Treatment of Wastewater Effluent by Coagulation and Filtration Process

Rumit Mehta[1] Viraj Shah[2] Pradnya Tikhe[3]
[1,2]B. Tech Student [3]Assistant Professor
[1,2,3]Department of Civil Engineering
[1,2,3]Indus University, Ahmedabad, India

Abstract— The aim of this research paper is to provide an overall description of coagulation-flocculation process and its applications in water and wastewater treatment. This study also deals with the parameters affecting the Reduction of chemical oxygen demand using Coagulation Process by using different coagulants and also deals with Jar Test and Natural Coagulants. The signifance of coagulation-flocculation in waste water is evaluated emphasizing on the series of applications employed including destabilization of colloids removal of organic and inorganic matter as well as removal of turbidity.

Keywords: Coagulation and Flocculation Process, Jar Test, Coagulants, Wastewater, Turbidity

I. Introduction

A. Wastewater

Waste water refers to all effluents from house hold, commercial and institutions, hospital, industries and so on. It also includes stromwater and urban runoff, agriculture, horticultural and aquaculture effluent. Types of wastewater include: domestic wastewater from households, municipal wastewater from communities (also called sewage) or industrial wastewater from industrial activities. Wastewater can contain physical, chemical and biological pollutants. The characteristics of wastewater vary depending on the source.

B. Dissolved Oxygen

Dissolved Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air–water interface. Dissolved oxygen (DO) refers to the volume of oxygen that is contained in the water. Oxygen in the aquatic environment is produced by photosynthesis of algae and plants and is removed by respiration of plants, animals, and bacteria, BOD degradation process, sediment oxygen demand, and oxidation. Variations in DO can occur seasonally, or even over 24 hour periods, in relation to temperature and biological activity (i.e. photosynthesis and respiration). There is a release of oxygen into the water as a result of photosynthesis during the day by the plants and algae, and there is an uptake from the water as a result of respiration by aquatic organisms.

C. Chemical Oxygen Demand

Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite. COD measurements are commonly made on samples of waste water or of natural waters contaminated by domestic or industrial wastes. Chemical oxygen demand is measured as a standardized laboratory assay in which a closed water sample is incubated with a strong chemical oxidant under specific conditions of temperature and for a particular period of time. A commonly used oxidant in COD assays is potassium dichromate (K2Cr2O7) which is used in combination with boiling sulphuric acid (H2SO4). Because this chemical oxidant is not specific to oxygen-consuming chemicals that are organic or inorganic, both of these sources of oxygen demand are measured in a COD assay.

Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite. COD measurements are commonly made on samples of waste water contaminated by domestic or industrial wastes.

D. Biological Oxygen Demand

Biochemical Oxygen Demand (BOD, also called Biological Oxygen Demand) is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The BOD value is most commonly expressed in milligrams of oxygen consumed per litre of sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water.

BOD can be used as a gauge of the effectiveness of wastewater treatment plants. BOD is similar in function to chemical oxygen demand (COD), in that both measure the amount of organic compounds in water. However, COD is less specific, since it measures everything that can be chemically oxidized, rather than just levels of biodegradable organic matter.

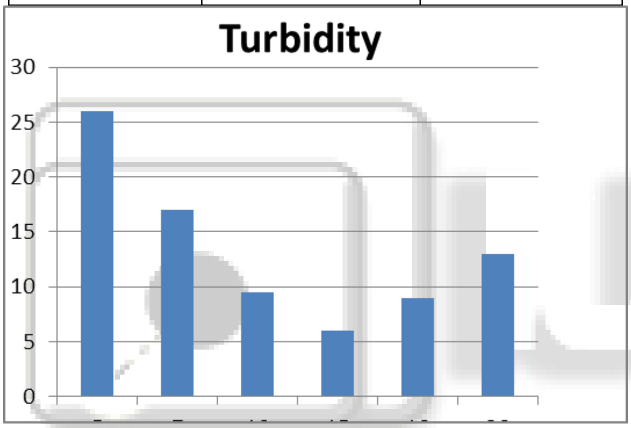
E. Coagulation

In water treatment coagulation involves the addition of polymers that clump the small, destabilized particles together into larger aggregates so that they can be more easily separated from the water. Coagulation is a chemical process that involves neutralization of charge whereas flocculation is a physical process and does not involve neutralization of charge. The coagulation-flocculation process can be used as a preliminary or intermediary step between other water or wastewater treatment processes like filtration and sedimentation. Iron and aluminium salts are the most widely used coagulants but salts of other metals such as titanium and zirconium have been found to be highly effective as well.

