic matters of 98%, COD content of 98% and TSS of 93% (Siti Muhimatul Ifadah and Sugito, 2012).

3.1. Effect of the influent BOD concentration on removing dissolved BOD_5

In general, organic substances removal occurs because decomposing microorganisms which break down the waste. They obtain food supplies (nutrients) from the waste to be processed in a processing reactor unit. Mechanisms of metabolic processes in the bio-filter system shows a bio-film system consisting of medium buffer, bio-film layer attached to the medium, waste water layer in the air located outside. The bio-film's thickness is limited until nutrients are able to reach the microorganisms which lie in the innermost layer. At some point, the bio-film thickness will reach maximum thickness until the nutrient cannot diffuse through the deepest layer. Due to food supply stopping, the microorganisms in the innermost layer (microorganisms stick to the media's surface) will undergo endogenous respiration stage. Under such circumstances, the microorganisms will lose their ability to stick to the media. Therefore, they will be detached and washed away from the bio-filter system along with water flow.

The removal of pollutant load in the influent BOD concentration of each variety will be presented in Figure-2.

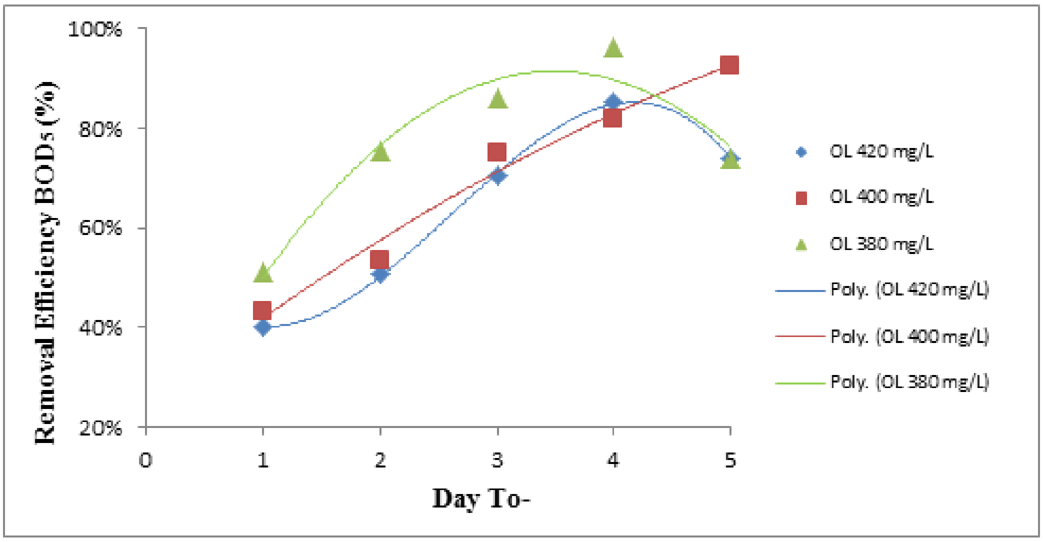

Figure-2. Allowance for the content ofdissolved BOD_5.

ARPN Journal of Engineering and Applied Sciences

The large amount of content of BOD's removal shows the role of microorganisms as waste decomposing agent, and is said to be maximum as it can remove pollutant load of BOD above 90%. The role of microorganisms in breaking down RPA waste which happens in every type of influent BOD concentration has occurred since the first day of observation.

The results of overall analysis, shows the largest removal efficiency on the content of dissolved BOD_5 occuring in the influent BOD concentration of 380 mg/L. Atan influent BOD concentration of 420 mg/L, the greatest removal is 87.2%. Atan influent BOD concentration of 400mg/L, the greatest removal is 94.2%. At an influent BOD concentration of 380 mg/L, the greatest removal is 98.1%. There is a greater removal occurring during the process of content of BOD removal in the influent BOD concentration of 380mg/L. This occurs because it is influenced by the concentration of contaminants which are smaller when compared with other influent concentration.

3.2. Effect of the influent BOD concentration on COD Allowance

The higher value of COD can affect the quality of the environment. Therefore, the higher the value, the higher the COD pollution caused by organic substances is. (Rahayu and Tontowi, 2008). In its oxidation capacity, the determination of the COD value is considered the best in describing the presence of organic materials can be decomposed either biologically or not. In generally, the source of oxygen used is $K_2Cr_2O_7$ which is in acidic conditions. Basically, COD measurement is the addition of potassium bichromate amounts. ($K_2Cr_2O_7$) as an oxidant in the sample (with a recognized volume) that has been added to the concentrated acid and silver sulfate catalyst, heated for some time, and then titrated with potassium bi chromate. Thus, potassium bi chromate used for the oxidation of organic material in the sample can be calculated and COD values can be determined. The effects of the influent BOD concentration on the removal of COD content will be presented in Figure-3.

