TREATMENT OF SEWAGE WATER WITH NATURAL COAGULATION

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Abstract

Coagulation and flocculation process are physical-chemical methods that widely used in treatment of wastewater. This paper reviewed usage orange peel powder, corn powder and prosopisjulifiora as a natural coagulant for wastewater treatment process. The identify orange peel powder, corn powder and prosopisjulifiora as an alternative to the commercial coagulant for treating wastewater is discussed. The efficiency of orange peel powder, corn powder and prosopisjulifiora in the reduction of wastewater parameters and improving the quality of treated wastewater is presented. The authors recommend that the flocculation process using natural coagulant depend on many factors including physical and chemical factors than the types of natural coagulant.

Keywords: *natural coagulation are orange peel powder, corn powder and prosopisjulifiora.*

Introduction

Water is a universal solvent and thus this is also transparent and nearly colourless substance which is a chemically oriented one that is the main source of earth's streams, seas, lakes, oceans and in times formed as a main need for most living organisms. Its chemical formula is H_2O. This chemical formula says that it has two numbers of hydrogen and one number of oxygen and thus they are connected together by a covalent bond. Water is a major solvent and this covers nearly 72 percentage of the the total earth's surface. It forms a vital sources through all walks of life and this is a vital source for all living organisms such as animals, birds, humans. On our earth 96.5 percentage of the earths crust is found on seas and oceans. Only 1.7 percent in groundwater, another 1.7 percent in glaciers and the icecaps formed on Antarctica and Greenland, and a very small amount of ice formed with 0.001 percentages as vapour, clouds and precipitation. Only 2.5 percentage of the water is fresh water and 98.8 percentage of the total surface water is in ice and groundwater. Less than 0.3 percentage of all the freshwater is used in rivers, lakes and the atmosphere and a very smaller amount of the freshwater is obtained within biological matters such as toilets, restrooms, kitchens, chimneys, mattresses and manufactured products obtained from many chemical and leather industries and then the Water present on earth moves continuously and random through the water cycle and in some water.

Waste water

Waste water is a type of water which have more negative impact when comparing with positive impact on human being. Waste water is a by-product and is used in and many of the domestic, industrial, commercial or agricultural activities. Wastewater is used when water released and accumulated from many domestic, industrial, commercial or agricultural activities. Waste water is used from water from any combination or can be used separately as of domestic, industrial, commercial, agricultural activities, surface runoff and any sewer inflow or sewer infiltration Waste water can have physical, chemical, biological pollutants when treating at varying concentration levels. Households may produce wastewater from flush toilets, sinks, dishwashers, sink washing machines, bath tubs and showers and sometimes may also be released from recreational parks. Liquid waste of domestic or industrial origin and it is foul in nature. It consists of 99.9% of water and collectively called as Sanitary sewage. In our project we have collected sewage from **Dairy Industries, Tanneries and House.**

Quality and Characteristics of Sewage

The quality of sewage plays an important role in design and construction of various treatment units. The treatment has to be given to the sewage such that it should be easily disposed-off in natural stream or river. The following are some of the characteristics of sewage:

Physical Properties

1. SPECIFIC GRAVITY: Specific gravity of sewage is nearly 1.
2. COLOUR: Fresh water is earthy grey or soapy or oily smell. It starts to give objectionable odour after few hours of production.
3. TURBIDITY: Normal sewage is usually turbid and it has some easily objectionable matter when sewage is fresh. Such matter includes faecal, night soil, paper, cigarette ends, grease, fruit skins, soap, matchstick, vegetable, debris.
4. ODOUR: Fresh sewage is musty in odour and it is not offensive within three to four hours, oxygen present in sewage gets exhausted and offensive odour of hydrogen disulphide and methane starts coming out.
5. TEMPERATURE: Increase in temperature increases the bacterial activities, average temperature in India is 20°C, which is quite close to the ideal temperature for biological activities. If temperature increases solubility of gases increases and dissolved oxygen gets reduced.
6. TOTAL SOLIDS: Sewage has about 99.9% of liquid and 0.1% of solids both in suspension and in solid state. It is estimated that 2 tonnes of sewage will hardly contain 1 kg of solids. This 1 kg will normally include 0.5Kg in solution stage and 0.25Kg in suspension state. Sewage has both organic and inorganic matter.

