Treatment of Industrial Waste Water by Using Orange Peels & Fish Scales

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Abstract— An experimental investigation was carried out for the treatment of diary waste water using low cost adsorbents. The peels of orange and fish scales were used as adsorbents in this study by carbonization and dehydration (bio sorption) methods and the effect of pH, contact time, adsorbent dosage, and adsorbent particle size in removal of pollutants present in dairy wastewater was evaluated. The studies showed that the orange peels are more effective than the fish scales in the removal of pollutants from the dairy wastewater. The carbonization method is found to be more efficient than the de-hydration method for both, orange and fish scales with high percentage removal of 50.1% and 31.25% respectively. The orange peels found to be more efficient in both methods with highest percentage removal of 50.1% and 14.3% respectively compared to the fish scales where percentage removal is found to be 31.25% & 8.2% respectively for the de-hydration method and carbonization method. The optimum pH for both methods, orange and fish scales found to be in a range between 6-8. The optimum contact time for de-hydration method of orange peel and carbonization method of fish scales is 120 min and for de-hydration of fish scales and carbonization of orange peel is 150 min. The optimum adsorbent dosage for the dehydration method of orange peel is 0.15 g and for fish scales is 0.25g. The optimum adsorbent dosage for carbonization of orange and fish scales is 0.3g and the optimum particle size for methods, orange and fish scales are 300µm.

Key words: Orange peels, Fish scales, Carbonization, Dehydration (biosorption) methods, Dairy wastewater

I. INTRODUCTION

Worldwide water demand is increasing day by day due to rapid population and industrial growth, and on the other hand there is continuous decline in ground and surface water levels due to over exploitation. Efforts are being made to find the alternatives for water supply and one prominent solution is treatment and re-use of industrial wastewater. The dairy industry involve processing of raw milk into products such as milk, yogurt, cheese etc. and generates lot of wastewater which contains very high concentration of organic substances such as proteins, carbohydrates and lipids. Many technologies are in practice to treat the dairy wastewater and in the present study, an attempt was made to investigate the application of low cost adsorbents from orange peels and fish scales for the treatment by considering the wastewater from local dairy form in Madurai. Organic and biodegradable materials that can disrupt aquatic and terrestrial ecosystems. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater cause serious environmental problems. Hence the importance of carrying out a whey treatment as a starting point in order to optimize a simple and economic method to treat the whole dairy effluent.

Moreover, the Indian government has imposed very strict rules and regulations for the effluent discharge to protect the environment. The wastewater treatment which does not give any monetary benefit to dairy industry owners they release it directly to nearby water streams or on land (i.e. in nature) by giving only some of the primary treatment; due to lack of awareness in this regard and lack of funds. In my research work, I wish to minimize the cost of the treatment plant using orange peels and fish scales as a jar test methods and effect of pH, contact time, adsorbent dosage and adsorbent particle size in removal of pollutants present in dairy waste water was evaluated.

A. Need of the Project

Waste water from dairies contain mainly organic and biodegradable materials that can disrupt aquatic and terrestrial ecosystems. Due to the high pollution load of dairy wastewater, the milk-processing industries discharging untreated/partially treated wastewater cause serious environmental problems. Hence the importance of carrying out a whey treatment as a starting point in order to optimize a simple and economic method to treat the whole dairy effluent. Moreover, the Indian government has imposed very strict rules and regulations for the effluent discharge to protect the environment.

The wastewater treatment which does not give any monetary benefit to dairy industry owners they release it directly to nearby water streams or on land (i.e. in nature) by giving only some of the primary treatment; due to lack of awareness in this regard and lack of funds. In my research work, I wish to minimize the cost of the treatment plant using orange peels and fish scales as a jar test methods and effect of pH, adsorbent dosage, and adsorbent particle size in removal of pollutants present in dairy waste water was evaluated.

B. Objectives of the Study

Reduce the organic content of the waste water. Remove or reduce nutrients that could cause pollution of receiving surface water or groundwater and remove or inactive potential pathogenic micro organisms or parasites.