F. Jar Test

The dose of the coagulant to be used can be determined via the jar test. The jar test involves exposing same volume samples of the water to be treated to different doses of the coagulant and then simultaneously mixing the samples at a constant rapid mixing time. The microfloc formed after coagulation further undergoes flocculation and is allowed to settle. Then the turbidity of the samples is measured and the dose with the lowest turbidity can be said to be optimum.

Beaker number	Alum dose (mg/l)	Turbidity(NTU)
1	5	26
2	7	17
3	10	9.5
4	15	6
5	18	9
6	20	13



II. CHARACTERISTICS OF WASTE WATER

SR NO.	CHARACTERISTICS	READING	UNIT
1	COD	260	mg/l
2	TSS	1.59	mg/l
3	TDS	51.7	mg/l
4	COLOR	62	--
5	pH	8.37	--

III. MATERIALS AND METHOD

1) Fill six jars with raw water sample of 1 litre
2) Place the jars under the jar testing apparatus and lower the mixers int the jars. Make sure the paddles will turn without scratching the sides of the jar
3) Adjust water properties
4) Rapid mix at 200 rpm
5) Quickly add the Alum coagulant of 10gm to and add appropriate dose of Alum to all jars
6) Continue rapid mixing for 1 minute
7) Reduce stirring speed to 25-30 rpm and continue mixing for 20 minutes. This slower mixing speed helps promote floc formation by enhancing particle collisions, which lead to larger flocs
8) Turn off the mixers and allow flocs to settle for 30-4- mins
9) Measure the final residual turbidity in each jar
10) Plot residual turbidity against pH
11) Raw Sample: 200ml in each 6 jars
12) Diluted total sample 1000ml

IV. REDUCTION OF COD

Reduction of chemical oxygen is performed with the addition of H_2O_2.
The ratio is 1:30 wastewater (rice wastewater)
H_2O_2 content is 2ml
Obtained COD from 800 reduced to 260

V. NATURAL COAGULANTS

- Natural coagulant is a naturally occurred; plants based coagulant that can be used in coagulation-flocculation process of wastewater treatment for reducing turbidity.
- The objectives of this study were to assess the possibility of using natural coagulants as an alternative to the current commercial synthetic coagulant such as aluminium sulphate and to optimize the coagulation process.
- Dolichas lablab , Azadirachta Indica , Moringa Oleifera, Hibiscus Rosa Sinensis have showed andmerely equalant coagulation comparing to commercial alum. The turbidity removal efficiency for Dolichas lablab, Azadirachta Indica, Moringa Oleifera, Hibiscus Rosa Sinensis respectively were 37.45% , 63.01% , 31.47% , 12.95% against 75.01% obtained from alum.
- Others natural Coagulants are

1) Aloe Vera
2) Fansi seeds
3) Pappaiya seeds
4) Cactus
5) Moringa seeds

VI. CONCLUSION

From this experiment, the successful of coagulation and flocculation process has been done. By the result, the studies of coagulation and flocculation process have gained some founding in the chemical reaction of the process. The results shows that the decreasing of turbidity shows that the achievable of this process in water and wastewater treatment. Use polymers for coagulant instead of well-known Alum. Even Alum is effective but polymers are more effective over a wider pH range than inorganic coagulants. They produce smaller volumes of more concentrated, rapidly settling floc. The floc formed from use of a properly selected polymer will be more resistant to shear, resulting in less carryover and a cleaner effluent.

REFERENCES

[1] Bratby, J. (ed), Coagulants, in Coagulation and Flocculation in Water and Wastewater Treatment, second ed., IWA Publishing, London, 2006, pp. 50-68
[2] J.C. Crittenden, R.R. Trussel, D.W. Hand, K.J. Howe, G. Technobanoglous (eds), Coagulation, mixing and flocculation, in: Water Treatment: Principles and

Design, second ed., John Wiley & Sons, New Jersey, 2005, pp. 643-779

[3] Kim,Y.H.(ed.), Coagulants and Flocculants; Theory and Practice, Tall Oaks Publishing, 1995, Littleton, USA.

[4] Roussy, J., Vooren, M. V., Dempsey, B. A. and Guibal, E. (2005). "Influence of Chitosan Characteristics on the Coagulation and the Flocculation of Bentonite Suspensions." Water Research. 39. 3247-3258

[5] Vera, G., Aleksandra, V. and Marjana, S. (2005). "Efficiency of the Coagulation/Flocculation Method for the Treatment of Dye Bath Effluents." Dyes and Pigments. 67. 93-97.