Chemical Properties

1. PH: Negative logarithm of hydrogen ion concentration is $-\log_{10}(H^+)$. The nature of purified sewage is alkaline and stale sewage is acidic. Fresh sewage has a pH of 7.3 to 7.5.
2. Chloride Content: It is not affected by biological action, human excreta adds about 6gm of chloride per person per day. Normal chloride content of domestic sewage is 120mg/l. If chloride content increases it indicates the presence of industrial and infiltration of sea water.

3. Nitrogen Content: Ammonia indicates the very first stage. Albuminoidal is the stage just before the decomposition of organic matter has started. Nitrate formation is the final stage. Nitrate formation represents the stale and it will be predominant in well oxidized sewage.
4. Presence of Fats, Oils and Greases: They are discharged from the animals and vegetable matter and from the industries like garages, mechanic sheds, service stations, kitchens of hotels and restaurant. This matter has been properly detected and removed.
5. Sulphide, Sulphates and H_2S Gas: They are measured very rarely but their presence on sewage reflects aerobic and anaerobic decomposition. Sulphides and sulphates are formed due to the decomposition often leads to evolution of H_2S causing bad odour and crown corrosion.
6. Dissolved Oxygen: Calculating of dissolved oxygen is very important because while discharging the sewage into river it is necessary to ensure that dissolved oxygen should be 4ppm. If it is greater than 4 ppm then it is ok .But if the DO is less than 4ppm then it kills fishes in river. Measuring the sewage before treatment gives the value of DO.
7. Biological Oxygen Demand: The amount of oxygen required for microbes to carry out the biological decomposition of dissolved solids or organic matter present in sewage water under the aerobic conditions at standard temperature.
8. Chemical Oxygen Demand: The amount of oxygen required for the chemical oxidation of the organic matter under the acidic condition is known as chemical oxygen demand. Thus COD is a measure of total organic matter both bio and non-bio degradable matter.
9. Theoretical Oxygen Demand: It is the oxygen demand that can be worked out theoretically. The oxygen required to oxidise the organic matter present in the given waste water can be theoretically computed, if the organic matter present in the water is known.
10. Total Organic Carbon: It is the important method of expressing organic matter in terms of its carbon content. Carbon is the primary constituent of organic matter and hence the chemical formula of every organic compound while reflects the extent of carbon present in that compound.
11. Ultimate Bod: It is the oxygen required to oxidise the biodegradable matters of sewage.

Biological Characteristics

Domestic sewage consists of various types of plants and animals and microorganism and the biological characteristic of sewage is related to the presence of these microorganisms. This microorganisms whose presence in sewage is 22 to 25 million numbers in a litre of sewage may be pathogenic, indicator organisms etc. The main source of pathogenic microorganism is excreta from the sick people and these microorganisms require living thing and tissues to grow and reproduce harmful to man.

Coagulation

Coagulation is also known as clotting. It is a state of change from liquid to gel. Positive charged coagulant is used in waste water treatment. There are various size of particles in wastewater and in order to remove this coagulants are used.

Chemical Coagulation

It is an important unit process of wastewater treatment and it is used for the removal of turbidity. It involves the addition of chemicals to alter the physical state of dissolved solids and this is used since ancient times and sometimes this is hazardous.

Natural Coagulants

Natural coagulants are used in industrial and urban waste water treatment plants. It is also used as the synthetic coagulant many suspended particles present in raw water undergoes sedimentation and reduces turbidity and have great advantage when comparing with traditional treatment and the content of oil in fat is very high it is removed by usage of natural coagulants. This can be used directly or can be used after dilution.

