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Evaluation of ability of ECORITE PAC-2010 to reduce Sludge Volume and Residual Aluminium in Water treatment

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Abstract: This paper describes the performance evaluation studies of ECORITE PAC–2010 of M/s. Shriram Consolidated Limited (DSCL) as a coagulant. It was observed that ECORITE PAC–2010 acts as a good coagulant over a wide range of turbidity and produces larger and more rapidly settleable flocs than the alum. It describes the studies of ECORITE PAC–2010 and alum to reduce the sludge volume and residual aluminium in water. The residual aluminium is less in ECORITE PAC–2010 treated water than that in alum treated water. The sludge volume generated by ECORITE PAC–2010 is less than that generated by alum for attaining the same quality of settled water from turbid raw water.
Key Words: ECORITE PAC-2010, Alum, Coagulants, Residual aluminium, Sludge.

Introduction

Coagulants are those substances which are capable of removing colloidal impurities from water, and coagulation is the process by which such removal is brought about. Alum has been traditionally used as a coagulant in water treatment for over hundred years. It is commonly available, relatively inexpensive and has long been recognized as a successful compound for removal of color and turbidity from water supplies.

However, more recently attention has been directed to alternative coagulants in water treatment in efforts to reduce residual aluminium in finished water, minimize sludge production and eliminates post precipitation of aluminium residues in the distribution systems[1]. Alum is conventional coagulant against which performance of other coagulant is generally compared. The Poly Aluminium Chloride (PAC) is an effective coagulant for removal of turbidity[2], organic matter[3] fluorides and heavy metals from water of different alkalinities.

The performance evaluation of Poly Aluminium Chloride (PAC) vis-a-vis alum as a coagulant in water treatment has been reported in this paper. The PAC investigated in this study was ECORITE PAC – 2010 a product from M/s Shriram Consolidated Limited (DSCL). It is a coagulant which is claimed by M/s DSCL to be the latest generation Poly Aluminium Chloride based liquid coagulant/

flocculant manufactured at Kota (Rajasthan) in India for the first time using state-of-the art technology imported from Italy.

The study involved extensive Jar Test experiments on different waters of natural origin as well as those prepared under laboratory conditions. The data generated in these investigations are presented in this paper.

Materials & Methods

Preparation of Coagulant Solution
The working alum solution was freshly prepared by dissolving 10 gm of alum (ferric alum grade 2 ISI specification) in one liter of distilled water. For making 1% solution of ECORITE PAC –2010 the dilution of this coagulant was done with distilled water on daily basis. The neat ECORITE – PAC 2010 was dosed by using a micro syringe.

Sampling
A large volume of raw water sample was collected at a time for the studies so that all the portions tested will be from the same source for a series of experiments. About 30 liters of water sample was collected each time to permit the requisite series of Jar Test of six portions each.

Jar Test Equipment
All the laboratory tests were carried out using Phipps and Bird Multiple Stirring Device (Jar Tester) equipped with stirring paddles and provision for controlled mixing. The floc size and its settleability were observed in illuminating device at the base of the apparatus.

Test Conditions
Measured volumes [1000 ± 10 ml] of samples were flocculated using the Jar Test apparatus in 1000 ml beakers. The beakers ware placed in position on the Jar Tester .The motor of the paddled stirrer was started. After the addition of coagulant in each beaker simultaneously, rapid mixing was maintained at 100 ± 10 rpm (rotations per minutes) for 30 seconds followed by slow mixing at 25 ± 5 rpm for 10 minutes. At the end of stirring period, the beakers were removed slowly from the Jar Tester platform and the contents of the beaker were allowed to settle for 20 minutes. For each series the Jar Tests were repeated and average value of turbidity recorded to eliminate subjective errors. The criteria used for the evaluation of the efficiency of the coagulants were settled water turbidity and visual appearance of flocs.

Test Waters
The test waters used for studies were natural waters or synthetic waters. The natural waters studied were river water collected from Kanhan River. The synthetic waters were prepared by preparing artificial turbid solutions. The preparation of artificial turbid solutions involved following procedure:

Air dried black cotton soil was collected from NEERI premises. The air dried black cotton soil from previous step was again oven dried at 100°C for one day. The soil was crushed manually using mortar & pestle and brought into powder form. The crushed soil was passed through 100 mm sieve. 20 gm of powder soil was added to 500 ml of distilled water, mixed thoroughly and soaked the entire soil completely. The soil was allowed to swell in water for about 24 hours (this allows maximum swelling of clay particles). The above suspension was then blended in high speed varying blends for 5 to10 minutes (This helps in breaking the swollen clay particles to the colloidal size such that the resultant liquid when diluted with water to form the suspension which will not allow any more settlements of particles after attaining stability). The blended portion was then further diluted with water to obtain suspension. This is then allowed to settle overnight. The supernatant of the above step was then decanted without disturbing the sediments and used as a Stock Turbidity Suspension. The standard turbidity suspension of desired turbidity was then prepared by diluting the Stock Suspension by approximate quantity of distilled water. The quantity of soil and water can be suitably increased to prepare lager quantity of Stock Turbidity Suspension.

