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Physico-Chemical Treatment of Textile Wastewater by Coagulation using Potassium Alum

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Abstract : The objective of this work is to investigate the effectiveness of chemical treatment on removal of color from dye solution. Dyes are coloring compounds being used almost in all textile industries and disposal of dye effluent is a major problem for the industries. Textile wastewater is one of the main environmental pollutants which exist in our society. Textile effluents cause great concern due to the alteration of properties of water bodies such as differences in temperature, organic load, pH, colour and turbidity. Turbidity is one of the most important parameters that should be removed from industrial wastewater because the penetration of ultraviolet (UV) light into the water body can be affected. The physico-chemical treatment has a great potential for dye color removal mechanism. Unfortunately little information is available concerning the influence of chemical nature of dyestuffs on the color removal. In spite of several research efforts like varying parameters, the problem of selectivity of chemical treatment for given dye waste still remains unresolved. A systematic approach to the problem is necessary. To this end, an attempt was made in the present study to investigate the response of various parameters on color removal with alum.
Keywords: Coagulation, Alum, Dosage, Dye concentration, Time, pH, RPM.

1. Introduction

In coagulation, we add a chemical such as alum which produces positive charges to neutralize the negative charges on the particles[1-4]. Then the particles can stick together, forming larger particles which are more easily removed. Textile effluents are usually extremely heterogeneous in composition with a large extent of toxic and sometimes unmanageable objects coming from dyeing and finishing processes[5-7]. These processes involve the input of a wide range of chemicals and dyestuffs, which are generally organic compounds with complex structures. Because all of them are not contained in the final product, ends up as wastewater, which needs to be treated before its final discharge[8-10]. The effluents are generally characterized by strong coloration, high load of suspended solids, COD, BOD and high conductivity. The removal of color from textile and dyestuff manufacturing industrial wastewaters is a major environmental concern. In addition, only 47% of dyestuffs are biodegradable and the rest of them remain in the environment[11-13].

2. Experimental

Materials:

Glassware, distilled water, colorimeter, pH meter and horizontal shaker, synozol yellow dye effluent, potassium alum.

Experimental Procedure

Experiments were conducted to treat dye effluent using alum as coagulant. Test dye solution of 100 mg/l was prepared from effluent solution and is taken in reagent bottles, varying doses of designated coagulant is added to study feasibility of color removal by chemical treatment and pH of the test mixture was adjusted when required. A number of such reagent bottles containing the test mixture depending upon the requirement were employed. Then the reagent bottles containing test mixture was placed in an orbital shaker operating at required RPM to facilitate effective mixing and precipitate formation. Then the reagent bottles containing the mixture were kept under undisturbed for 1 hr for settlement of precipitation formed. The settled precipitate is separated from the mixture by filtration with the help of filter paper. The filtrate is analyzed for percentage color removal using the calibration curve prepared. The effect of parameters like dosage, dye concentration, pH, time and RPM were studied[14-18].

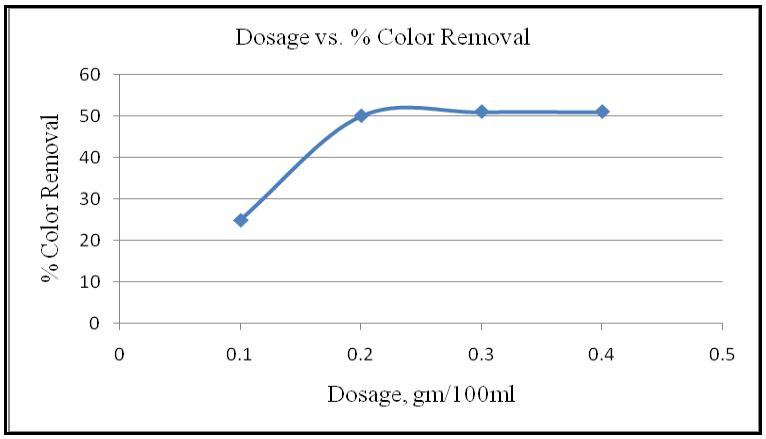
3. Results and Discussion

The study was undertaken to seek information regarding removal of color from direct dye stuffs by chemical treatment with alum and experimental results are presented in graphical from.

Effect of dosage

Table 1: Effect of dosage on % color removal

Dosage, gm/100ml	0.1	0.2	0.3	0.4
% CR	25	50	51	51



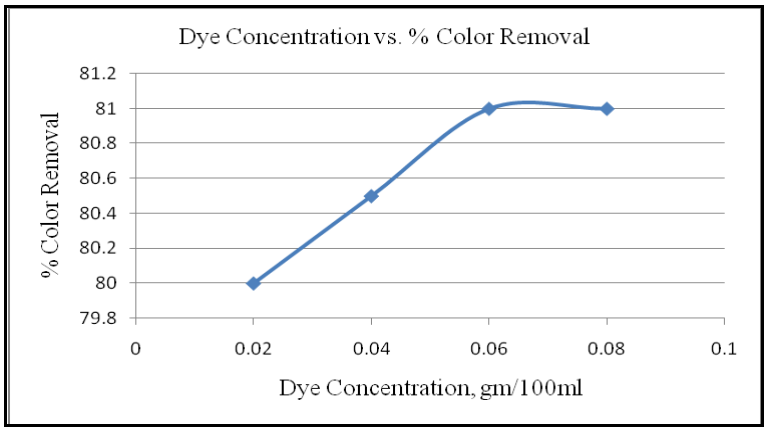
Graph 1: Dosage vs. % color removal

Variation of color removal with dosage is given in table 1 and graph 1. Maximum color removal of 51 % occurs at optimum dosage of 0.3 gm/100ml.

