

Investigation of Chicken Slaughterhouse Wastewater Treatment using Bleaching earth and Bentonite Clay

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Abstract: Chicken processing industry is one of the main poultry industries in the world. The industrialization of chicken processing industry has become well known. Due to the increasing of it, the wastewater from the poultry industry must be treated. In this study, the researcher investigates the wastewater from chicken's slaughterhouse using bleaching earth and bentonite clay to determine the physical property and comparison between BOD and COD of chicken wastewater after bleaching earth and bentonite clay treatment according to DOE standard. Two types of method was used in this research. The first method is filtration using bleaching earth and bentonite clay without magnetic stir hot plate. Preparation of wastewater in method 1 shows bleaching earth is more efficient rather than bentonite clay. This is because sample 4 shows the chicken wastewater changed to clear water and the smell of chicken blood also disappeared. Meanwhile the result for BOD is 16.87 mg/L and COD is 67.48 mg/L. While for the second method is using bleaching earth and bentonite clay with magnetic stir hot plate. The result is contrary with method 1. Method 2 shows bentonite clay is more efficient to get clear water. It shown in Sample 4. During the interval the BOD result is 15.00 mg/L while COD is 60.00 mg/L. Both method shows the result for BOD and COD is in between DOE standard. As conclusion, the chicken wastewater treatment successfully done by Using 2 method of clay with are bleaching earth and bentonite clay. Both clay allow the chicken wastewater turn colour into clear water. It can be alternative way to treat water and become useful for other application.

Keywords: Poultry, Wastewater, Bleaching Earth, Bentonite Clay

1. Introduction

Chicken processing industry is one of the main poultry industries in the world. The industrialization of chicken processing industry has become well known. Due to the increasing of it, the wastewater from the poultry industry must be treated. Poultry wastewater refer to organic matters such as proteins, blood residues, fats and lard that is heavily polluted. To avoid environmental degradation such as eutrophication and the spread of water-borne diseases, appropriate wastewater treatment is required prior to discharge into a water body. [1]

Chicken/duck production in 2013-2017 was the greatest egg self-sufficiency ratio (113.70 %), followed by poultry meat (98.20 %). Slaughterhouse effluent levels have risen dramatically and have resulted in large amounts of wastewater. As a result, Slaughterhouse wastewater treatment should be undertaken to protect the environment. Thus, the researcher discusses on how to treat the wastewater using bentonite clay and the characteristic of physical and chemical property in the wastewater. [2]

Poultry processing activities are usually done near drainage systems. Untreated wastewater from this activity which contains oil, fat, blood and incoming hairs will flow thoroughly towards the drainage system. Poultry slaughterhouses produce large quantities of highly polluted wastewater, especially during the slaughtering process and the periodic washing of waste particles, resulting in substantial differences in the concentration of decomposable organic matter. Organic matter is considered a major contaminant in slaughterhouse waste. The chemical industry will use clay treatment methods to treat contaminated wastewater for reuse. It will be required to either improve existing wastewater treatment processes or develop a combination of various processes. This is driving the expansion of potential treatments available in high strength wastewater treatment sites. [3]

Poultry slaughterhouse from wastewater is considered an undesirable production because if this untreated material is disposed of in an uncontrolled manner, it will produce negative environmental effects. [4] The problem of chicken slaughterhouses produce large amounts of highly contaminated wastewater, particularly during the slaughtering process and the periodic washing of waste particles, resulting in significant variations in the concentration of decomposable organic matter. In slaughterhouse waste, organic matter is regarded as an important pollutant. [5]

2. Literature Review

Wastewater from untreated poultry slaughter can cause environmental pollution of poultry industry such as containing oil, fat, blood, and feathers. This chapter focuses on the treatments that will be used to treat untreated waste using bentonite clay treatment. Wastewater is classified as any water that has been polluted by human activity. Wastewater is defined as used water resulting from any combination of domestic, industrial, commercial, or agricultural activity, surface runoff or storm water, and any sewer input or sewer infiltration." As a result, wastewater is a by-product of human activity, whether it be home, industrial, commercial, or agricultural. The properties of wastewater differ depending on the source used. [6]

Wastewater treatment is a method used to remove and convert impurities from wastewater or sewage into an effluent that may be reintroduced to the water cycle. Once it has been returned to the water cycle, effluent has a low influence on the environment and can be reused for a variety of applications [7]. The treatment process takes place in a wastewater treatment plant (WWTP). Domestic waste and industrial waste are the two types of waste. Both types of waste are treated at the appropriate treatment plant. For industrial waste, Treatment takes place at either a separate industrial wastewater treatment plant or at a sewage treatment plant, depending on the situation.