Analytical Methods
The study involved extensive Jar Test experiments on different waters of natural origin as well as those prepared under laboratory conditions to obtain the optimum dose of coagulant. However the exact dose for different waters will depend upon many factors such as the nature of turbidity, alkalinity, nature of organic matter and other characteristics of that particular water[4, 5, 6]. Correct dose has to be optimised by performing Jar Test experiments on individual waters. The actual dose for the water treatment plants can be ascertained only after performing plant trials. There is always a plant factor which may vary from plant to plant and will be responsible for deviation in the Jar Test value and the actual value of coagulant to be applied in water treatment plant.

All the analytical estimations were done as per the procedures described in the 20th Edition of Standard Methods[7]. Spectrophotometric method was used for aluminium estimation using Eriochrome Cyanine R[ECR] dye .With the ECR dye, dilute aluminium solutions buffered to a pH of 6.0 produce a red to pink complex that exhibits maximum absorption at 535 nm. The optimum aluminium range was between 20 and 300 µg/L, but could be extended upward by sample dilution. The instrument used for absorbance measurement was Hach DR/2000 spectrophotometer. The alkalinity of the water samples was determined by titrimetric method.

Study of Residual Aluminium

These studies were carried out using test waters having turbidities of 5 NTU, 500 NTU and 1000 NTU. Test waters were laboratory tap water and turbid waters prepared by mixing the tap water with bank sediments of Kanhan River. Jar Test experiments were performed on these waters as described earlier. It was observed that ECORITE PAC-2010 treated water always contained less residual aluminium than water treated with same amount of alum. The results obtained for residual aluminium are presented graphically in **Fig. 2.**