Literature Review

Thuraiya Mahir AI Khusaibi, Joefel Jessica Dumaran, M. Geetha Devi, L. Nageswaran Rao and S. Feroz (2017), were investigated the samples collected from dairy industry. In this experimental study, orange and banana peels are used as natural adsorbent in the removal of pollutant from dairy waste water. Carbonisation method and dehydration method is used here for preparing adsorbent. The optimum PH is maintained about 6-8 for both. As a result the optimum adsorbent dosage for the dehydration method of orange peel is 0.15g and for banana peel is 0.25g. The optimum adsorbent dosage for the carbonisation method of orange peel is 0.3g and for banana peel is 300µ. The result were validated using Langmuir and Freundlich equations.

Aakanksha Darga, S.J.Mane (2014), were studied about treatment of industrial waste the maximum efficiency of removal of heavy metal is 60% and 70% respectively. The process of bio sorption has many attractive features compared to conventional methods. The study investigate successful use of eco-friendly adsorbents banana peels and fish scales. Banana peel and fish scales were washed, dried and ground to 150-200µm and 160 µm respectively, before being used for treatment of pharmaceutical waste water. The combination of both these bio sorbent was used for treatment of waste water with of adsorbents different proportion, variation of PH and contact time.

Nur Fathinatul Akmalbinti Saharudin, Rajesh Nithyanandam (2013), studied about the treatment of wastewaters using natural coagulants. Natural coagulant is natural based coagulant that be used in coagulation process of waste water treatment for reducing turbidity. The objective of this study were assess the possibility of using natural coagulant as an alternative to the current commercial synthetic coagulant such as aluminium sulphate and to optimize the parameters related in the working condition of coagulation process. Based on the experimental result it was concluded that this natural coagulation efficiency which can removed up to 99.1% of turbidity in the synthetic wastewater is comparable to the synthetic coagulant.

Tasneembanokazi, Arjunvirupakshi (2013), were studied about the treatment of tannery waste water using natural coagulant. Cicerarietinum, Moringaoleifera, Cactus were used us locally available natural coagulants in this study to reduce the turbidity and COD of tannery waste water. The tests were carried out using tannery waste water with a conventional jar test apparatus. Optimum dosage and Optimum PH were determined. The optimum dosage Cicerarietinum, Moringaoleifera, and Cactus were found as 0.1, 0.3, and 0.2gm per 500ml respectively. The optimum PH value Cicerarietinum, Moringaoleifera, and Cactus was found to be 5.5, 4.5 and 5.5. In Cicerarietinum, Moringaoleifera, and Cactus maximum reduction in turbidity were found to be 81.20%, 82.02%, and 78.54%.Among the natural coagulants used in this study maximum turbidity reduction of 82.02% and COD reduction of 90% was found with Moringaoleifera and Cicerarietinum.

Saravanan. J, Priyadharshini. D, Soundammal. A, sudha, G, Suriyakala. K (2013), explored about waste water treatment using natural coagulants. The objective of the study to access the possibility of using natural coagulants as an alternative the current commercial synthetic coagulant such as alum and to optimize the coagulation process based on the experimental results it was concluded that the natural coagulants such as Hibiscus rosasinesis, Moringaoleifera, Azadirachtaindica and Dolichas lablab are merely equallent Coagulation comparing to alum. The turbidity removal efficiency is found to be 12.95%, 31.47%, 37.45%and 63.01% against 75% obtained from alum.