To identify a sustainable, low cost, locally available, simple, reliable, acceptable, eco-friendly, household level point of use waste water treatment technology most suitable for rural population of developing countries. To use various low cost adsorbents (Orange peels & fish scales) from the generation of organic waste in the market for the waste treatment. To find the optimum adsorbent dosage, effective contact time & particle sizes. To find a process that allowed efficient removal of pollutants from Dairy waste water. To evaluate the filtration process followed by suitable method for separation of the flocs formed using low cost adsorbents (Orange peels & Fish scales).

II. LITERATURE REVIEW

Nikolaeva, et al., (2013) conducted a study on dairy wastewater treated by anearobic fixed bed reactor from laboratory to pilot-scale plant using hybrid material composed of tier rubber and zeolite. The effect of hydraulic retention time was evaluated from 1-5.5 days. It was concluded that, in the laboratory scale, COD (Chemical Oxygen Demand) removal efficiencies varied from 28.3% to 82.1% respectively. Whereas, pilot-scale plant, COD removal efficiency achieved at 63.6% in a hydraulic retention time of three days. Abdur Rahman, et al., (2013) studied the removal of dyes from textile waste water using orange peels as adsorbent. The study evaluated the effect of different pH, contact time, and amount of adsorbent. The experiment showed that the percent removal was 60-70% at pH 7, retention time of 120 minutes and amount of adsorbent of 1.5 grams. Kartik, et al., (2012) studied the adsorption of Congo red onto carbon prepared from Neem leaf litter and Raw Neem leaf and it was discovered that the adsorption of Neem leaf litter carbon is showed to have higher adsorption capacities of Congo Red compared to Raw Neem leaf litter adsorbents.

Velmurugan. P, et al., (2011) conducted a study on dye removal (Methyl blue) from aqueous solution using low cost adsorbent. The adsorbent were prepared from orange, banana, and neem leaves. The effects of pH, contact time, adsorbent dosage were experimented. It was concluded that the orange peel is very effective compared to others, as the maximum removal found to be 99%.It was also concluded that the optimum pH, time and adsorbent dosage was at 6.5 pH, 45 min, and 1 grams respectively. Kanawade and Gaikwad, (2011) studied the removal of dyes (Acid orange–II) from dye effluent by using sugarcane bagasse ash as an adsorbent.

The effects of contact time, bed height, column diameter and pH were investigated. For the effect of pH, it was concluded that the rate of removal of acid orange–II is very high at pH 7 because of its in neutral medium. For the effect of time, it was concluded that the removal of acid orange–II decreases due to the minimum time of contact between adsorbent and adsorbate.

Mohapatra, et al., (2010) discusses about the usefulness and characteristics of banana peel, and it was concluded that banana peels are strong antioxidant and colorabsorber.Vieira, et al., (2010) studied the treatment of wastewater using Moringaoleifera seed as natural adsorbent. The main objective of the study is to use the MO (Moringaoleifera) seeds as natural adsorbent for the treatment of dairy wastewater. He evaluated the effect of time, pH, MO biomass dose and concentration. The MO seed keeps its adsorption power under pH range between 5-8 and has the potential to be used in the dairy wastewater treatment in an efficient way with low cost. Adsorption of heavy metals from water using banana and orange peels was studied by Annadurai, et al., (2002). The effect of pH was experimented for both orange and banana peels on different metals. It was concluded that the maximum adsorption occurs at pH 68 for orange and banana peels. Taiuddin, et al., studied the removal of carcinogenic substance in waste cooking oil using banana peels. The banana peels was prepared using different methods, de-hydrated banana peel, carbon banana peel, activated carbon banana peel, shallot and commercial activated banana peel. It was concluded that the de-hydrated banana peel is the best compared to other methods, because de-hydrated banana peel have absorbent potentiality and high absorption capacities as a result of absorbing high amount of peroxide from waste cooking oil. Ademiluyi, et al., (2009) studied the adsorption of organic contaminates from refinery waste using activated carbon from waste Nigerian bamboo. The effect of various time (1,2,3,4 and 5 hours) on the removal of COD was investigated. It was concluded that as the time is increased the percent removal decreases. The optimum percent removal was in the first hour with percentage of 62.4 %.

