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Treatment of Dyeing Waste Water by Using Garlic Extract as a Natural Coagulant

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Abstract

Coagulation is the process of removal of very fine particles by forming bigger flocs in the water. But this process is not much efficient in waste water treatment as in the treatment of drinking water. This is because of adding chemical coagulant for the treatment of waste water. Use of chemicals in treatment of dyeing waste water causes formation of non-biodegradable sludge. To avoid this we made an attempt in the treatment of water by using plant based natural coagulant. Here we tried garlic, as natural coagulant for the treatment. The extract of garlic was obtained and it was used in this process. The result was found in a greater efficiency in the removal of hazardous chemical composition present in the dyeing waste water. From the result, it was obtained that 96% of COD and 93% of BOD has been achieved. Also the iron and chromium have been removed 100%.

***Keywords**: Garlic extract, natural coagulant, water treatment, coagulation*

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INTRODUCTION

Dyeing industry is one of the highly developing industries in India. Many districts like Tirupur have dyeing industries as the backbone of their city development. In this scenario, the waste water releasing from these industries forms a major environmental problem. As this industry consumes a large volume of water for the coloring and bleaching of clothes, the water consumed in this industry became waste at the end of the process. This water contains highly hazardous chemicals which are discharged directly into the river or sewer lines that are hazardous to the environment. So in order to prevent this, treatment of this waste water is essential. For this purpose, some treatment plants are established in the city itself. In these plants, processes such as aeration, sedimentation, coagulation, filtration, reverse osmosis, etc., are followed. Among these processes coagulation is the most important because it can remove very finely suspended particles also. For the removal of suspended particles, some chemical coagulants are added to the waste water in this process. The addition of chemical coagulants results in the formation of non-biodegradable sludge.

The plant based coagulant mechanisms are used for treatment of wastewater which can be easily processed[1]. The distillery waste water is treated with bean extract in the coagulation process. The distillery waste water is highly polluted it is most crucial environmental issue[2]. The performances of strychnos potato ram seed extract as primary coagulant are comparable with the performance of alum[3]. The evaluation of cactus and hyacinth bean peels as natural coagulants have also been used to treat the industrial wastewater like textile mill wastewater[4].

The usage of natural coagulants such as tamarind seed powder for treating low turbid waste water is also done[5]. The polymers which have the capability of coagulation flocculation in suspended materials are used in different extent[6]. Tannins are presented as a promising source for new coagulant agent and are mostly vegetal water-soluble poly phenolic compounds[7]. The sedimentation results are accelerated when we use iron salts and thus, we get best water sludge ratio[8]. It has been observed that natural coagulants can be used as an effective coagulant material that successfully remove the color and turbidity[9].

By using natural coagulant (tamarind seed extract) as coagulant, sludge volume index in treatment operation will be reduced. Moringaolifera can be effectively used as a coagulant aid with any chemical coagulant[10]. When magnesium chloride is combined with polyelectrolyte the result were much better, but it works only at higher pH[11]. When polyelectrolyte is used as coagulant aid along with magnesium chloride 97% of turbidity and 95% of transmittance is achieved[12].

The present study is carried out in the Moringaoleifera seed as a natural coagulant to remove the turbidity of water which also inhibits growth of water borne pathogens[13]. The high degree of effectiveness of poly-aluminium chloride (PAC) as coagulant for reactive dyes in waste water is observed. The degree of dye removal is varied due to both; the types of dye and the coagulant dose[14]. Natural polymers such as starch, sodium-aliginate, amylopectin, guar gum, xanthan gum, chitosan and okra mucilage have been reported as flocculants[15]. The use of these flocculants seems to be an economical and cleaner alternative for textile waste water treatment[16]. Cactus opuntia and water hyacinth have the potential to be utilized for waste water applications[17].

The main objective of our project is to find an alternative coagulant instead of chemical coagulant. So in our present research, we made an attempt using garlic as a plant based natural coagulant. This extract was added in different dosages such as 1, 2, 3 ml, etc., along with 1 ml of poly aluminium chloride (PAC) as coagulant aid.