The Guidelines for the reference of implementing agencies, this document has been prepared in accordance with the Cabinet Meeting on 15 August 2012. These standards apply to all chicken, duck, and other poultry slaughterhouses in Peninsular Malaysia that are under the jurisdiction of local

authorities. While this is happening, the adoption of these recommendations in the states of Sabah and Sarawak is contingent on acceptance by the PBN state authorities in the respective jurisdictions in addition, the location of the slaughterhouse construction should be in the zone or an industrial area with the following categories that have been shown in table 1 small and medium scale poultry slaughter and processing premises management manual of the veterinary services department. However, its location is not close or is in an area prone to flooding. At a minimum, the position should be at least 100 meters away from the wastewater treatment plant's inlet (water intake point) as well as at the top of any pollution sources, such as a landfill.

Table 1: Small and medium scale poultry slaughter and processing premises management manual of the veterinary services department

Slaughterhouse Category	Small	Medium	Big
Number of slaughters per day	Less than 500	From 501-5000	Less than 5000
Premise area	< 20' x 50'	< 20' x 70'	≥ 20' x 70'

The quality of wastewater discharge, Table 2 shows waste disposal from slaughterhouses located at the inlet of a water treatment plant using standard A and downstream of the inlet of a water treatment plant using standard B, environmental regulations (industrial effluent) 2019. This is for the purpose of designing effluent treatment systems. All slaughterhouse premises were required to achieve all environmental quality act 1974 and natural environment (industrial effluent) rules 2009 criteria. [8]

Table 2: Acceptable conditions for the discharge of industrial effluents or mixed effluents for standards A and B (Environmental Quality Act 1974)

Parameter	Standard A	Standard B
BOD	< 20	< 50
COD	< 80	< 200
TSS	< 50	< 100
pH	< 6.0-9.0	< 3.3-9.0
Oil & Grease	< 1.0	< 10
Ammonia nitrogen	< 10	< 20
Temperature	< 40	< 40
Color	< 100	< 200

3. Methodology

This section will explain the development of this project from the beginning and from the beginning to the completion of the effort. Therefore, flow chart diagram are important to represent the replacement of tasks for completing work as guidelines that need to be implemented and need to be adhered to. Typically, a flow chart is compiled at an early stage to show the flow of processes that must be performed in the project. The methodology will be well structured and organized to support the final project. Therefore, each stage of the project path does not miss the preparation and perspective, or more specifically, the results of the study must meet the requirements of the problem to be solved. Furthermore, each step and process involved in the development of the methodology of this study is important to be studied and understood more details.

This section also show the procedure/step to investigate of poultry wastewater treatment using bleaching earth and bentonite clay. In order to achieve the objectives of this project, the Organic matter is considered a major contaminant in slaughterhouse waste. The chemical industry will use bleaching earth and bentonite clay treatment methods to treat contaminated wastewater for reuse.it will be required

to either improve existing wastewater treatment processes or develop a combination of various processes. This is driving the expansion of potential treatments available in high-strength wastewater treatment sites. [9]. Before conducting the analysis, a pre-treatment method is used where results from chicken wastewater treatment with using different among bleaching earth and bentonite clay. Figure 1 below shows the process flow of all the research.