Tests and Experiments

Tests:

1. pH test
2. Colour test
3. Total solids
4. Total suspended solids
5. Total dissolved solids
6. Chloride test
7. Biochemical oxygen demand
8. Chemical oxygen demand
9. Hardness test
10. Alkalinity test
11. Oil and Grease test
12. Turbidity
13. Electrical conductivity
14. Zinc test
15. Copper test
16. Manganese
17. Iron test

Table 1 Sample water quality parameter

S. No	Parameters	Dairy Waste Water	Tannery Waste Water	House Waste Water
1	Color	>1 hue	>1 hue	>1 hue
2	Odor	Disagreeable	Disagreeable	Disagreeable
3	Turbidity	486NTU	257NTU	371NTU
4	Total Solids	3047 mg/l	1387 mg/l	2147mg/l

5	Total Suspended Solids	1065mg/l	481mg/l	961mg/l
6	Total Dissolved Solids	1902mg/l	964mg/l	1106mg/l
7	pH	8.02	7.96	7.14
8	Temperature	34	33	32
9	Dissolved Oxygen	2.2mg/l	1.2mg/l	0.8mg/l
10	Biochemical Oxygen Demand	416mg/l	614mg/l	285mg/l
11	Chemical Oxygen Demand	213mg/l	116mg/l	78mg/l
12	Electrical Conductivity	1.24ds/m	1.35ds/m	1.53ds/m
13	Carbonate	NIL	NIL	NIL
14	Bi Carbonate	389mg/l	342mg/l	390mg/l
15	Chloride	236mg/l	186mg/l	256mg/l
16	Sulphate	96mg/l	117mg/l	120mg/l
17	Phosphate	0.05mg/l	0.03mg/l	0.06mg/l
18	Silicate	2.63mg/l	1.54mg/l	1.98mg/l
19	Nitrate	0.62mg/l	0.06mg/l	0.72mg/l
20	Nitrite	0.21mg/l	0.02mg/l	0.23mg/l
21	Fluoride	3.16mg/l	2.53mg/l	3.68mg/l
22	Aluminium	0.07mg/l	0.02mg/l	1.67mg/l
23	Calcium	215mg/l	189mg/l	234mg/l
24	Magnesium	112mg/l	106mg/l	156mg/l
25	Sodium	218mg/l	189mg/l	126mg/l
26	Potassium	0.12mg/l	0.02mg/l	1.34mg/l
27	Zinc	0.19mg/l	0.05mg/l	1.54mg/l
28	Copper	0.10mg/l	0.06mg/l	0.4mg/l
29	Iron	1.16mg/l	0.61mg/l	4.68mg/l
30	Manganese	0.15mg/l	0.05mg/l	2.34mg/l
31	Oil And Greases	0.28mg/l	0.14mg/l	1.2mg/l

Results and Disscussion

Table 2 Effects of three coagulants at different dosage and ph of a dairy waste water sample

Dosage in (mg/l)	Orange Peel Powder	Corn Powder	Prosop is Julifiora
0.2	7.94	7.22	7.13
0.4	7.65	7.03	7.07
0.6	7.02	6.74	7.45
0.8	6.79	7.16	6.79
1	6.65	7.58	6.56

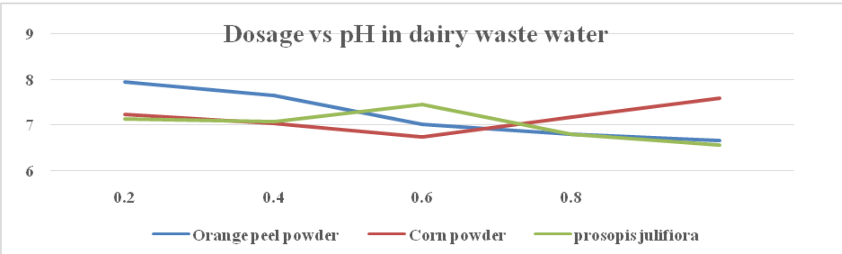

Figure 1 Dosage Vs. PH in diary waste water

Table 3 Effects of three coagulants at different dosage and Turbidity of a Dairy waste water sample

Dosage in (mg/l)	Orange Peel Powder (NTU)	Corn Powder (NTU)	Prosopisjulifiora (NTU)
0.2	380	237	80
0.4	243	180	33
0.6	90	207	107
0.8	160	254	198
1	200	224	235