The reason for the requirement of treatment for the collected sample is the value of the physical and chemical parameters determined initially were very high than the standard values given in IS: 10500 provided by the central pollution control board of India. So the water had to be treated before discharging. The initial values and the values obtained as per norms are given in Table 1 as follows:

Table 1: *Initial Values and PCB Norms.*

Parameters	Values as per PCB Norms	Initial Values of Sample
pH	5.5 to 9.0	9.3
Turbidity	5 NTU	14.9 NTU
BOD	30 mg/L	408 mg/L
COD	250 mg/L	510 mg/L
Iron	3 mg/L	4 mg/L
Chromium	2 mg/L	0.36 mg/L
Ammonia	5 mg/L	2.5 mg/L

MATERIALS AND METHODS

Sample Collection

In this study, the waste water was collected from nearby dyeing unit in Tripur district. This industry consumes approximately 20,000 L of water as its intake and the whole water becomes waste at the end of dying process.

In these, 100% water input is converted into wastage which is sent to some zero liquid discharge plants or common effluent treatment plants. The initial characteristics given shows that the values obtained are above the discharge norms of pollution control board standards. Also, it is evident that this water should be treated before letting it into sewers or letting it for

evaporation process. This study aims to introduce newer technologies in the treatment plants to make the treatment process efficient.

Most of the industrial waste water treatment plants involves the units like screening, grit removal, coagulation with sedimentation, filtration or aeration with biological treatment process, sludge removal, reverse osmosis process.

Sampling and Testing

Sampling of waste water was done at the main collecting tank by using grab sampling method, the sampling bottles were of 50 L capacity which were cleaned three times with tap water, then with distilled water and rinsed fully with 6N HNO_3 for removal of every signs of pathogens or odor.

Samples collected were used immediately for the study. Before conducting the study, the initial parameters were noted. The coagulation sedimentation process was conducted by using jar test apparatus. All the tests were conducted by both spectrophotometry and titremetry as per the APHA laid procedure based on 20th edition of APHA standards.

All the instruments used in this study were pre-calibrated by using standard solutions to enable accurate results. Chemicals used in this study were obtained from Merck specialties Pvt.

limited and all of them were of laboratory grade, solutions were prepared as per APHA procedure and stored in glass containers with anti-spill lock.

Coagulant Preparation

The garlic was collected from the local market and kept at muffle furnace for the complete removal of water content. Then, the garlic was grained and stored in an air tight container. From this, 100 g garlic powder was added with a 250 ml of distilled water and mixed well by using magnetic stirrer at a speed of 1000 rpm. This mixture was kept soaked for 24 h, after that 250 ml of water was added to the mixture.

This solution was mixed by keeping it in magnetic stirrer at 900–1000 rpm. Then, the solution was filtered by using filter paper and the filtrate was stored in refrigerator for future use. This extract was added in the sample water in different dosages such as 1, 2, 3 ml, etc., along with 1 ml of poly-aluminium chloride (PAC) for 250 ml of sample water.

This sample water was mixed by using jar test apparatus with rapid mixing for 5 min followed by slow mixing for 5 min. The sample was further kept undisturbed for 30–45 min for the settlement of the flocs. After this, the sample was tested for both physical and chemical parameters.

RESULT AND DISCUSSION

From the results, it is clear that garlic extract can be used as an effective coagulant. The result shows that the optimum dosage was found to be 16 ml/L (4 ml / 250 ml) at pH 5. In this dosage, almost all the parameters had been reduced in a greater efficiency. The effect of this coagulant is shown in the graph below:

The transmittance of the sample got increasing with the increase in coagulant dosage.

The maximum transmittance achieved for the treated sample was 75% and the minimum was 68%; both the values are sufficient for the discharge of waste water.