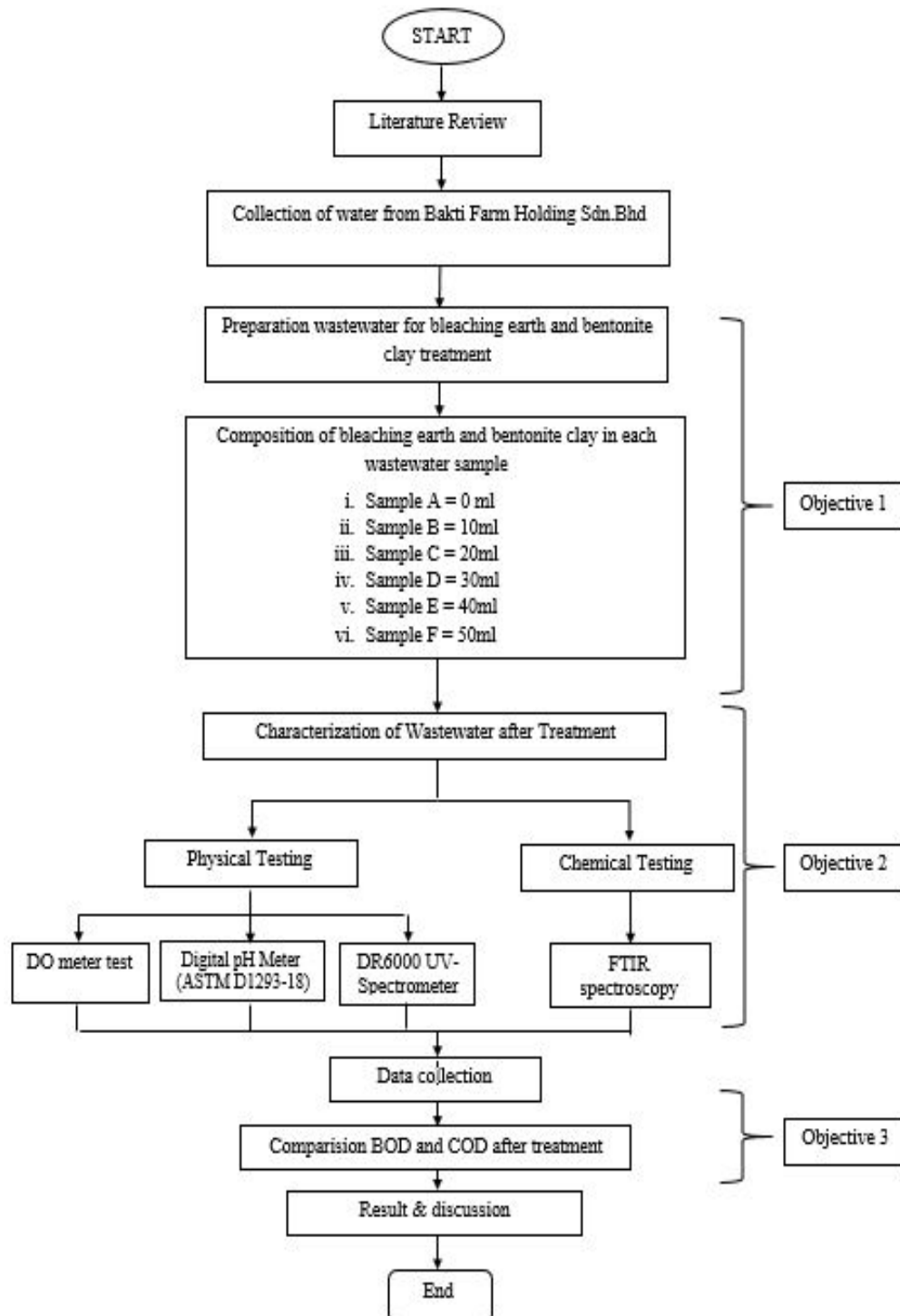


Figure 1: Methodology

3.1 Preparation Raw Material Wastewater

Samples of chicken slaughter waste were collected From Bakti Farm Holding Sdn.Bhd which address No. 120/121, Jalan Perdana 6 Taman Perindustrian Perdana Lukut, Port Dickson, Negeri Sembilan, Malaysia. Wastewater sample will be collected and analysed to identify the composition of the wastewater using Digital pH Meter, BOD, COD and FTIR spectroscopy are carried out on the wastewater.

3.1 Preparation of Bleaching Earth and Bentonite Clay Powder

In the preparation of wastewater sample, there are 6 samples namely 1, 2, 3, 4, 5 and 6 differently. A 50ml wastewater sample is divided into each beaker. Table 3 shows the wastewater samples were prepared into two different methods by using mass granule bleaching earth and bentonite clay

Table 2: the mass granule bleaching earth and bentonite clay in preparing wastewater sample

Sample	Bleaching earth (ml)	Bentonite clay (ml)
1	0	0
2	10	10
3	20	20
4	30	30
5	40	40
6	50	50

Two methods have been use in this research. The first method is filtration using bleaching earth and bentonite clay without magnetic stir hot plate. While second method is filtration using bleaching earth and bentonite clay with magnetic stir hot plate.

3.2 Pre-Treatment Method 1

First of all, before starting the experiment it is necessary to make sure that the tools to be used are intended to facilitate while conducting the experiment. Second, prepared the equipment such as beaker, gas jar, filter funnel and filter paper. Third, chicken wastewater will be put into a beaker and divided equally which is 6 beakers to represent 6 samples that each beaker contains as much as 50ml.Next, insert the bleaching earth into the filter paper with different quantities. In addition, Chicken waste water is poured into filter paper and time will be taken and the slow filtration process take place. Furthermore, a clear colorless filtrate was collected. After finish using bleaching earth, filtration using bentonite will be carried out and the same step have been used.Last but not least, all the sample were collected for testing.

