REMOVAL OF COLOR AND COD FROM TEXTILE EFFLUENTS BY USING NATURAL AND CHEMICAL COAGULANTS

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Abstract : Textile industry is one of the water-intensive industries which consume large quantities of water for various processes and discharges equally large volumes of wastewater containing a variety of pollutants. It is estimated that 10-70 litres of water may be required for processing one meter of cloth. There are various treatment techniques to remove dye wastewater pollutants such as physical, chemical, physico-chemical and biological methods, Among Physico-chemical process, Coagulation method is generally applied to treat textile industries, as it is effective in removing color and COD. The present study was performed using jar test apparatus, spectrophotometer and open reflux apparatus with chemical and natural coagulants like alum, ferroussulfate and moringaoliefera, aloevera as coagulants. These are used to increase the size of flocs at various pH values and at various chemical doses. After the process, the residual color and COD, as well as pH of water were measured. The results showed for alum significant increase in color and COD removal to the extent of about 97.01% and 81.39% at an optimum pH of 8.0 for both and at a optimum dosage of 800mg/l, 1100mg/l respectively. For ferroussulfate significant increase in color and COD removal of 63.16% and 67.44% at an optimum pH of 6.0 for both and at a optimum dosage of 1850mg/l, 1300mg/l respectively. In case of moringaoliefera significant increase in color and COD removal of 88.05% and 79.06% at an optimum pH of 10 for both and at a optimum dosage of 2800mg/l, 3600mg/l respectively. Finally aloevera also removes color and COD 50.23% and 48.83% at an optimum pH of 8.0 for both and at a optimum dosage of 1800mg/l, 1400mg/l respectively. In this research comparison was done between natural and chemical coagulants.

IndexTerms **- Color, COD, jar test apparatus, spectrophotometer, open reflux method, alum, ferrous sulfate, moringaoliefera, Aloevera Coagulation/flocculation, Textile effluents.**

I. INTRODUCTION

Industrial activities generate large volumes of a variety of waste products which are generally discharged either into the water bodies or onto/into the soil matrix. The nature of industrial waste depends on the industrial processes from which they originate. The problem of handling industrial wastewater is much more complex and difficult than domestic wastewaters because industrial wastewaters are heavily laden with organic and inorganic matter with corrosive, poisonous, inflammable and explosive substances. Textile wastes are coloured, highly alkaline, high in BOD, COD, Suspended solids and temperature, and contain nitrogen, phosphates, toxic chemicals, oil and grease, and sulphides, etc. In addition to the above common chemical constituents, textile wastes also contain a host of auxiliary chemicals like starches, dextrin, dyes and pigments, gums, glucose, waxes, pectins, alcohols, fatty acids, acetic acids, soaps, detergents, chlorides, cellulose materials, gelatin, dye carriers, chlorine and peroxides.

Colored water is not aesthetically acceptable to the general public though it may be non-toxic. In fact, given a choice, consumers tend to choose clear, non-coloured water of otherwise poor quality over treated potable water with an objectionable colour. Highly coloured water is unsuitable for laundering, dyeing, papermaking, beverage, and textile, plastic, dairy and other food-processing industries.

Recent reports suggest that color causing substances are micro toxic to aquatic biota, they decrease light concentration and photosynthetic activity levels in water, it results low dissolved oxygen and then growth of aquatic life. COD is a very dangerous Pollutant, with high COD the DO level becomes less, causing damage to aquatic life.

There are various treatment techniques to remove dye wastewater pollutants such as physical, chemical, physico-chemical and biological methods. Physical methods are ineffective for treating colored and COD effluents. These includes equalization, neutralization, sedimentation and floatation. Biological treatment method are generally effective for Biological Oxygen Demand (BOD) and suspended solid (SS) removal. But not effective for removal of color from textile effluent because textile effluent have slow biodegradation rate.

Chemical treatment methods such as oxidation-reduction, precipitation, ozone oxidation, coagulation process etc. have been investigated for treating color and COD textile mill effluents and found to be effective at varying degrees. Physicochemical treatment method include coagulation and flocculation, precipitation, electro dialysis, floatation, ultra filtration adsorption. Among Physico-chemical process, Coagulation method is generally applied to treat textile industries, as it is effective in removing COD and color.