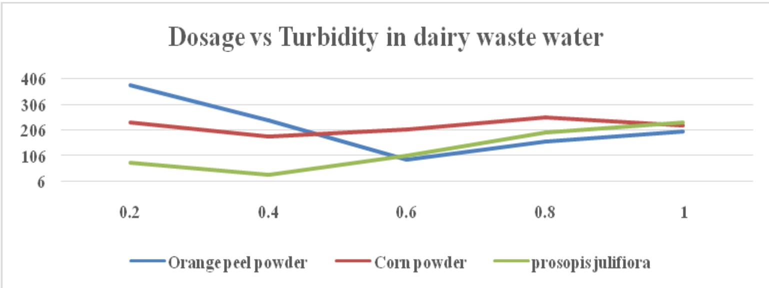

Figure 2 Dosage Vs. Turbidity in diary waste water

Table 4 Effects of three coagulants at different dosage and total dissolved solids in a dairy waste water sample

Dosage in (mg/l)	Orange Peel Powder (mg/l)	Corn Powder (mg/l)	Prosopisjulifiora (mg/l)
0.2	2047	1086	954
0.4	1154	1040	886
0.6	1070	1216	1046
0.8	1134	1537	1174
1	1456	1689	1498

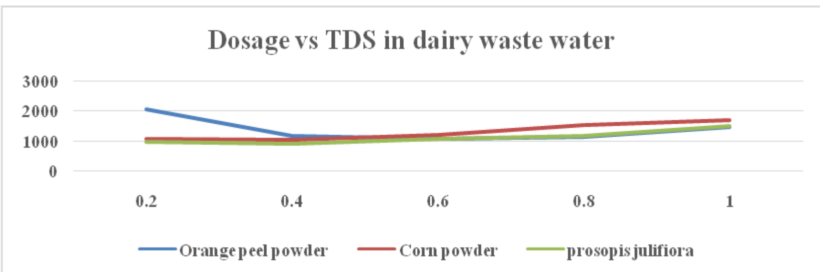

Figure 3 Dosage Vs. TDS in diary waste water

Table 5 Effects of three coagulants at different dosage and ph of a house waste water sample

Dosage in (mg/l)	Orange Peel Powder	Corn Powder	prosopisjulifiora
0.2	7.48	7.85	7.53
0.4	7.22	7.68	7.68
0.6	6.93	7.76	7.11
0.8	6.74	7.23	6.58
1	6.70	7.34	6.38

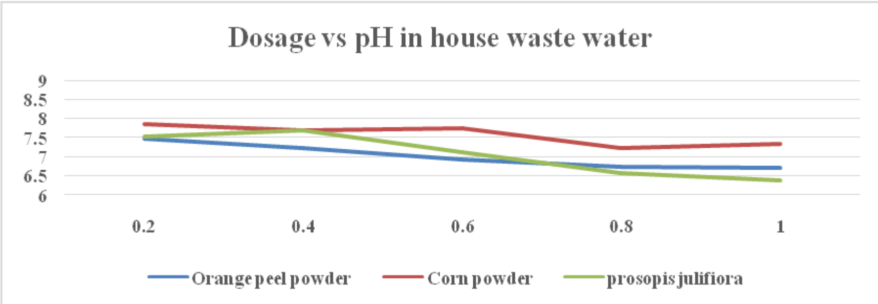

Figure 4 Dosage Vs. PH in house waste water

Table 6 Effects of three coagulants at different dosage and turbidity of a house waste water sample

Dosage in (mg/l)	Orange Peel Powder (NTU)	Corn Powder (NTU)	prosopisjulifiora (NTU)
0.2	64	181	110
0.4	38	153	97
0.6	108	106	82
0.8	132	59	70
1	161	79	32