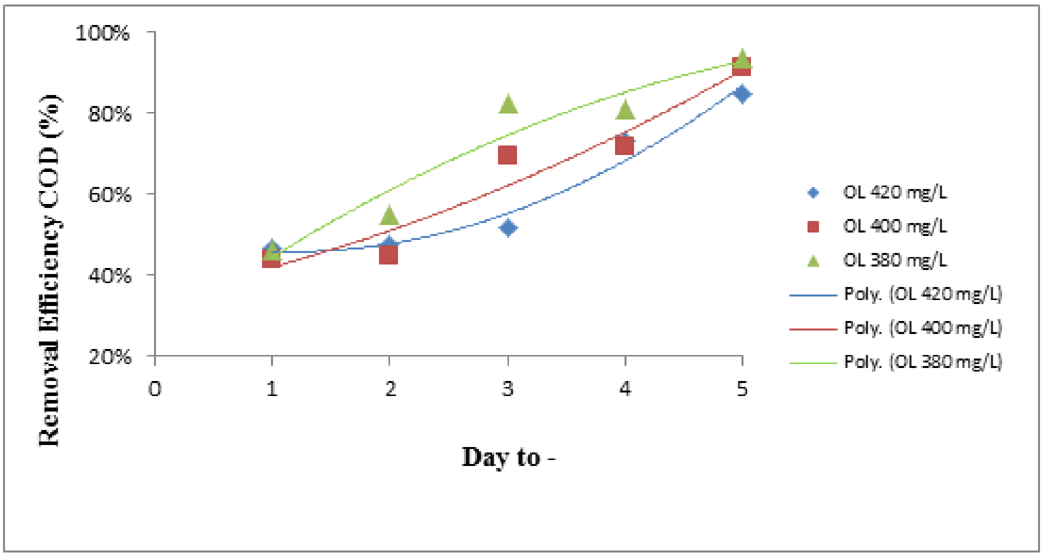

Figure-3. Allowance for the COD content.

Generally every type of influent BOD concentrations experienced removals of pollutant load content from the first day of observation. Yet, the removal is not significant.The wastewater treatment of chicken slaughterhouse by using submerged up flow anaerobic bio filter to reduce the content of COD has been done by several researchers. The use of media hydraulic load at 0006m^3/m$^2_{media}$.day able to reduce the content of COD is 96.32% (Al Kholif, M and Hermana, J, 2013).

Similarly, as what happened to the removal process of BOD content, the removal also occurs during the process of removing COD content to exceed the figure of 90 %. All variety of influent BOD concentrations generally occur provision for the content of pollutant load. Atan influent BOD concentration of 380 mg/L, the allowance COD content is highest in the 5th day of observation with 96.21 % Figure. Atan influent BOD concentration of 420mg/L are capable of removing COD content of 92 % and the influent BOD concentration of 400 mg/L are capable of removing up to 86.67 % of COD.

Slaughterhouse wastewater pollutant level depends on many parameters, such as type of operations (like cleaning and butchering), type of the slaughterhouse, and amount of the slaughterhouse. Slaughterhouse wastewater consists of a higher organic pollution loading as well as a large part of food waste, which is easily biodegradable. The influence of fiber biomass carrier biofringe with activated sludge has compared with conventional activated sludge systems by using suspended growth bioreactors. The performance of activated sludge with biofringe reactor efficiently removed BOD, COD removal due to supply both attach and suspended growth which support aerobic and anaerobic conditions in the activated sludge with biofringe systems. Wastewater treatment slaughterhouse using a combination of activated sludge treatment and biofringe capable of removing BOD and COD content is greater. On the processing capable of removing BOD content of 99.1% and set aside 97.5% of COD (Bakar, *et al*, 2015).

4. CONCLUSIONS

Results of the analysis can be concluded that the removal of wastewater pollutant load RPA of each influent BOD concentrations generally decrease or significant allowance. This is evidenced by the preliminary figures pollutant load content that reaches more than 90%. It also indicates that the use of processing technology with anaerobic bio-filter system highly suitable for application in treating slaughterhouse waste water which has a concentration of pollutant load is quite high. Preliminary figures that occur in the influent BOD concentration of 380mg/L preliminary figures show that the highest when compared with the great removal that occurs in the influent BOD concentration of420mg/Land400mg/L. on influent of BOD concentration of 380mg/L of microorganisms capable of removingdissolvedBOD_5pollutantloadby98.08%, and the content of COD is96.21%.

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