In AP Nagari (Chittoor dis,.)Town has large number of textile manufacturing industries, which release untreated textile effluents to common Effluent treatment plant (CETP).Raw effluent samples were collected from CETP at Nagari. In present study, chemical coagulants and natural coagulants were used and color and COD removal was observed.

II. OBJECTIVES

(i) To evaluate the efficacy of coagulants of two natural and two synthetic coagulants, namely Moringaolifera seeds, Aloevera gel dry powder, Alum and Ferrous sulfate.

(ii) To investigate color and COD removal efficiency at various pH values and at various coagulant dosages.

(iii) To find the optimum removal efficiency at optimum values of pH and coagulant dosages.
(iv) To find out the more suitable coagulant among Moringaoleifera seeds, Aloevera gel, Alum and Ferrous sulfate for treating effluent from CETP.
(v) To compare the removal efficiency of Color and COD parameters.

III. MATERIALS

(i) All glassware used in present study were of Pyrex quality manufactured by Borosil glassworks limited, Mumbai and Marketed under brand name 'Corning'. The glass ware were cleaned with chromic acid and rinsed with water before use. They were further acid washed and rinsed with water after use
(ii) Water used in all experiments was laboratory distilled water, prepared with a glass Distillation unit, the pH of this water in the range of 6.8 to 7.1.
(iii) In this study, Color was measured using Thermo make UV-VIS spectrophotometer of Evolution 201, Systronics electrode-based pH Meter, York Horizontal shaker (100 rpm),Precision/analytical balances, pipette, burette, jar test Apparatus, COD reflux apparatus.
(iv) All the chemicals and natural coagulants used in the present study are alum ($Al_2(SO_4)_3$), ferrous sulfate($FeSO_4$), Standard ferrous ammonium sulfate ($FeH_8N_2O_8S_2$), standard potassium dichromate ($K_2CR_2O_7$), sulfuric acid reagent (H_2SO_4), Mercuricsulfate($HGSO_4$), ferroinindicator($C_{36}H_{24}FeN_6O_4S$) and Moringaoliefera, Aloevera. pH of test dye solution was adjusted by using Hydrochloric acid(0.1N) and sodium hydroxide(0.1N).