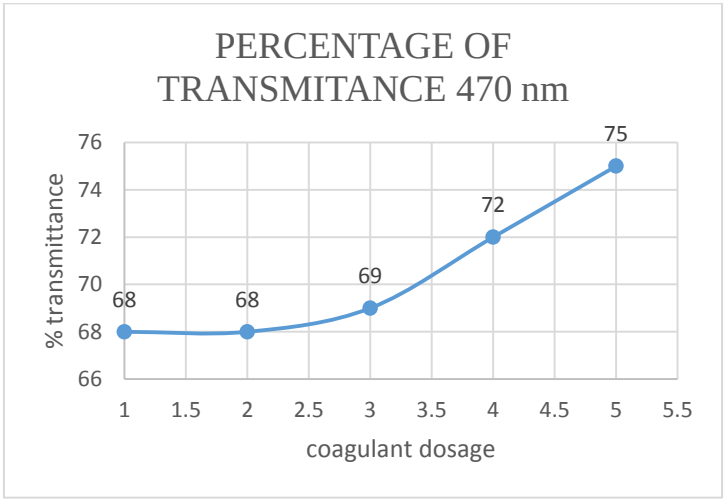

Fig. 1: *Effect of Garlic on Transmittance.*

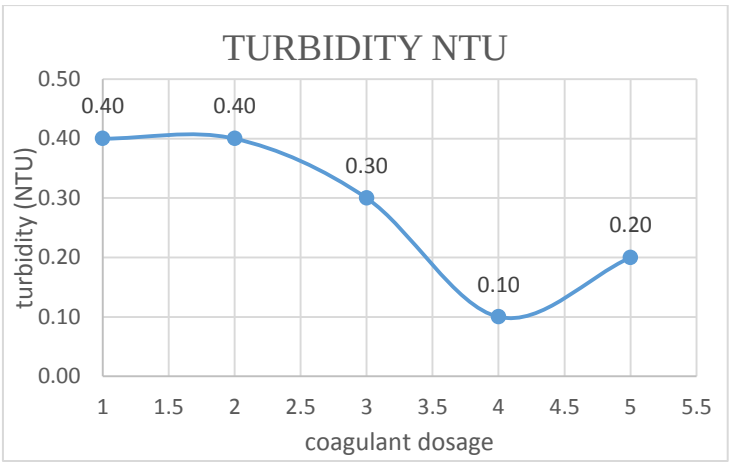

Fig. 2: *Effect of Garlic on Turbidity.*

According to the central PCB norms the turbidity value for discharging industrial waste water should be less than 5 NTU. But the initial value of collected waste water sample was 14.9 NTU. While using garlic extract as coagulant the turbidity had been reduced upto 0.1 NTU which is similar to the drinking water. Also the turbidity value was reduced not only to the optimum dosage but also for the other dosages.

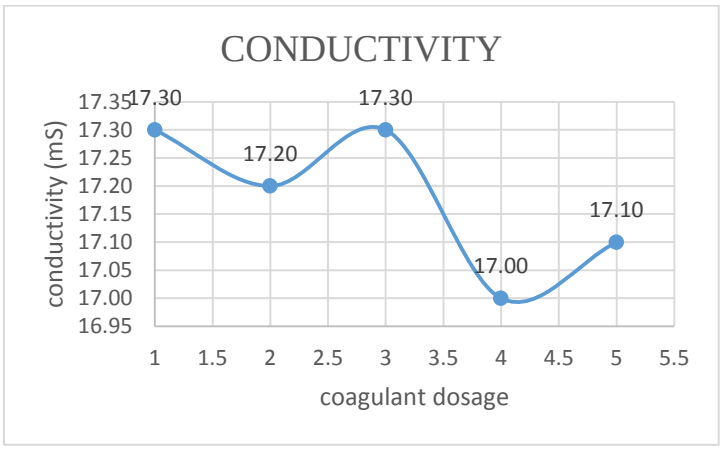

Fig. 3: *Effect of Garlic on Conductivity.*

The conductivity obtained from the above graph for the optimum dosage was 17.00 ms. All the dosages of the garlic had attained the conductivity in the range of 17 to 17.3 ms which are effective values.