Jatto, et al., (2010) studied the treatment of wastewater from food industry using snail shell. The parameters turbidity, COD (Chemical Oxygen Demand), BOD (Biological Oxygen Demand), TSS (Total Suspended Solids) and TDS (Total Dissolved Solids) was studied before and after treatment was studied before and after treatment, turbidity, COD, BOD, TSS and TDS. It was concluded that snail shell is effective in the treatment of wastewater as the turbidity decreases from 332 to 133 NTU, COD decreased from 872 to 215 mg/L and the BOD decreased from 29.27 to 19.77.El Zayat and Smith, (2007) studied the removal of heavy metals contaminates from water and wastewater using activated carbon from cotton stalks.

The effect of pH on the removal of heavy metals was investigated. It was concluded that, the high removal of heavy metals at pH values greater than 5.5 is motivated by the electrostatic interaction between the activated carbon with its high negative charge and the heavy metal element with their positive charge (+2). However, in some cases a notable removal has occurred at lower pH values which may be due to surface complexation.

III. EXPERIMENTAL PROGRAM

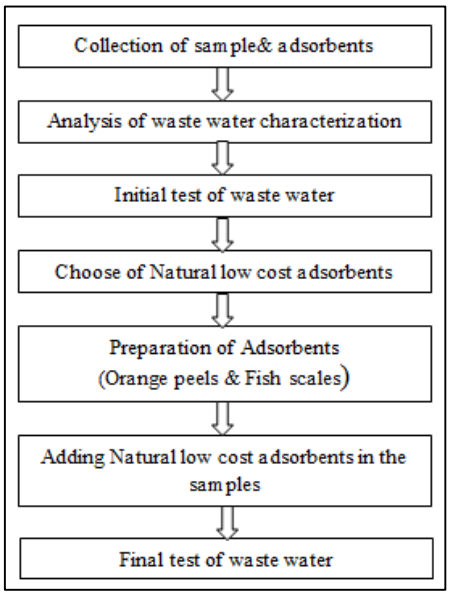

Fig. 1:

A. Collection of Sample & Adsorbents

The Waste Water sample collected from Avain at Madurai. Clean 1000 ml plastic bottles were rinsed several time with distilled water and twice with water which were being

sampled. Samples were transported to laboratory and starts the further tests.

The Adsorbents are obtained from the local market area. Orange peels are collected in the market organic wastes which is collected and remove the dirt in it and it is washed with distilled water. The fish scales is collected from the fish market waste which is washed with distilled water and dried for the further laboratory test.

B. Analysis of Water Characterization

Variation in concentrations of selected parameters for the waste water samples from Avain Dairy waste water sources had high pollutants level above TNPCB standard maximum permissible limits. The water characterisation factors such as pH,Turbidity, COD, BOD, TSS, TDS, Sulphate, Chloride.

C. Initial Test of Waste Water

The initial concentration which gives rise to the highest pollutants uptake was investigated. The effect of initial pollutants concentration in the sample of waste water which is not suitable for discharge to the natural water bodies. So the pollutants concentration in the sample will reduced for discharge to the natural water bodies to protect the environment and aquatic life.

S. No.	Parameters	Initial Test Result	TNPCB Standard
1.	pH	5.35	5.5-9.0
2.	TDS	1803 mg/l	2100 mg/l
3.	TSS	729 mg/l	100 mg/l
4.	BOD	530mg/l	30 mg/l
5.	COD	790mg/l	250mg/l
6.	Sulphate	1208 mg/l	1000 mg/l
7.	Chloride	1104 mg/l	1000 mg/l

Table 1: Initial test Result of Dairy Waste Water

D. Choose Natural Low Cost Adsorbents

Natural low cost Adsorbents were extracted from the following organic wastes.