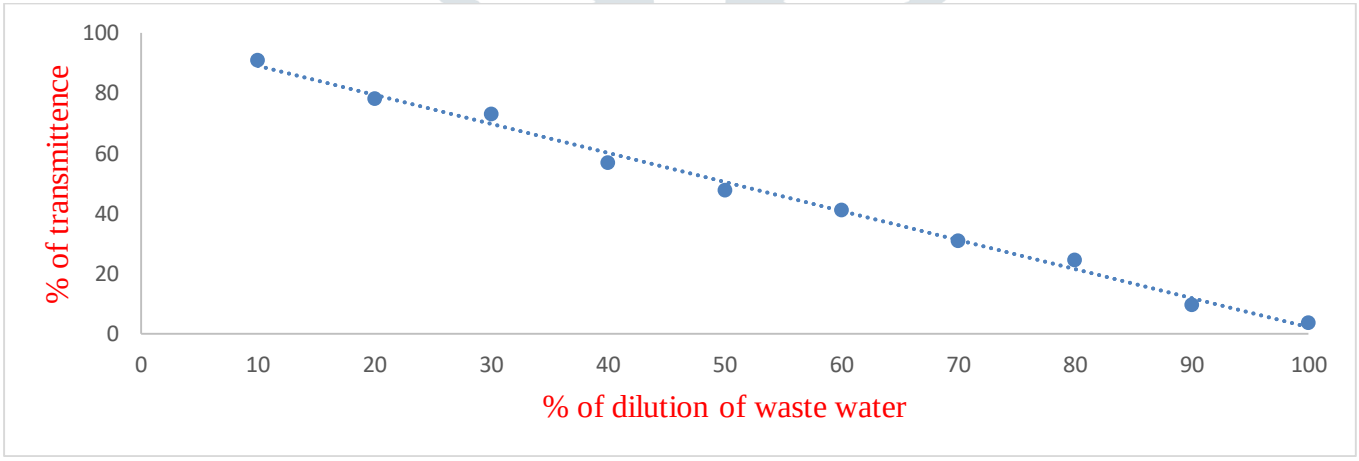
IV. REASEARCH METHODOLOGY

preparation of aloevera and moringaoliefera stock solution

The upper and lower green layer are removed and the margin of the leaf were taken and allowed to dry in the laboratory oven at a temperature of 50 °C for 24 hours The resulting solidified was ground in to medium fine powder with domestic food blender.
Moringaoleifera seeds were collected from farms in nagur colony village, thirupati rural mandal, chittoor district. The seeds are allowed to dry in the laboratory oven at a temperature of 50 °C for 24 hours. A rice husk removing machine was used to remove the hulls and wings from the kernels. The kernels were ground in to medium fine powder with domestic food blender of approximate size 600 µm to achieve Solubilization of active ingredients in the seed.
Stock solution was prepared by adding distilled water to Moringaoleifera and Aloevera powder to make 20% suspension (20grams of Moringaoleifera and Aloevera were added to 100ml of water each separately).The suspension was vigorously shaken for 0.5 h using a magnetic stirrer and then passed through What man no.1 filter paper, Fresh solutions were prepared daily and kept refrigerated to prevent any ageing effects. Solutions were shaken vigorously before use.

Color measurement

First, the raw water was scanned (Thermo make UV-VIS spectrophotometer of Evolution 201) by measuring absorbance at every 50nm intervals in the range of 340nm to 840nm to determine the optimum wavelength, i.e. wavelength where the absorbance is maximum. Then a calibration curve was prepared by measuring %T at optimum wavelength of known concentration of the dye solutions.
In this Investigation, The optimum wave length of wastewater was found to be **610nm**, A calibration curve was plotted for various known concentrations of % color dilution v/s % transmittance and this plot was used for further determination of color dilution of unknown samples.



Calibration curve

COD measurement

COD was measured by standard methods as per APHA by open reflux method. Organic matter is oxidized by boiling a mixture of chromic and sulfuric acids. The sample is refluxed in strong acid solution with a known excess of potassium dichromate ($K_2Cr_2O_7$).After digestion, the remaining unreduced $K_2Cr_2O_7$ is titrated with ferrous ammonium sulfate to determine the amount of $K_2Cr_2O_7$ consumed and the Oxidizable matter is calculated in terms of oxygen equivalent.

Coagulation experiments

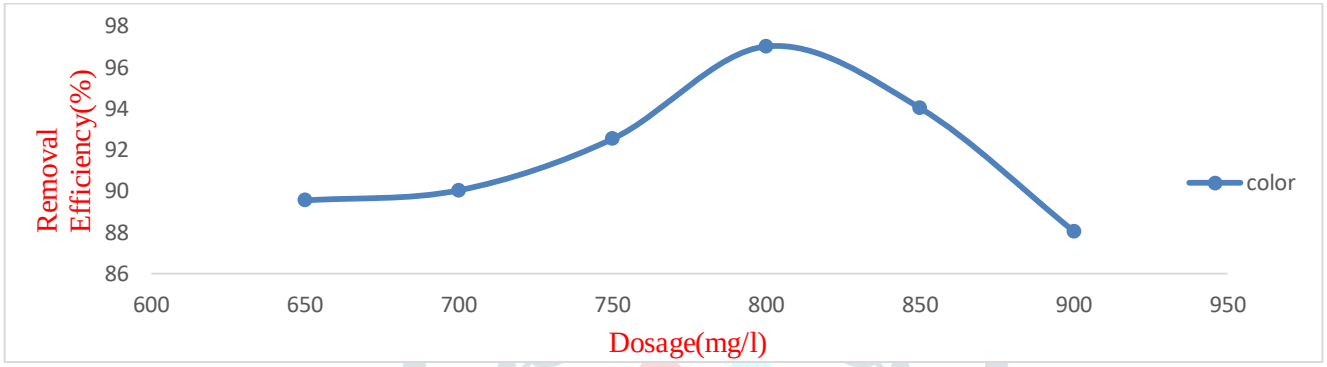
Chemical coagulation experiments were conducted by standard jar test procedures using a six place jar test apparatus. To a 1000ml sample of raw sample taken in beaker, chemical coagulants of aluminum sulphate, ferrous sulfate and natural coagulants of aloevera, moringaoliefera were added individually. Mixed for a typical rapid mixing time of 2 minutes at 120rpm followed by slow mixing at 30rpm for 20minutes.the contents were then sedimented for 4hours and aliquot of supernatant was withdrawn and analysed for color and COD concentration