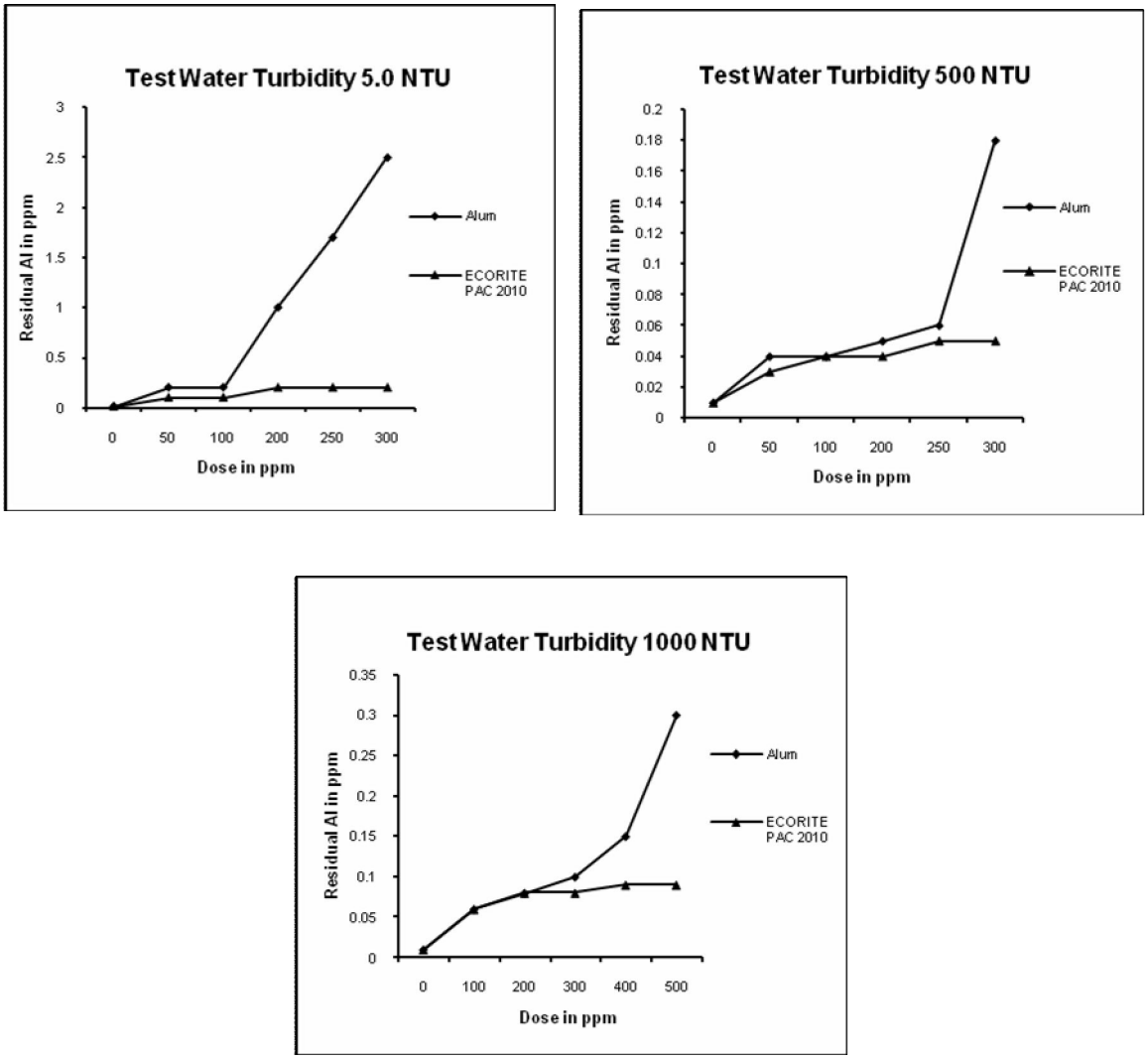

Fig.1. Residual Aluminium Studies of Alum and ECORITE PAC 2010 at different test water turbiditie.

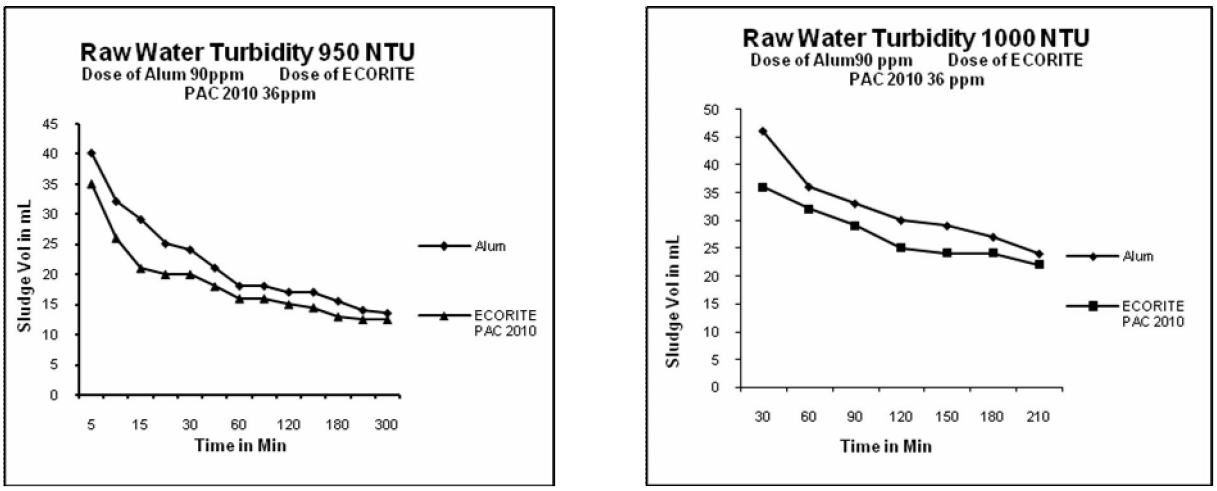

Fig. 2.Sludge Volume produced by Alum and ECORITE PAC 2010 at different test water turbidties.

Study of Sludge Volume

The sludge volume generated by alum and ECORITE PAC-2010 was compared by studying their performance on Kanhan River water and synthetic water prepared from black cotton soil. The doses of alum and ECORITE PAC-2010 were optimised by Jar Test experiments to obtain a settled water turbidity of 5 NTU. One liter of turbid water was subjected to sludge volume analysis in Imhoff cones after subjecting to half minute flocculation in the Jar Test apparatus. The results obtained are presented graphically in Fig.5. It was observed that with 3 hours settling period the reduction in sludge volume with ECORITE PAC-2010 as compared to that obtained with alum was 16% in case of Kanhan water and 11% in case of synthetic turbid water.

Conclusions

ECORITE PAC- 2010 acts as a good coagulant over a wide range of turbidity. It produces larger and more readily settle able flocks than alum at different test water turbidities. The results obtained in the study showed that the consumption of alkalinity and drop in the pH is more in case of alum than with ECORITE PAC-2010. The residual aluminium is less in ECORITE PAC- 2010 treated water than that in alum treated water. The sludge volume treated by ECORITE PAC- 2010 is less than that generated by alum for attaining the same quality of settled water from turbid raw water.

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