3.2 Pre-Treatment Method 2

First of all, before starting the experiment it is necessary to make sure that the tools to be used are intended to facilitate while conducting the experiment. Second, Prepared the equipment such as magnetic stirrer hot plate, beaker, gas jar, filter funnel and filter paper. Third, chicken wastewater will be put into a beaker and divided equally which is 6 beakers to represent 6 samples that each beaker contains as much as 50ml.Next, Method must add the bleaching earth by a little while stirring the solution using magnetic hot plate. Furthermore, the mixture was then stirred for 15 minutes at 50°C. Besides, Effluent absorption experiments were conducted at room temperature by mixing 50ml wastewater with bleaching earth at a constant stirring speed of 450 rpm. After 15 minutes, the mixture is poured into the filter paper and time will be taken. In addition, the slow filtration process take place and a clear colourless filtrate is collected .Then, the process was repeated for the next 10ml, 20ml, 30ml, 40ml and 50ml.After finish using bleaching earth, filtration using bentonite will be carried out and the same step have been used. Finally, all the sample were collected for testing.

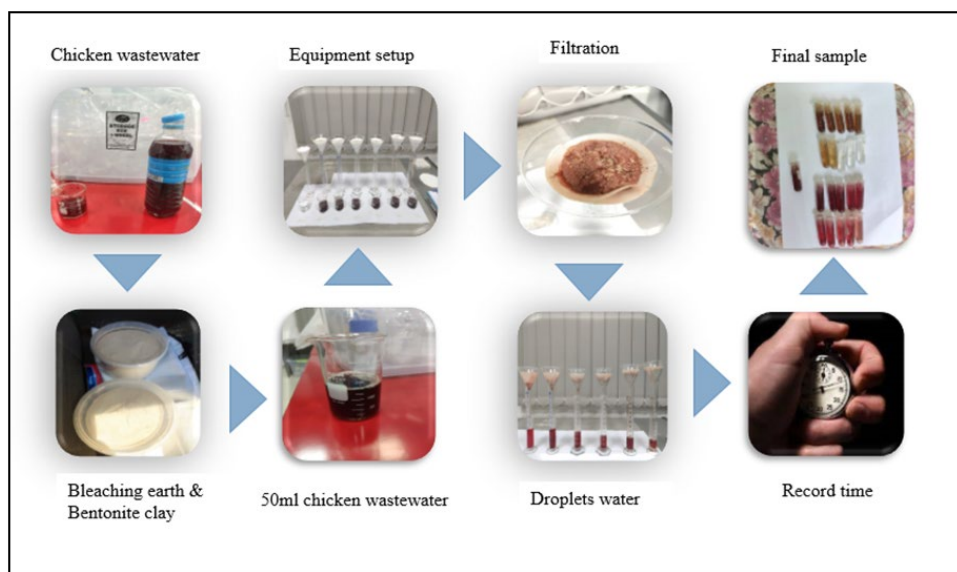


Figure 2: Method 1 pre-treatment without magnetic stir hot plate

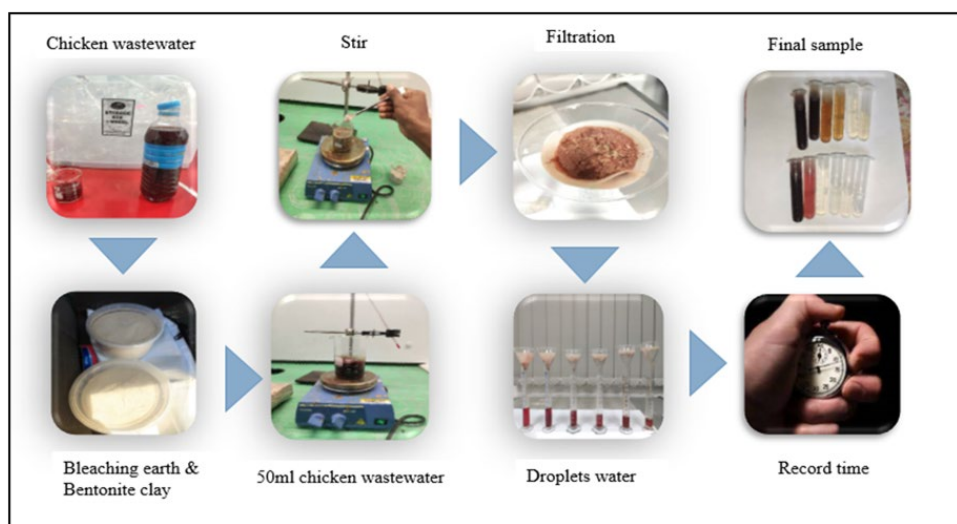


Figure 3: Method 2 pre-treatment using magnetic stir hot plate

4. Result and Discussion

The results of experiments that have been conducted to obtain wastewater to clear water through filtration. The objective of this study is to investigate and improve the environmental issues in chicken wastewater treatment. The time taken for each volume of substances is varied because the researcher measured the time with the last drop of water for both methods. Next, the physical properties of chicken wastewater using bleaching earth and bentonite clay after filtrations conducted are Digital PH meter, DO meter for BOD measured, DR6000 UV-Spectrometer for COD measured and Fourier Transform Infrared (FTIR) spectroscopy.