V. Results and discussion

The aim of the present study is to investigate and assess the potential of selected coagulants Alum, Ferrous sulfate, Moringaoliefera seeds, Aloevera for removing color and COD parameters. Selected coagulants are low in cost and abundantly available. For removal of color and COD from textile wastewater by physicochemical process of flocculation and coagulation employing batch studies. Therefore, the present study was conducted in three phases for four coagulants. First phase involves the determination of optimum dosage with raw textile wastewater pH value. In second phase involves determination of optimum pH with optimum dosage, which are selected in first phase. In third phase involves determination of optimum dosage with optimum pH, which are selected in second phase. The results of all the experiments are presented in graphical form and are followed by a discussion of the results.

REMOVAL OF COLOR AND COD USING ALUM AS COAGULANT:

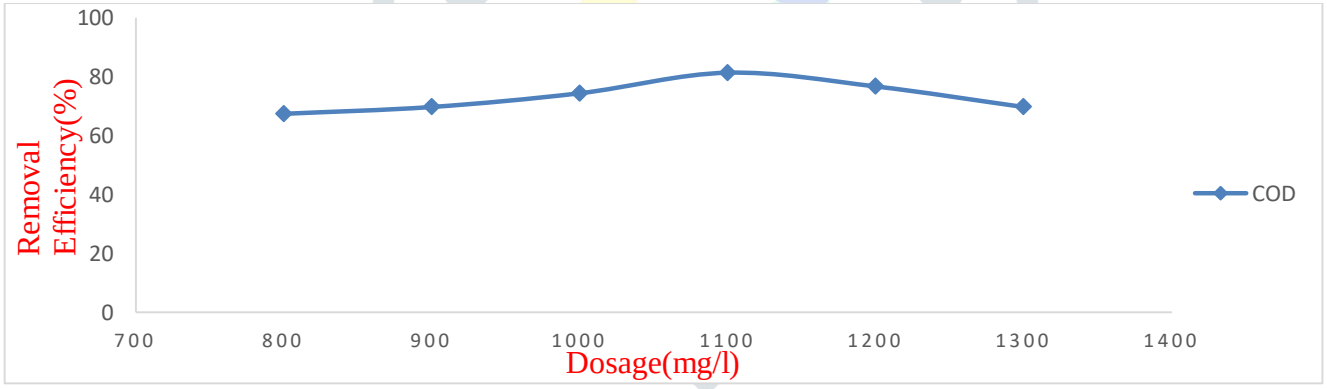
Color Study



Color Removal at optimum dosage of alum with optimum pH 8.

It can be observed that at the optimum values of dose and pH, Color removal got further increased to97.01%.