- Orange Peels
- Fish Scales

1) Description of Natural Low Cost Adsorbents

a) Orange Peels

Recent research has demonstrated that orange peel waste is a potentially valuable resource that can be developed into high value products such as methane. Orange peels which control the following parameters in the industrial waste water such as pH, COD, TSS (Total suspended Solids),TDS(Total suspended Solids), Chloride, Volatile acidity, Sulphate and total nitrogen, nitrate and nitrite, total phosphorous. Highly coloured industrial waste water is a serious environmental problem as it seriously discolours waterways as well as blocking sunlight for photosynthesizing plant species in the water.Orange peels could be used to remove acid dyes from industrial effluent. Orange peels was employed in this work as raw material for the production of citric acid by solid state fermentation. Orange peels contains soluble sugars and pectin as the main components. The orange peels contains the soluble sugars 16.9%, starch 3.75%, fats 1.95%, proteins 6.50% and hemicelluloses 10.5%.

Fig. 2: Orange peels

b) Fish Scales

Bio sorption of heavy metals by fish scales is one of the treatment that has emerged as an environmental friendly method for the removal of metal from synthetic and domestic waste water. To characteristic of fish scales determine the adsorption isotherm and bio sorption kinetics in synthetic wastewater, and efficiency of fish scales in removing zinc (Zn) ion and ferum (Fe) ions in domestic wastewater.

A new method is proposed based on the use of fish scales, parameters such as pH , chemical oxygen demand(COD),suspended material(SM),TDS,TNK and phosphours, controlling the organic pollution of the dairies effluents.

Fig. 3: Fish Scales

E. De –Hydrated Method

The collected peels were cut into small pieces ,washed with distill water to remove dirt and suspended impurities and then dried for 48 hours in an oven at 100ºC to remove the moisture content from the peels .after the drying process, the peels were removed from the oven and kept in the desiccators for 30 minutes. The desiccators contains calcium chloride ($CaCl_2$) which is used to cool and maintain a dry environment and then the peels are ground to fine powder and sieve through 600µm,300µm for the different partical size. these dehydrate peels partical size. These dehydrated peels used as biosorbent in the experimental investigations.

F. Carbonization Method

The collected peels were cut into small pieces, washed with distil water to remove dirt and suspended impurities and then dried for 48 hours in an oven at 100ºC to remove the

moisture content from the peels ..after the drying process, the peels were removed from the oven and kept in the desiccators for 30 minutes and then the dried peels kept in the furnace for 3 hours at 200ºC to convert it into carbon. After that the peels were removed, cooled and ground to fine powder and sieve through 600µm,300µm for different partical size.

IV. RESULT

A. *Effect of pH:*

pH was adjusted according to the label value using 0.1N NaOH and 0.05N HCl. 0.1g of 300 µm adsorbent (dehydrated orange / fish scales or Orange / fish scales Carbon) was weighed using electronic balance and added to each of the samples. Figure 1 shows that the maximum adsorption occurs between pH 6-8 in both methods for orange and fish scales.

S. NO	pH	% Removal of COD in Carbonization Method		% Removal of COD in De- hydration Method	
		Orange Peels	Fish Scales	Orange Peels	Fish Scales
1.	2	38.90	28.68	3.10	2.96
2.	4	41.25	30.97	3.70	3.50
3.	6	47.76	31.57	4.90	4.20
4.	8	45.20	33.20	4.75	12.6
5.	10	38.32	38.18	3.85	2.10
6.	12	28.79	25.09	3.90	1.40