4.1 Results of Method 1

The Figure 4 shows the data on the second filtration method using bleaching earth involved in this research. The most chicken wastewaters after filtration that involved in this research are sample 2 and sample 3 with time taken of 17 minutes. Meanwhile very little is Sample 1 with time taken of 8 minutes. The Figure 5 shows the most chicken wastewaters after filtration that involved in this research are sample 1 with quantity (V) of 34.00 ml and the least Sample 6 with quantity of 10ml. The processes

filtration was continues with method 1. The result for the second filtration shows that from the physical observation to the colour of the water from red into clear water. Among the 6 sample of using bleaching earth, sample 4, 5 and 6 get clear water after filtration present the smell of chicken blood is disappeared. This is because bleaching earth function is to remove undesired matter found in the chicken wastewater [10].The researcher perceive that bleaching earth absorb the red colour from the chicken wastewater efficiently because it works better with water rather than bentonite clay.

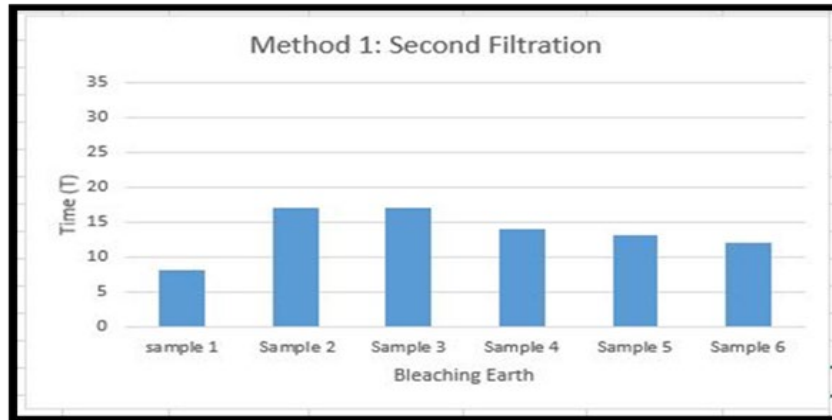


Figure 4: Second Filtration

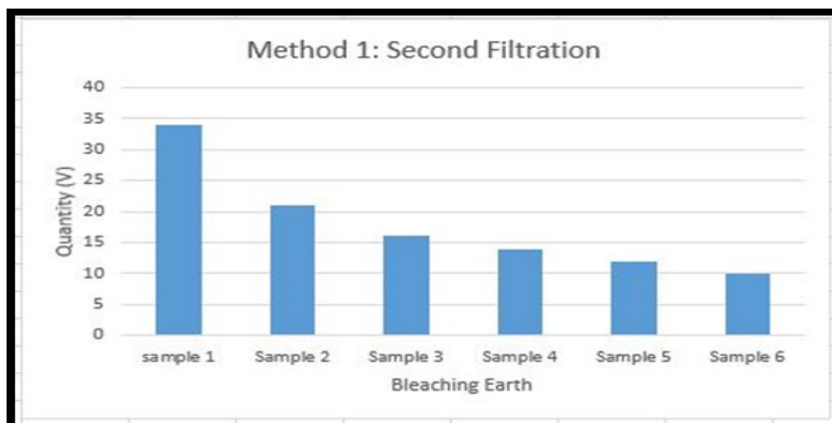


Figure 5: Second Filtration

The Figure 6 shows the most chicken wastewaters after filtration that observed are sample 6 with time taken of 26 minutes and the least Sample 1 with time taken of 8 minutes. The Figure 7 shows the most chicken wastewaters after filtration that involved in this research are sample 6 with quantity (V) of 6ml and the least Sample 1 with quantity of 26.00 ml. The result shows the water left 6 ml from 50 ml chicken wastewater. Meanwhile, for bentonite clay treatment the shown does not get any clear water for all the 6 samples. Thus, the smell of chicken blood is still present. In conclusion, when wastewater turn to smell of chicken blood disappeared while the sample that not make any changes of the colour wastewater after treatment the smell is still that.