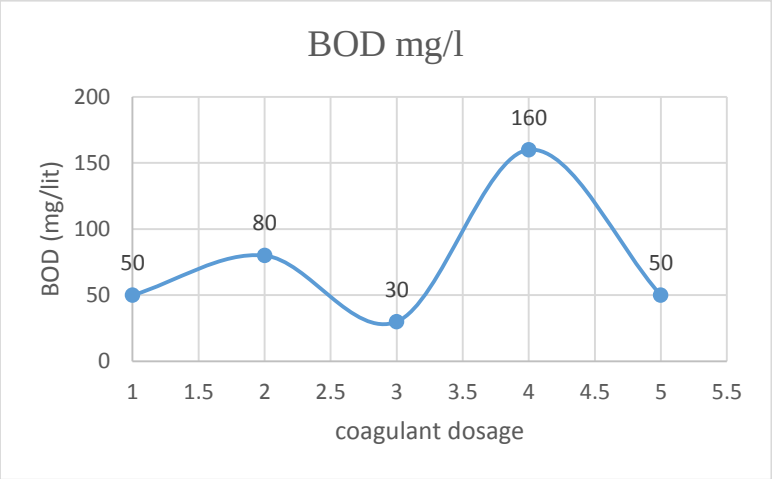

Fig. 5: *Effect of Garlic on BOD.*

The BOD value was reduced to 93% from the initial value and reached the value of 30 mg/L which is sufficient for discharge. According to the PCB norms the value of BOD should be less than 30 mg/L as given in Table 1. Here, for the other dosages of garlic extract it was higher than the values mentioned in the norms. But for the optimum dosage we can get the value as per the norms.

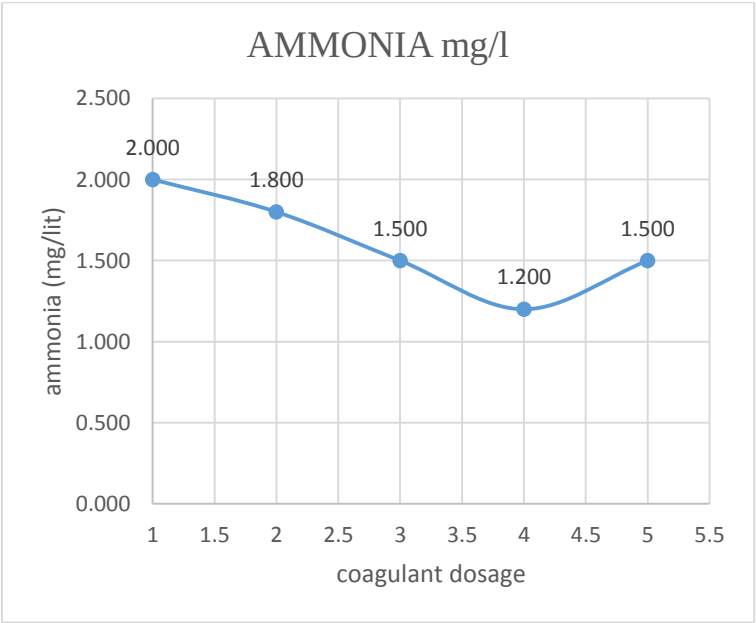

Fig. 6: *Effect of Garlic Ammonia.*

The value of ammonia had been reduced to 1.2 mg/L which is less than the PCB norms for discharging the liquid. The presence of ammonia had been reduced in all the dosages of garlic extract and has been shown in the above Figure 6. Therefore garlic has a good effect in the reduction of ammonia.