Table 2: Effect of pH on percentage removal of COD

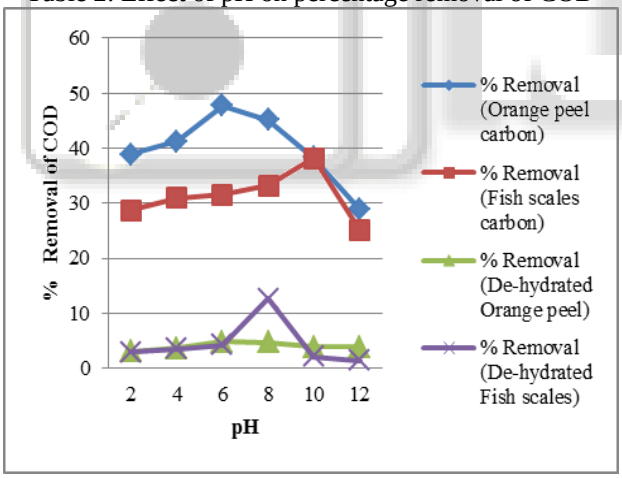

Fig. 4: Effect of pH on percentage removal of COD

B. *Effect of Contact Time*

The optimum contact time was studied at optimum pH, 0.1 g of 300 µm of adsorbent (de-hydrated orange / fish scales or Orange / fish scales Carbon) at different contact times of 30,60,90,120, and 150 minutes respectively. The Figure 2 shows that, the percent removal increases gradually as the time is increased. It can be attributed to the fact that more time becomes available for the organic substances to stick with the adsorbent surface, as well as surface adsorption increases with time. However, a slight decrease on the percent removal at 150 min in de-hydrated orange peel and fish scales carbon, this may be due to desorption of pollutants from the adsorbent surface due to continue stirring process.

S. NO	Contact time in mm	% Removal of COD in Carbonization Method		% Removal of COD in De- hydration Method	
		Orange Peels	Fish Scales	Orange Peels	Fish Scales
1.	30	38.87	29.80	9.80	5.24
2.	60	41.25	32.14	10.70	4.50
3.	90	47.90	34.54	11.60	4.30
4.	120	53.41	36.16	11.50	3.92
5.	150	54.35	38.60	12.50	1.63

Table 3: Effect of Time on percentage removal of COD

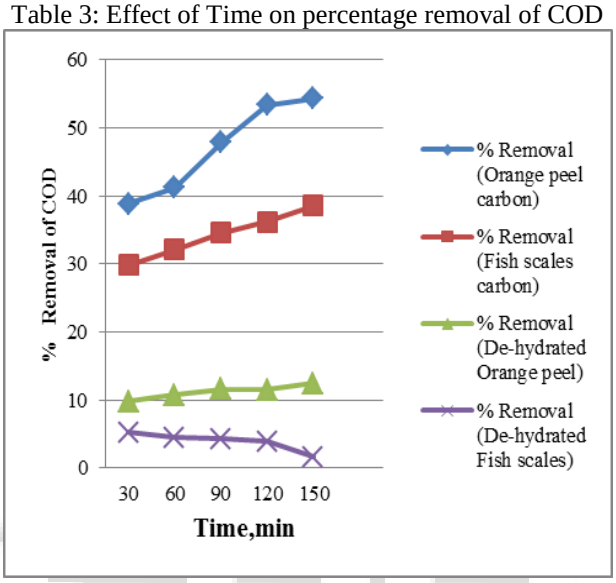

Fig. 5: Effect of Time on percentage removal of COD

C. *Effect of Adsorbent Dosage:*

The optimum adsorbent dosage was studied at optimum pH, 0.1 g of 300 µm of adsorbent (de-hydrated orange / fish scales or Orange / Fish scales Carbon) at different dosages of 0.05, 0.1, 0.15, 0.2, 0.25, and 0.3g respectively. Figure 3 shows that the percent removal increased as the mass of adsosrbent dosage was increased. This result indicates that more surface area was made due to increased mass of adsorbent. In some cases, the percent removal started to decrease which indicates that the adsorbent reach its optimum adsorption and desorption of the organic substances form the surface of adsorbent occurs. Then it will remove using by filter papers.