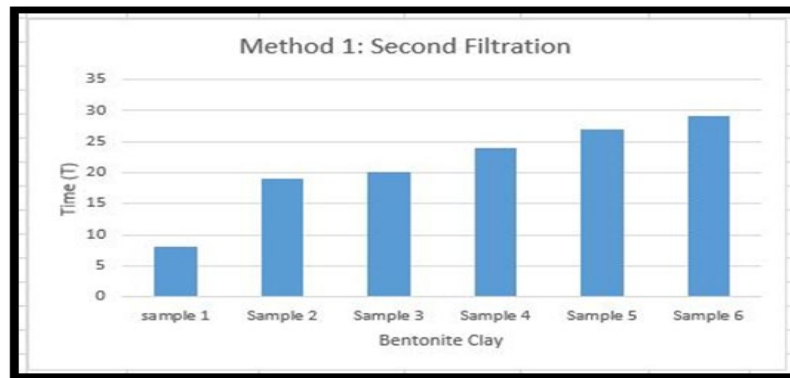


Figure 6: Second Filtration

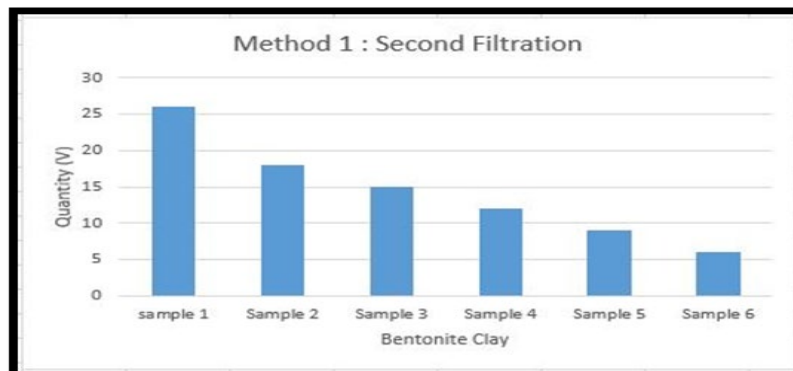


Figure 7: Second Filtration

4.2 Results of Method 2

The Figure 8 shows the data on the first filtration method 2 with mixture bentonite clay and chicken wastewater using magnetic stirrer hot plate involved in this research. The most chicken wastewaters after filtration that involved in this research are sample 1 with time taken of 19 minutes and the least Sample 4 and sample 5 same data with time taken of 3 minutes. The Figure 9 the most chicken wastewaters after filtration that involved in this research are sample 1 with Quantity (V) of 41 ml and the least Sample 6 with Quantity (V) of 1.50 ml. Meanwhile, the figure 10 for first filtration using bentonite clay also show the color of the water from red become clear water. The researcher discovers bentonite clay is more effective rather than bleaching earth in gating clear water. The bentonite clay is more effective to get clean water rather than bleaching earth. This is because bentonite has the ability to high absorptions is a large amount of protein molecules and swelling rate [11].