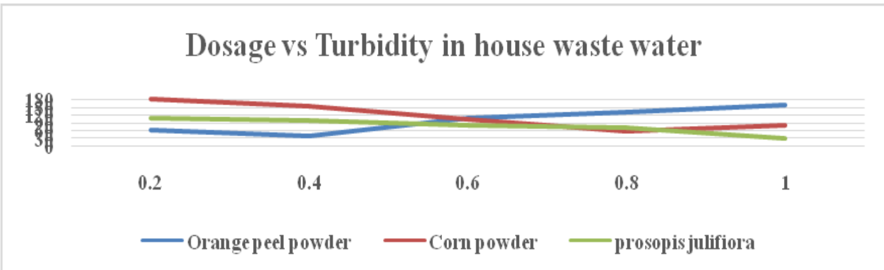

Figure 5 Dosage Vs. Turbidity in house waste water

Table 7 Effects of three coagulants at different dosage and total dissolved solids in a house waste water sample

Dosage in (mg/l)	Orange Peel Powder (mg/l)	Corn Powder (mg/l)	prosopisjulifiora (mg/l)
0.2	930	1124	1056
0.4	1023	1867	982
0.6	1129	1345	793
0.8	1178	1200	678
1	1189	1345	879

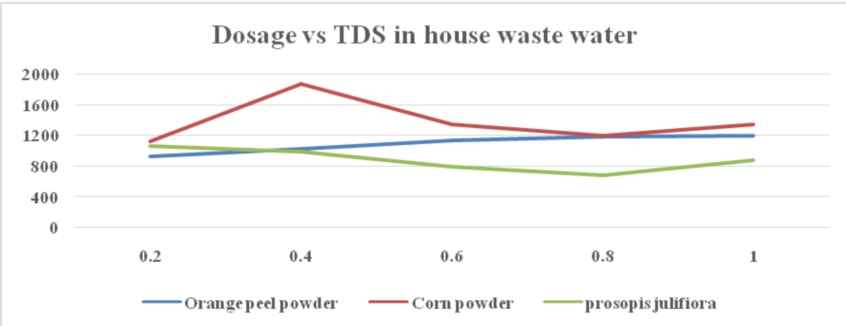

Figure 6 Dosage Vs. TDS in house waste water

Table 8 Effects of three coagulants at different dosage and pH of a Tannery waste water sample

Dosage in (mg/l)	Orange Peel Powder	Corn Powder	prosopisjulifiora
0.2	6.32	6.53	6.87
0.4	6.43	6.93	6.73
0.6	6.29	7.29	6.82
0.8	5.93	7.34	6.78
1	5.81	7.54	6.45

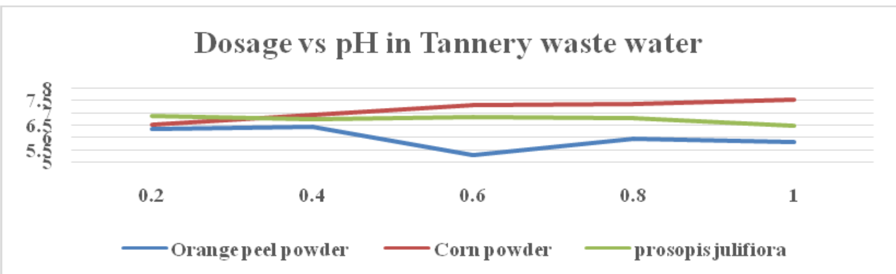

Figure 7 Dosage Vs. PH in tannery waste water

Table 9 Effects of three coagulants at different dosage and turbidity of a tannery waste water sample

Dosage in (mg/l)	Orange Peel Powder (NTU)	Corn Powder (NTU)	prosopisjulifiora (NTU)
0.2	325	229	348
0.4	126	173	360
0.6	320	174	280
0.8	256	275	346
1	382	340	404