S. NO	Adsorbent Dosage,mg/l	% Removal of COD in Carbonization Method		% Removal of COD in De- hydration Method	
		Orange Peels	Fish Scales	Orange Peels	Fish Scales
1.	0.05	47.48	30.15	11.63	5.71
2.	0.10	48.20	41.58	12.52	5.10
3.	0.15	48.90	42.50	14.39	4.30
4.	0.20	53.50	43.29	11.54	4.77
5.	0.25	54.39	43.50	10.51	6.30
6.	0.30	56.68	44.69	12.43	2.60

Table 6: Effect of Adsorbent dosage on percentage removal of COD

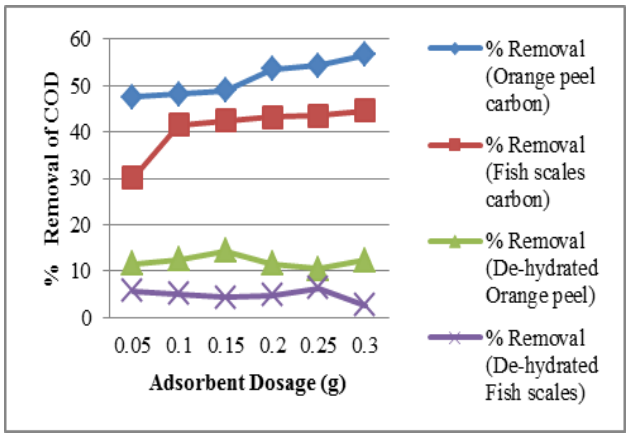

Fig. 6: Effect of Adsorbent dosage on percentage removal of COD

D. Effect of Particle Size:

The optimum adsorbent particle was studied at optimum pH, 0.1 g of 300 µm of adsorbent (de-hydrated orange / fish scales or Orange / Fish scales Carbon) at different particle size 300, 425, and 600 µm respectively. Figure 4 shows that, decrease in adsorbent particle size results, an increase of percent removal of COD and this may be due to the increase in the available surface area for the adsorption process.

S. NO	Particle size in m	% Removal of COD in Carbonization Method		% Removal of COD in De- hydration Method	
		Orange Peels	Fish Scales	Orange Peels	Fish Scales
1.	300	47.24	47.35	11.28	5.14
2.	425	54.15	40.82	12.39	5.10
3.	600	48.9	37.16	14.30	4.30

Table 6: Effect of Particle size on percentage removal of COD

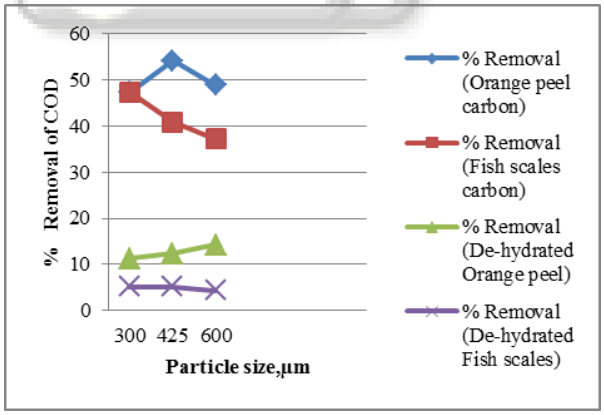

Fig. 7: Effect of Particle size on percentage removal of COD

S. NO	PARAMETERS	INITIAL TEST VALUE	FINAL TEST VALUE	
			Orange peels	Fish Scales
1.	pH	5.35	6.78	5.63
2.	TDS	4803 mg/l	2098.23 mg/l	1076.74mg/l
3.	TSS	729 mg/l	97.62 mg/l	81.87 mg/l
4.	BOD	530 mg/l	29.74 mg/l	19.67 mg/l
5.	COD	494.73 mg/l	246.86 mg/l	209.87mg/l
6.	Sulphate	1208 mg/l	997.45 mg/l	878.36mg/l
7.	Chloride	1104 mg/l	992.39 mg/l	873.32mg/l