COD Study

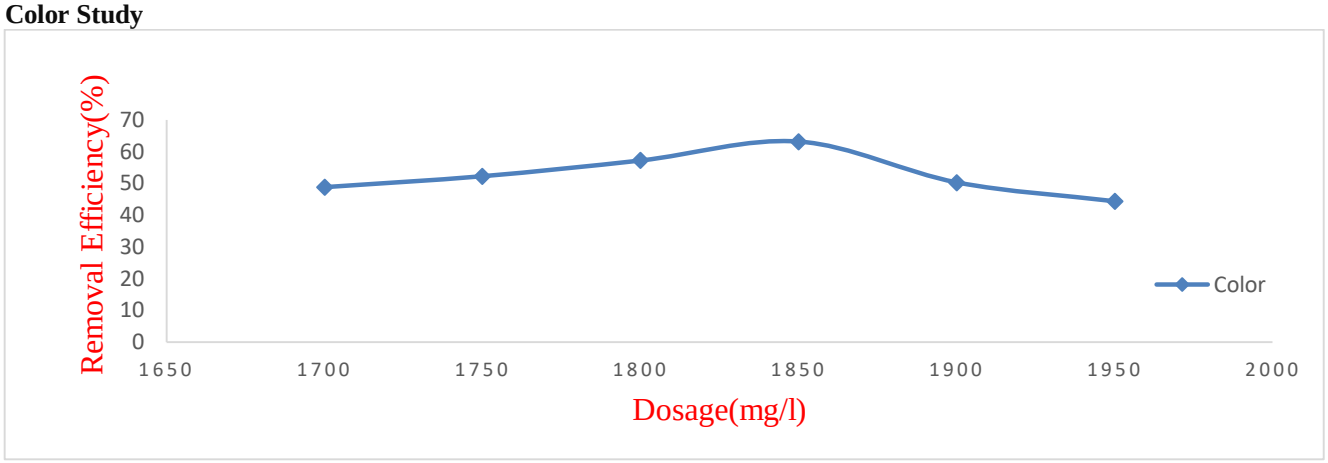


COD Removal at optimum dosage of alum with optimum pH 8.

It can be observed that at the optimum values of dose and pH, COD removal got further increased to 81.39%.

REMOVAL OF COLOR AND COD USING FERROUS SULFATE AS COAGULANT:

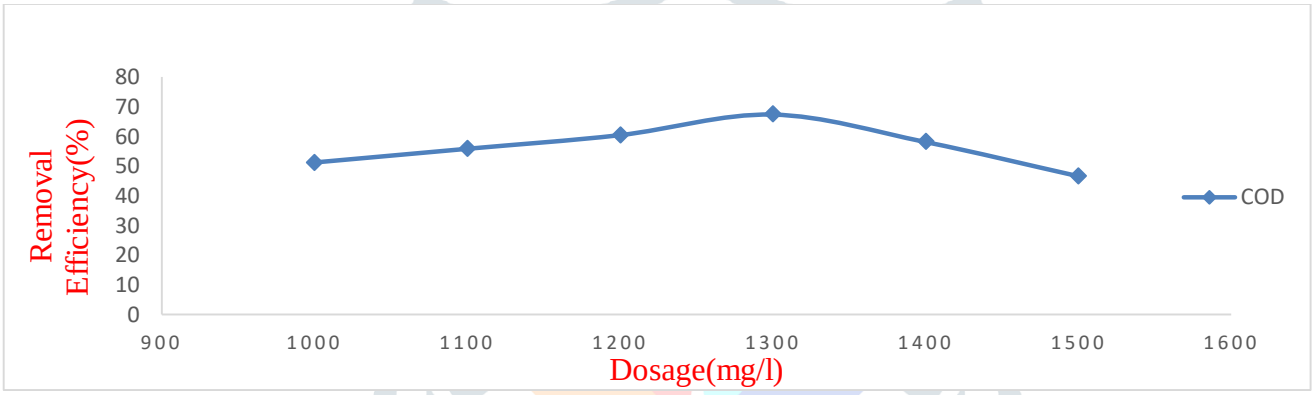
Color Study



Color Removal using $FeSo_4$ at optimum dosage with an optimum pH 6

It can be observed that at the optimum values of dose and pH, Color removal got further increased to63.16%