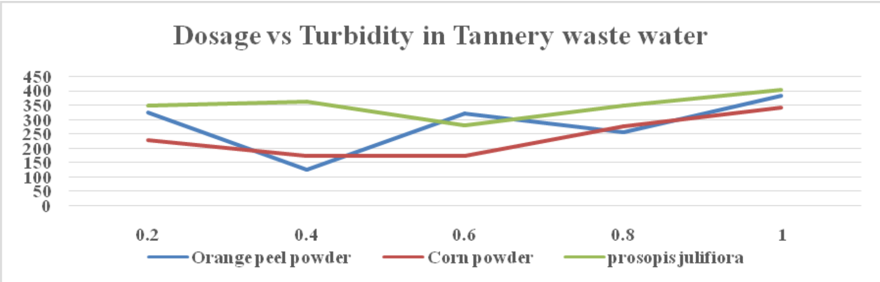

Figure 8 Dosage Vs. Turbidity in tannery waste water

Table 10 Effects of three coagulants at different dosage and total dissolved solids in a tannery waste water sample

Dosage in (mg/l)	Orange Peel Powder (mg/l)	Banana Peel Powder (mg/l)	Fish Scale (mg/l)
0.2	1873	1743	1675
0.4	1643	1633	1924
0.6	1321	1238	987
0.8	1432	1175	1945
1	1671	1095	1830

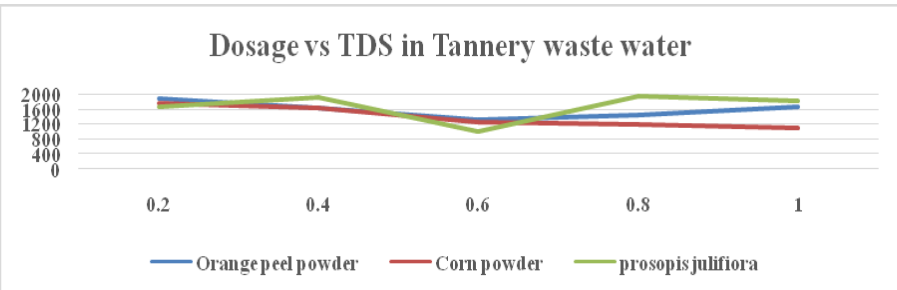

Figure 9 Dosage Vs. TDS in tannery waste water

Conclusion

The following conclusions were drawn from the present study on the use of natural coagulant in waste water treatment.

The batch experimental data obtained from different dosages of different coagulants were summarized here.

Dairy Wastewater

1. In case of orange peel powder, the optimum dosage was found to be about 0.6mg/l, which maintains a pH around neutral about 6.85 and has a lower level of turbidity about 70 NTU. The turbidity was removed to about 83.53%.
2. In case of banana peel powder, the optimum dosage was found to be about 0.4mg/l, which was maintained pH to a range of 7.45 and has a turbidity level of 160 NTU. The turbidity was removed to about 62.35%.
3. In case of fish scale powder, the optimum dosage was found to be about 0.4mg/l, which maintains a pH around neutral about 7.33 and has a lower level of turbidity about 19. The turbidity was removed to about 95.53%.
4. While in the case of alum powder the pH was maintained to about 7.13, the turbidity was about 16 NTU at dosage of 0.6mg/l. The turbidity was removed to about 96.23%.
5. Finally we can concluded that in dairy waste water, alum at dosage of 0.6 mg/l can be replaced with a natural coagulant fish scale at 0.4mg/l. it may also be replaced by orange peel powder at dosage of 0.6 mg/l, whereas banana peel seems to be quiet inefficient when compared to other three coagulants.

House Wastewater

1. In case of orange peel powder, the optimum dosage was found to be about 0.4mg/l, which maintains a pH around neutral about 7.22 and has a lower level of turbidity about 38 NTU. The turbidity was removed to about 84.48%.
2. In case of banana peel powder, the optimum dosage was found to be about 0.8mg/l, which was maintained pH to a range of 7.23 and has a turbidity level of 59 NTU. The turbidity was removed to about 75.92%.
3. In case of fish scale powder, the optimum dosage was found to be about 1mg/l, which maintains a pH around neutral about 6.38 and has a lower level of turbidity about 32. The turbidity was removed to about 86.94%.
4. While in the case of alum powder the pH was maintained to about 7.13, the turbidity was about 49 NTU at dosage of 0.8mg/l. The turbidity was removed to about 80%.
5. Finally we can conclude that in hostel waste water, alum at dosage of 0.8 mg/l can be replaced with a natural coagulant orange peel powder of 0.4mg/l. It may also be replaced by fish scale powder at dosage of 0.6 mg/l but pH was not around neutral, whereas banana peel seems to be quiet inefficient when compared to other three coagulants.