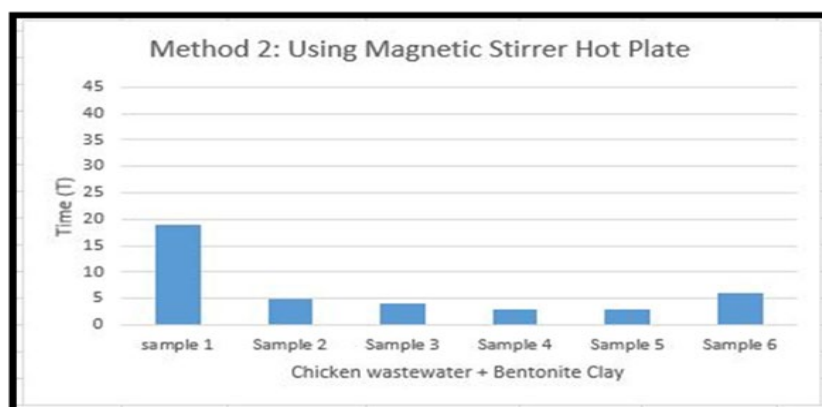


Figure 8: First Filtration

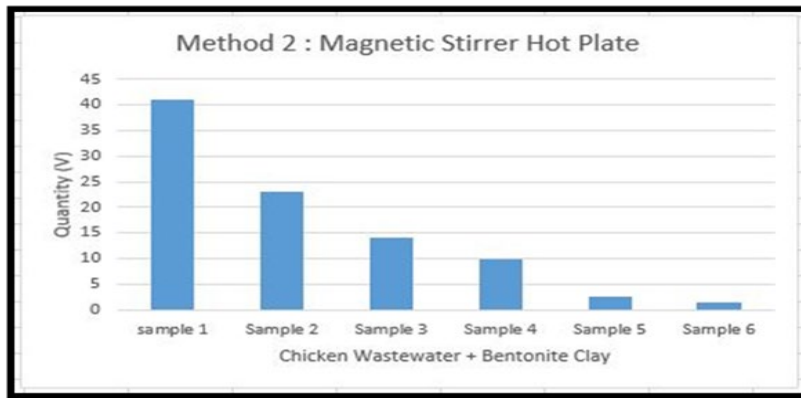


Figure 9: First Filtration

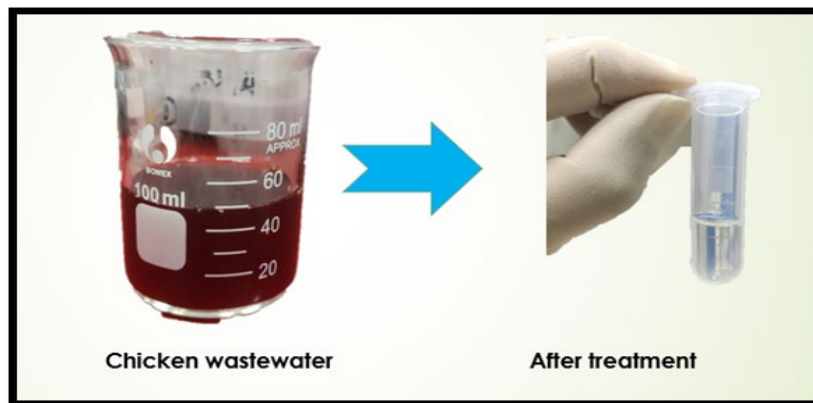


Figure 10: Before and After Filtration

4.3 BOD and COD Laboratory Measured

Table 3: Chicken wastewater treatment sample using bleaching earth

Chicken Wastewater Sample	BOD (mg/L)	COD (mg/L)	pH
Sample 1	15.62	62.48	6
Sample 2	17.5	70	4
Sample 3	17.5	70	4
Sample 4	16.87	67.48	3
Sample 5	16.87	67.48	3
Sample 6	16.87	67.48	3

Table 4: Chicken wastewater treatment sample using bentonite clay

Chicken Wastewater Sample	BOD (mg/L)	COD (mg/L)	pH
Sample 1	15.62	62.48	6
Sample 2	15.62	62.48	6
Sample 3	15	60	7
Sample 4	15	60	7
Sample 5	15	60	7
Sample 6	15	60	7

Table 3 shows the chicken wastewater treatment sample using bleaching earth. The sample was categorized into 3 parts according to the same pH, while Table 4 shows the chicken wastewater treatment sample using bentonite clay, and the sample was also categorized into 2 parts. According to environmental quality Act 1974, the researcher used Standard A to measure the condition for the discharge of industrial effluents or mixed effluents. Based on the experiment done by the researcher, it shows the parameter is still under Environmental Quality Act 1974. [8]. The parameters from Standard A for BOD, COD and pH value are as below:

Table 5: Parameter from standard A (Environment Quality act 1974)

No.	Parameter	Unit	Standard A	Average
1	BOD	Mg/L	< 20	16.03
2	COD	Mg/L	< 20	64.15
3	pH	-	< 6.0-9.0	5.25

3.2 FTIR Spectroscopy

FTIR analysis result of wastewater treatment using bleaching earth and bentonite clay are shown in Figure 10. There are 3 number of peak in the result and it so the sample as a simple spectrum where the compound analyses are simple organic compound and small mass molecular weight. Peak is broad absorbent then in the range of point wavenumber between 3000-3500. This band matching up with the group of Intermolecular H Bond. This band shows the existence of hydrate (H₂O) and hydroxyl (OH).

Next, there is a peak at 2200-2300. This inform some nitrogen multiple and cumulated double bond compound with from aliphatic cyanide/nitrile, Aromatic cyanide/nitrile, cyanate (-OCN and C-OCN stretch) and Isocyanate (-N=C=O asym.stretch). Furthermore, the wavenumber shows the last peak in 1600-1700. The peak show the present of alkenyl C=C stretch, aryl-substituted C=C and conjugated C=C. Based on above interpretation, several conclusions can be obtained, the result shows there r few peak in the FTIR analysis. This material have few functional group from Coates, (2000) such as alcohol and hydroxyl compound, Olefinic (alkene) and acetylenical (alkyne). Since the peak were not more than 5 peaks, the wastewater treatment is a small organic compound.