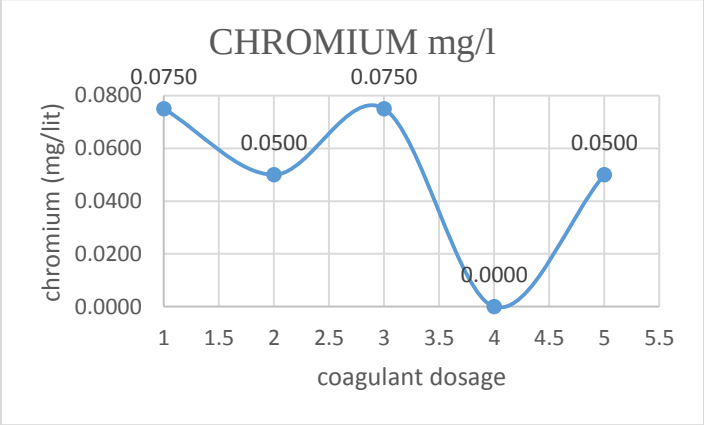

Fig. 7: *Effect of Garlic on Chromium.*

The chromium was removed 100% in the optimum dosage of the garlic extract and the remaining values also got decreased to 0.075 and 0.05 mg/L. Thus it is clear that by using garlic extract we can surely remove or reduce the amount of chromium present in the waste water.

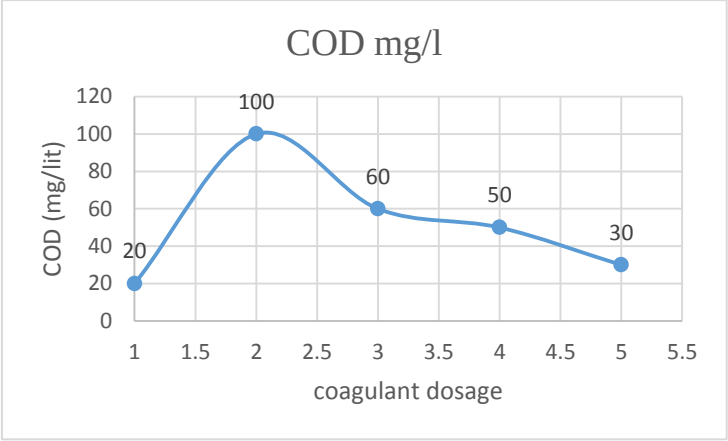

Fig. 8: *Effect of Garlic on COD.*

According to the PCB norms the COD value for the discharging waste water should be 250 mg/L. While using garlic extract as coagulant we can reduce it from 510 to 20 mg/L and it shows high removal efficiency. All the COD values for garlic treated sample reduced to less than 100 mg/L.

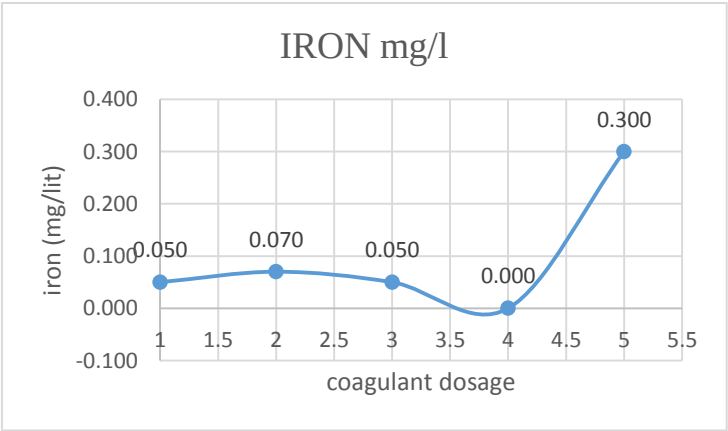

Fig. 9: *Effect of Garlic on Iron.*

The iron was removed 100% at the optimum dosage and in other dosages also the value of iron got decreased than the value mentioned in the PCB norms. So that the hazardous nature of the water gets completely decreased and the water tends to be free for discharge.

CONCLUSION

Thus, we conclude that by using garlic extract we can treat the dyeing waste water as per the requirement of the pollution control board norms. The optimum dosage identified from the above study is 16 ml/L at pH 5 along with 1 ml of PAC which shows greater efficiency. The values of BOD and COD have been reduced up to 93 and 96% respectively and these values satisfy the pollution control board norms for the discharge of waste water. Also, the iron and chromium have been removed 100%; which is effective for discharge. The value of ammonia has also been reduced according to the PCB norms and reaches the value of 1.2 mg/L. Therefore, garlic can be used as a coagulant for the treatment of dyeing waste water.

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