Tannery Wastewater

1. In case of orange peel powder, the optimum dosage was found to be about 0.4mg/l, which maintains a pH around neutral about 6.43 and has a lower level of turbidity about 126 NTU. The turbidity was removed to about 72.25%.
2. In case of banana peel powder, the optimum dosage was found to be about 0.6mg/l, which was maintained pH to a range of 7.29 and has a turbidity level of 173 NTU. The turbidity was removed to about 68.11%.
3. In case of fish scale powder, the optimum dosage was found to be about 0.6mg/l, which maintains a pH around neutral about 6.82 and has a lower level of turbidity about 280. The turbidity was removed to about 38.33%.
4. While in the case of alum powder the pH was maintained to about 7.13, the turbidity was about 132 NTU at dosage of 1mg/l. The turbidity was removed to about 48.03%.
5. Finally we can concluded that in tannery waste water, alum at dosage of 1 mg/l can be replaced with a natural coagulant banana peel powder at 0.6mg/l. it may also be replaced by orange peel powder at dosage of 0.4 mg/l, whereas fish scale powder seems to be quiet inefficient when compared to other three coagulants.

References

1. Babu R, Chaudhuri , Home water treatment by direct filtration with natural coagulant.
2. G. Vijayaragavan, T. Sivakumar, A. Vimal Kumar, “Application of plant based coagulants for wastewater treatment”, International Journal of Advanced Engineering Research and Studies, Volume I, Issue I, 2011 December.
3. Tasneembanokazi, ArjunVirupakshi, “Treatment of tannery wastewater using natural coagulants”, International journal of Innovative research in Science, Engineering and Technology, Volume II, Issue VIII, August 2013.
4. BaisaliSarkar, P.P. Chakrabarti, A. Vijay kumar, Vijay Kale,(2006), ― Wastewater treatment in dairy industries — possibility of reuse pp. 141–152, 2006.
5. G. Durai, M. Rajasimman and N. Raja mohan (2011), ―Kinetic studies on biodegradation of tannery wastewater in a sequential batch bioreactor , Journal of Biotech Research [ISSN: 1944-3285], 3:19-26,2011.
6. M. A. Aboulhassan, S. Souabi, A. Yaacoubi, (2008), ―Pollution reduction and biodegradability index improvement of tannery effluents, Int. J. Environ. Sci. Tech., 5 (1), pp 11-16, 2008.
7. Md. Asrafuzzaman, A.N. M. Fakhruddin, and Md. Alamgir Hossain,(2011),―Reduction of Turbidity of Water Using Locally Available Natural Coagulants ISRN Microbiology Volume , Article ID 632189,2011.
8. Harush D. P, Hampannavar U. and Mallikarjunaswami M. E ,(2011) , ― Treatment of dairy wastewater using aerobic biodegradation and coagulation , International Journal of Environmental Sciences and Research Vol. 1, No. 1, 2011, pp. 23 26.

9. B. S. Shilpa, Akanksha, Kavita, P. Girish, (2012), ―Evaluation of Cactus and Hyacinth Bean Peels as Natural Coagulants, International Journal of Chemical and Environmental Engineering , Volume 3, June 2012.
10. Veeramalini , Sravanakumar. K and Joshua Amarnath. D, (2012), ―Removal of reactive yellow dye from aqueous solutions by using natural coagulant (moringaoleifera).International Journal of Science, Environment and Technology, Vol. 1, No 2, 56 - 62, 2012.