COD Study

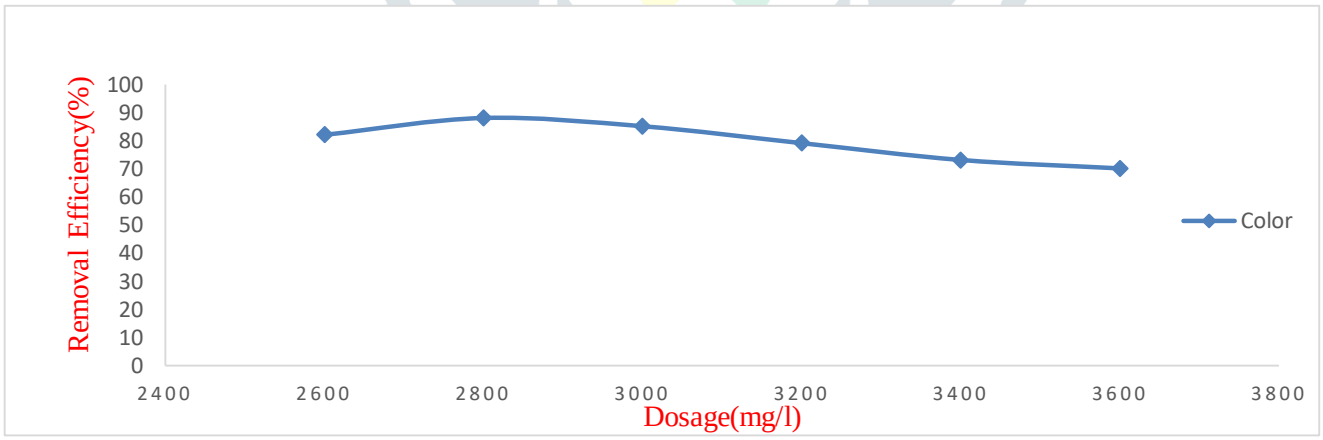


COD Removal using $FeSo_4$ at optimum dosage with optimum pH 6

It can be observed that, at the optimum values of dose and pH, COD removal got further increased to 67.44%.

REMOVAL OF COLOR AND COD USING MORINGAOLIEFERA AS COAGULANT:

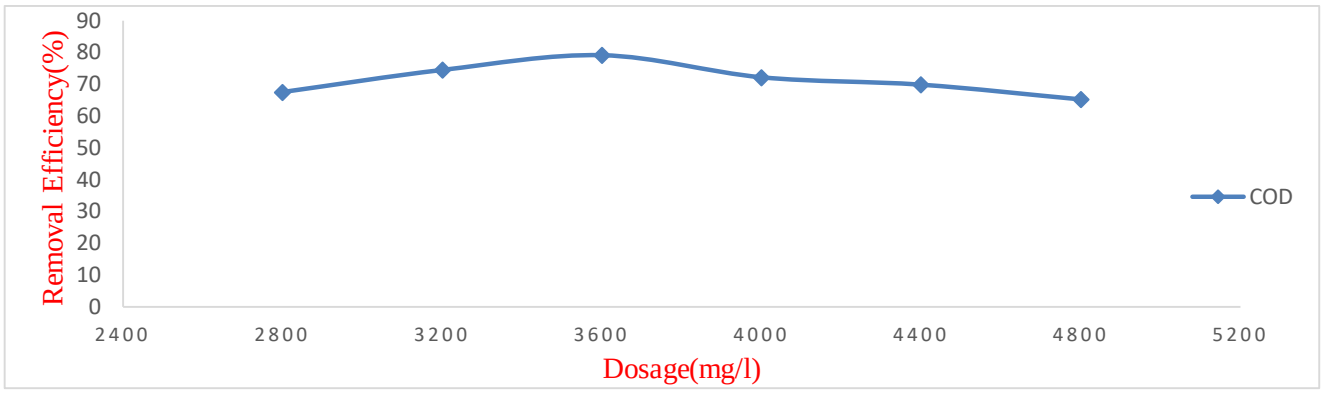
Color Study



Color Removal using M.oleifera at optimum dosage with optimum pH 10.

It can be observed that at the optimum values of dosage and pH, Color removal further increased to 88.05%.

