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Treatment of Water by using Natural Coagulant

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Abstract: **-- Water treatment plants use a variety of chemicals to remove contaminants that affect the taste, odor, cloudiness and overall safety of the water. The natural coagulant is a natural based coagulant that can be used in coagulation process of water treatment for reducing turbidity. The paper presents the investigation of the coagulation-flocculation potential of coagulants derived from plants, such as Cactus opuntia, Kidney bean and Cicer arientinum, for removing the turbidity from synthetic turbid water prepared from local clay with the effect of Jet for mixing.**

***Key Words*:- Flocculation, Jet mixing, Cactus opuntia, Cicer Arientinum.**

I. INTRODUCTION

In water treatment Coagulation flocculation is most regular and important process. Water purification is very critical as they have immediate impact on human health. Chemical coagulants such as salts of aluminium and iron and polyelectrolytes are extensively used to remove turbidity in water. Chemicals used to treat water may also have side effects. New developments in Environmental Engineering are providing promising solutions to many water pollution problems. In recent years various investigations were carried out and results into development of new coagulants, extracted from natural and renewable sources. Natural Coagulants contain large quantities of water-soluble proteins which carry an overall positive charge when in solution. The proteins bind to the primarily negatively charged particles that cause turbidity (e.g. sand, silt, clay). The use of natural coagulants which are grown in the vicinity may results in economical and sustainable viable alternative. The various studies explains about regrowth of pathogens in the distribution system which is caused due to high residual turbidity in the treated water, leading to the water borne disease outbreaks. The numerous studies on a variety of plant materials which can be used as a source of natural coagulant have been reported.

The experimental results has shown that this natural coagulant efficiency which are removed up to 99.1% of turbidity in synthetic wastewater is comparable to the synthetic coagulant. All the studies indicate that, though science have done advancement in the field of the coagulants and water treatment process, still there are significant drawbacks and harmful effects which are imparted due to the synthetic coagulants. In this study, the effectiveness of a natural macromolecular coagulant derived from a cactus species, Kidney bean and chickpea powder for turbidity removal from river water were evaluated. It was observed that the natural coagulants does not have a considerable variation in final pH of the water.

Selection of coagulants The natural coagulants taken for coagulation process are:

Cactus opuntia(Cactaceae) is the most commonly studied cactus genus for water treatment. The high coagulation capability of Opuntia is recognized and used as a coagulant. Chickpea(Cicer Arientinum) belongs to the family Fabaceae, which can reduce turbidity up to 95.89% for highly turbid water, which is almost as same as the reduction capacity of alum. It has been also reported that it has the ability to absorb heavy metals from water. Kidney bean powder is also used as a coagulant in flocculation process. With many advantages of Kidney bean Powder that can be used as a natural coagulant for water treatment.

Preparation of turbid water

Locally available natural clay was used to prepare synthetic turbid water. Clay was soaked for 24 hours in tap water and then blended for 10 min. The suspension was washed through a 75- micron sieve. This was kept as a stock suspension for preparation of different turbidities such as low, medium and high. A part of the stock suspension was diluted with tap water and after 30min of settling in a container, the supernatant was carefully

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decanted and desired turbidities of 34.2 NTU (low), 146.8 NTU (medium) and 314.4 NTU (high) were obtained.

Preparation of Coagulants

Cactus opuntia powder is prepared by cutting cactus cover into the small stripes of width 1 to 1.5 cm where length depends upon how cactus is long (Make sure the peeled cactus does not have any spikes since it adds additional turbidity). Allow the peeled cactus for drying in oven, maintained the temperature of 130 0centigrade for 24 hours. For smell out the dried cactus is exposed to air for minimum 1 hour. Ground the dried cactus and Sieving is done with particle size not more than 300 micron. To prepare a Chickpea (Cicer Arientinum) powder Seeds are extracted from the plant fruits. They are dried up for minimum 24 hrs. Seeds are ground into fine powder providing more efficiency to the various tests.. Kidney bean powder is prepared by collecting Kidney bean seeds and allow to dry for few hours. Sort out the seeds and care is taken for the spoiled seeds not to be taken into account. Grind the seeds in the mechanical grinder to form a fine powder. Sieve the powder through 75 micron sieve. Figure 1,2 &3 shows the three different materials in a powdered form which was used for experimentation.

Fig. 1- Kidney beans and Kidney beans powder

Fig. 2- Cactus and Cactus powder

Fig. 3- Chickpea and Chickpea powder

Preparation of stock Turbid solution

Concentrated solution of turbid water is created by using 16 litres of tap water, it is added with 3.6 kgs of locally available red clay which is sieved through IS 75 microns sieve. This mixture is stirred for 1hr using mechanical stirrer and then left stagnant for 24 hrs. After 24 hrs the supernatant solution is decanted, and that solution is used as stock solution for adding controlled turbidity (due to 24 hrs detention time micro particles of soil are fused into water thus enabling it to remain in suspension form and preventing it from further settling)

Experimental setup

Mixing plays very important role in various industries & plants. Jet mixing is the best alternative of mechanical agitators. The effect of various parameters as well as coagulant types and dosages, shape and size of jet, effect of power consumption on mixing time, effect of fluid property on mixing time plays very important role. For the study the given methodology is adopted.