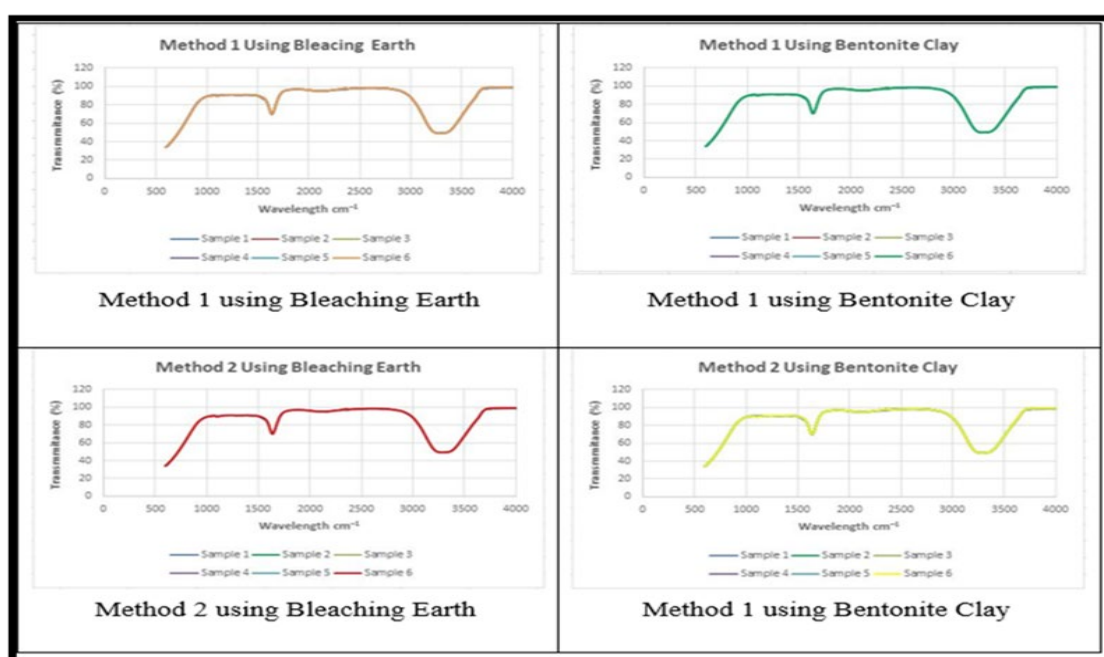


Figure 10: FTIR analysis

4. Conclusion

In conclusion, this study was carried out to fulfil the objective that have been set out for chicken slaughterhouse wastewater treatment using bleaching earth and bentonite clay. The researcher compare the effectiveness of chicken wastewater using bleaching earth and bentonite clay using two methods which are direct filtration without magnetic stirrer hot plate and filtration using magnetic stirrer hot plate. The volume of wastewater used is the same while the amount of substances (bleaching earth and bentonite clay) are different for each sample.

The experiment using method 1 which is filtration without magnetic stir hot plate observed the bleaching earth is more effective to get clean water rather than bentonite clay. This is due to bleaching earth absorb the red color from the chicken wastewater efficiently because it works better with water. Furthermore, the time taken for wastewater to change clear water is faster than bentonite clay.

While for method 2 of wastewater treatment the bentonite clay is more efficient to get the outcome for clean water. The bentonite clay is capable of adsorbing organic materials because of its huge chemically surface. Besides, the comparison between the COD and Bod of the chicken wastewater according to Standard A (Environmental Quality Act 1974). The parameter for COD is four time greater than BOD which the researcher get for sample 4 using bleaching earth where COD (16.87) while BOD (67.48) and for sample 4 using bentonite clay get (15) while BOD (60).The benefits of this study give more information to future researcher about chicken wastewater using two different types of clay which are bleaching and bentonite clay.

Wastewater treatment is one of the ways to prevent water pollution. In Malaysia, there are many slaughterhouse not only for chicken but also for others animals. Therefore it is very crucial to prevent the wastewater to become polluted. To enhance this study, further improvement can be taken by the following considering and recommendation:

- I. Use other techniques such as chlorination to find chemical property. Rather than
- II. Use FTIR, the future researcher also can use (Liquid cells & IR windows) because FTIR can detect molecules of water only.

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