COD Study

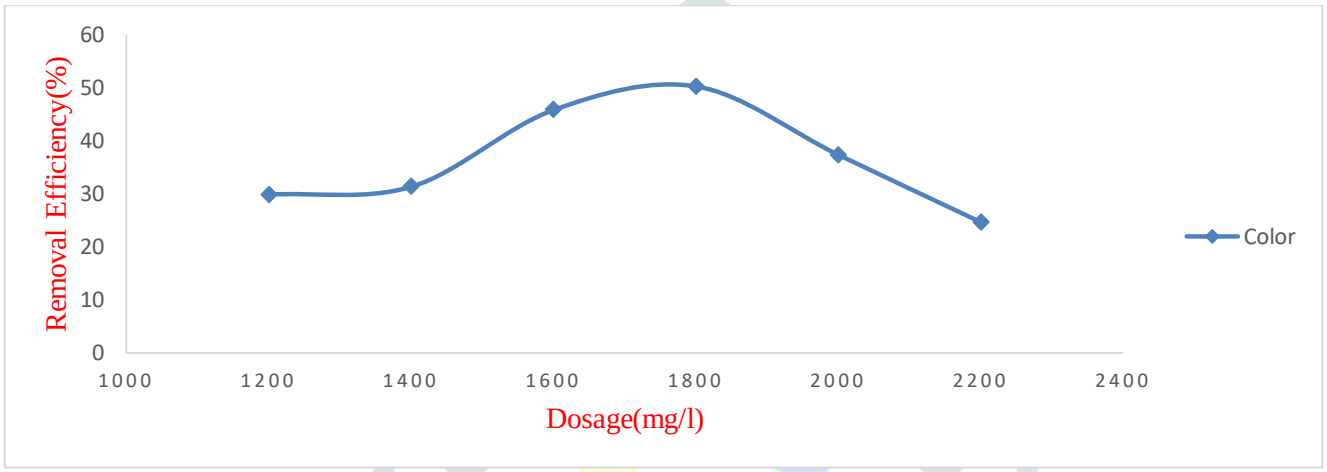


COD Removal using M.oleifera at optimum dosage with optimum pH 10

It can be observed that at optimum values of dose and pH, COD removal got further increased to 79.06%.

REMOVAL OF COLOR AND COD USING ALOEVERA AS COAGULANT:

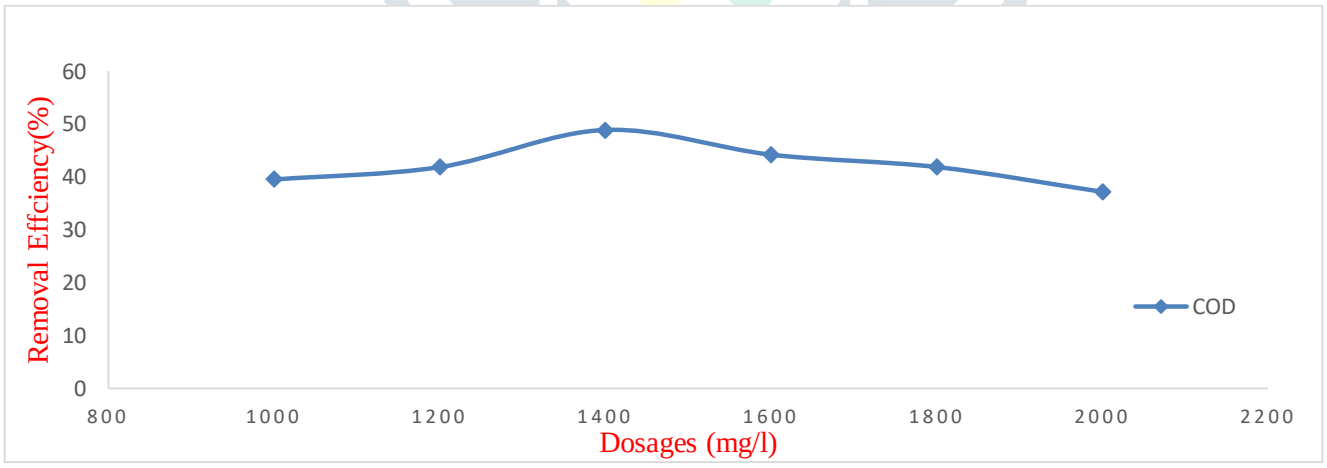
Color Study



Color Removal using Aloevera at optimum dosage with optimum pH 8.

It can be observed that at optimum values of dose and pH, Color removal got further increased to50.23%.

COD Study



COD Removal using Aloevera at optimum dosage with optimum pH 8

It can be observed that at the optimum values of dose and pH, COD removal got further increased to 48.83%.

VI. CONCLUSIONS

The study demonstrated that selected coagulants (alum, ferrous sulfate and moringaoliefera, aloevera) Exhibited high to excellent color and COD removal. Influence of pH found to be significant and treatment at optimum pH conditions resulted in either increase in color and COD removal or decrease in chemical dose requirement or even both. Comparing with ferrous sulfate and Aloevera, Alum and moringaoliefera seeds removes color and COD effectively. Alum removes 97.01% at optimum dosage of 800mg/lit and 81.39% at optimum dosage of 1100mg/lit of color and COD respectively with pH 8. Moringaolifera seeds performed well in color and COD removal 88.05%at optimum dosage of 2800mg/lit and 79.06% at optimum dosage of 3600mg/lit respectively with pH 10.All the four coagulants responded favorably to remove color and COD in acidic and alkaline

nature. Alum (pH=8), moringaoliefera (pH=10) and aloevera (pH=8) removes in alkaline nature, but ferroussulfate (pH=6) removes in acidic nature.

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