Experiments were performed in a flocculation chamber with dimensions as 0.8m*0.8m*0.9m. The overhead tank is circular tank of 0.4m diameter having capacity of 500 litres, which was placed at a height of 1.8m from a bottommost sedimentation tank of dimension 0.85m*0.85m*1m. Stirrer arrangement is done at overhead tank so as to provide uniform mixing rate to made the water turbid by addition of required stock solution for each reading. Assembly of jet insertion having 7cm diameter is provided in flocculation chamber for proper mixing. Optimum coagulant dosages were added for different coagulants and mixing is done using jet in flocculation chamber. In this study, above mentioned natural coagulants were considered using jet effect and comparison is done amongst them for various parameters like turbidity, alkalinity, colour, odour and pH for the detension time of 15, 30, and 90 minutes. Since larger containers are used, the results obtained would be practically used in WTP.

II. RESULT & DISCUSSION

Comparison of Turbidity

The Fig-1 shows the cumulative results of turbidity reduction. Chickpea shows the maximum removal of turbidity as compare to other coagulants.

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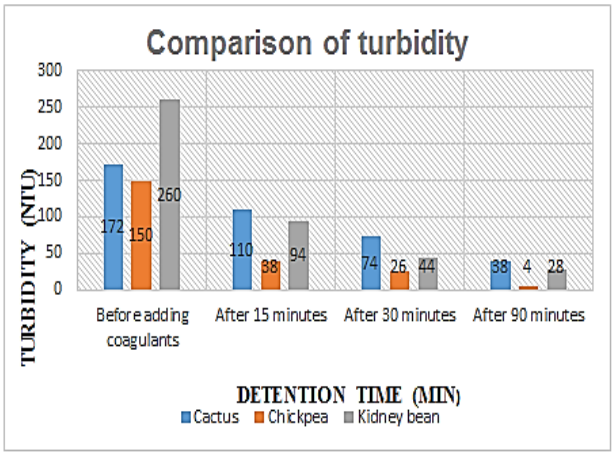

Fig 1 . Turbidity

Comparison of Alkalinity

Fig-2 shows the different alkalinities found after testing over the treated water samples at detention time of 15, 30 and 90 mins. Figure shows the cumulative results of Alkalinity reduction. Cactus shows the maximum removal of alkalinity but the alkalinity ranges for all three coagulants is beyond the permissible limit (200mg/lt). Therefore it shows the unpleasant test.

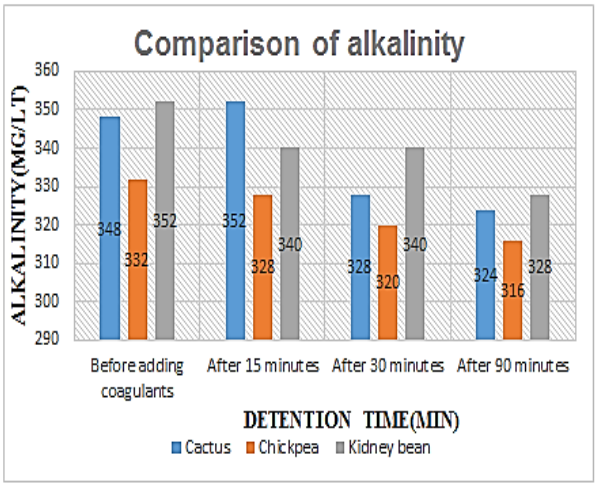

Fig 2 . Alkalinity

Comparison of pH

Fig 3 shows that all three coagulants are in permissible limit after testing for pH. There is no remarkable variation observed in pH value after addition of all the three coagulants.

Fig 4 . pH

Comparison of Colour

The acceptable limit of colour is below 5. From the Fig 5. It can be concluded that, colour test is satisfied for all the coagulants before and after treatment too.

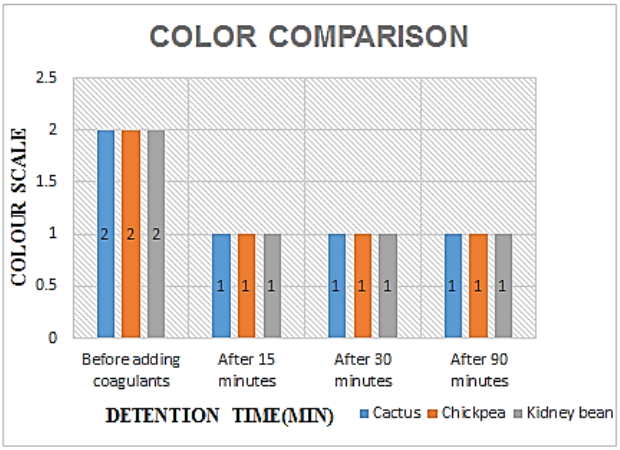

Fig- Colour

III. CONCLUSION

The results obtained from the testing enables us to conclude the properties of the various coagulants on the basis of the performance and efficiency. The use of jet flocculator is used for mixing purpose, it offers consistent mixing and reduces human effort. Following conclusions are drawn from the experimentation.

1. Jet flocculator increases the rate of mixing as compared to the hand mixing or rotating fan mixer.
2. Considering the turbidity reduction the main criteria of coagulation, Chickpea is found to be most effective as it reduces turbidity upto 97.33% for the detension time of 90 minutes.

3. However the reduction in the alkalinity of water is seen consistent, thus an inference can be drawn that natural coagulants are less efficient in reducing Alkalinity.
4. The other parameters such as color, odour & pH are in acceptable limits after using the natural coagulants.
5. After comparing all the results Chickpea has proven its efficiency and can be used for treatment of domestic water, or in water treatment plant.
6. The properties of Kidney bean powder were also satisfactory, and can be used if fused with synthetic Coagulant or alum.
7. Cactus was proven the least efficient of all the three coagulants, and high amount of additives should be added for using in day to day life.

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