Table 6: Comparision of Initial & Final Dairy Waste water test result

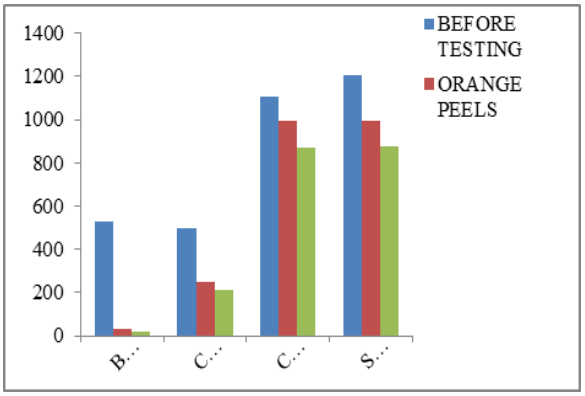

Fig. 7: Comparision of Initial & Final Dairy Waste water test result

V. CONCLUSION

The removal of organic substance from dairy waste water using de-hydration and carbonization methods for orange peels and fish scales was studied by investigation the effect of pH, time, adsorbent dosage and particle size. The carbonization method is found to be more than the de-hydration method for both orange peels and fish scales with high percentage removal of **50.1%** and **31.25%** respectively.

The carbonization method is considered to be better since carbon is a strong oxidant and has a unique pores structure which adsorbs the organic to its surface easily. The orange peels found to be more efficient in both methods with highest percentage removal of 50.1% and14.3% respectively compared to the fish scales where percentage removal is found to be 44.1%& 8.2% respectively for the de-hydration method and carbonization method. This is due to the characteristics of orange peels in its content fiber which its contain more hydroxyl radicals, hence more adsorption capacity.

The optimum pH for both methods, orange and fish scales are found to be in a range between pH 6-8. The optimum time for dehydration method of orange peel and carbonization method of fish scales is at 120 min. The optimum time for dehydration of fish scales and carbonization of orange peel is at 150 min. The optimum adsorbent dosage for the dehydration method of orange peel is at 0.15 grand for fish scales is at 0.25g. The optimum adsorbent dosage for carbonization method of orange and banana peel is at 0.3g. The optimum particle size for both methods, orange and fish scales are at 300µm.

REFERENCES

[1] Taylor, C. and Yahner, J.,Wastewater Treatment Protects small Community Life Health. [Online]. Available from: https://engineering.purdue.edu/~frankenb/NU-prowd/disease.htm, 1996.

[2] Odebunmi, E. O. and Okeola, O.F., Preparation and Characterization of Activated Carbon from Waste Material. J. Chem. Soc. Nigeria.,2001,26(2):149 – 155.
[3] Jatto, E.O., Asia, I.O., Egbon, E.E., Otutu, J.O., Chukwuedo, M.E. and Ewansiha, C.J. Acaedmia Arena., 2010,2(1):32–36.
[4] Velmurugan, P., Rathina Kumar, V. &Dhinakaran, G., International journal of environmental sciences.,2011, 7(1):1492-1496.
[5] Kanawade, S.M. &Gaikwad, R.W., International Journal of Chemical Engineering and Applications.,2011, 2(3):202 – 206.
[6] AbdurRahman, F., Akter, M. and Abedin, M.Z., International Journal of Scientific & Technology Research.,2013,2(9), 47 – 50.
[7] Bazarafshan, E., Moein, H., Mostafapour, F.K. and Nakhaie, S., Journal of Chemistry, 2013.
[8] World Health Organization, Environmental management.[Online].Availablefrom:http://www.who.int/denguecontrol/control_strategies/environmental_management/en/, 2014.
[9] Wikipedia,Water. [Online], Available form http://en.wikipedia.org/wiki/Water, 2014.
[10] Wikipedia, [Online] Freundlich equation from [Online],Availablefrom:http://en.wikipedia.org/wiki/Freundlich_equation, 2014.
[11] FAO Corporate Document Repository, n.d. Management of waste from animal product processing. [Online].Available from: http://www.fao.org/wairdocs/lead/x6114e/x6114e03.htm. [Accessed:31st May 2014].