Effect of dye concentration

Table 2: Effect of dye concentration on % color removal

Dye concentration, gm/100ml	0.02	0.04	0.06	0.08
% CR	80	80.5	81	81



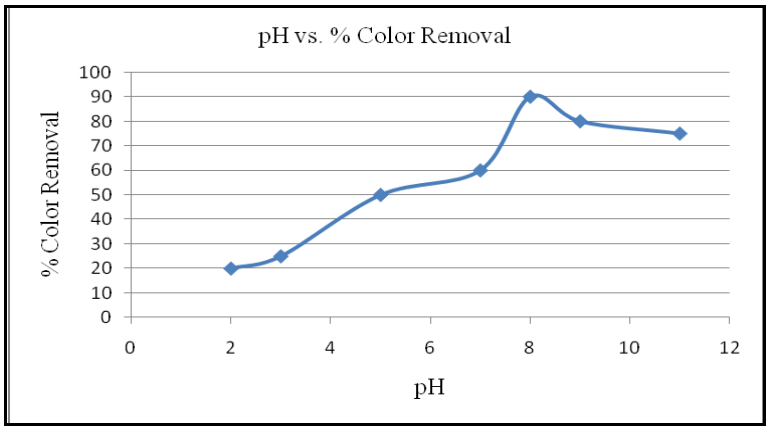
Graph 2: Dye concentration vs. % color removal

Variation of color removal with dye concentration at optimum dosage of 0.3 gm/100ml is given in table 2 and graph 2. Maximum color removal of 81 % occurs at optimum dye concentration of 0.06 gm/100ml.

Effect of pH

Table 3: Effect of pH on % color removal

pH	2	3	5	7	8	9	11
% CR	20	25	50	60	90	80	75



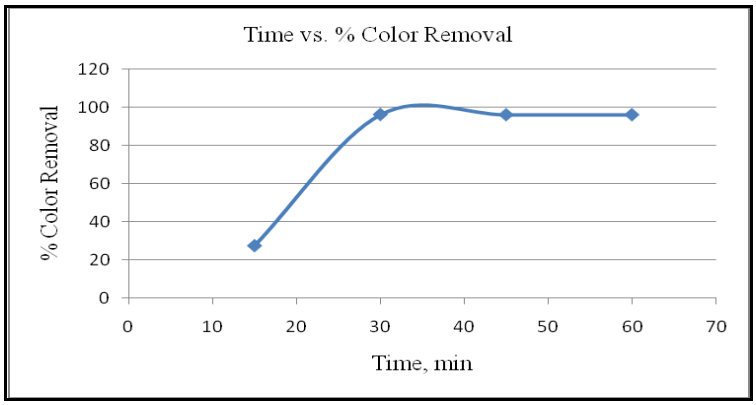
Graph 3: pH vs. % color removal

Variation of color removal with pH at optimum dosage of 0.3 gm/100ml and optimum dye concentration of 0.06 gm/100ml is given in table 3 and graph 3. Maximum color removal of 90 % occurs at optimum pH of 8.

Effect of time

Table 4: Effect of time on % color removal

Time, min	15	30	45	60
% CR	27.7	96.1	96	96



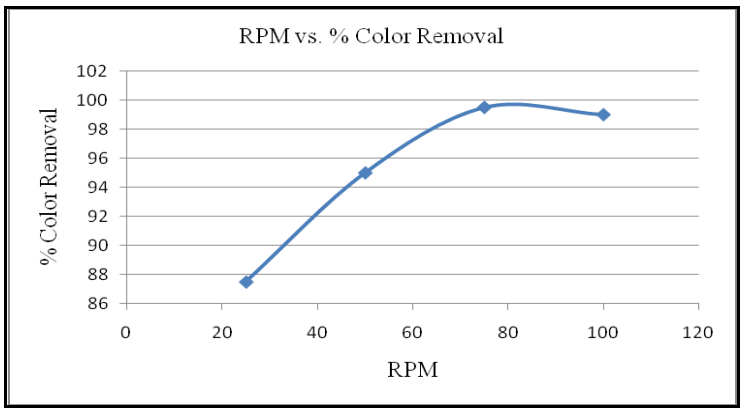
Graph 4: Time vs. % color removal

Variation of color removal with time at optimum dosage of 0.3 gm/100ml, optimum dye concentration of 0.06 gm/100ml and optimum pH of 8 is given in table 4 and graph 4. Maximum color removal of 96.1 % occurs at optimum time of 30 min.

Effect of RPM

Table 5: Effect of RPM on % color removal

RPM	25	50	75	100
% CR	87.5	95	99.5	99



Graph 5: RPM vs. % color removal

Variation of color removal with RPM at optimum dosage of 0.3 gm/100ml, optimum dye concentration of 0.06 gm/100ml, optimum pH of 8 and optimum time of 30 min is given in table 5 and graph 5. Maximum color removal of 99.5 % occurs at optimum RPM of 75.

4. Conclusion

From the above studies, it may be concluded that dyes are amenable for their color removal and show positive response for treatment by chemical process using alum.

- ✓ Optimum dosage is 0.3 gm/100ml
- ✓ Optimum dye concentration is 0.06 gm/100ml
- ✓ Optimum pH is 8
- ✓ Optimum time is 30 min
- ✓ Optimum RPM is 75

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