ABILITY EVALUATION OF PAC TO REMOVE COLIFORM ORGANISMS AND REDUCE SLUDGE VOLUME IN WATER TREATMENT

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A B S T R A C T

This paper describes the performance evaluation studies of ECORITE PAC-2010 for removal of total, feacal coliforms and to reduce sludge volume from waters of different turbidities of natural origin and synthetic water samples. ECORITE PAC-2010 is a coagulant Poly Aluminum Chloride (PAC) a product of M/s. Shriram Consolidated Limited (DSCL). The removal of coliforms from municipal water and their possible harmful effects are major problems to tackle, making use of special processes and methods to remove coliforms from municipal water seems so essential to avoid the health risk. 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 with reduced sludge volume and also removes the coliform organisms from the water. It was observed that the coliform removal efficiency of ECORITE PAC-2010 and alum show a similar trend over a different turbidity of the test water under the test.

1. INTRODUCTION

Coliforms are a group of bacteria that are widespread in nature. The coliforms are used as indicators of possible water contamination because they are commonly found in human and animal feces. Although they are generally not harmful themselves, they indicate the possible presence of pathogenic (disease causing) bacteria, viruses, and protozoans that also live in human and animal digestive systems. Therefore, their presence in streams suggests that pathogenic microorganisms might also be present and that consumptions of such contaminated water might be a health risk. In addition to the possible health risk associated with the presence of elevated levels of fecal bacteria, they can also cause cloudy water, unpleasant odors, and an increased oxygen demand. For drinking water, total coliforms are still the standard test because their presence indicates contamination of a water supply by an outside source.

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 colour and turbidity from water supplies. However, more recently attention has been directed to alternative coagulants in water treatment in efforts to reduce more efficiently turbidity, residual aluminium in finished water, minimize sludge production[1], eliminate post precipitation of aluminium residues in the distribution systems [2], reduce TOC and microorganisms in water. The Poly Aluminium Chloride is an effective coagulant for removal of turbidity [3][4], organic matter [5] [6] [7], fluorides, heavy metals, dyes [8] landfill leachates [9], and coliforms [10]from water. PAC gives more

rapid flocculation and stronger flocs than for alum at equivalent dosages [11]. Alum is conventional coagulant against which performance of other coagulant is generally compared.

The performance evaluation of Poly Aluminium Chloride (PAC) *vis-à-vis* alum as a coagulant to remove coliform organisms 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 waters of different turbidities of natural origin. The data generated in these investigations are presented in this paper.

2.MATERIALS AND METHODS

2.1.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 litre 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 ECORITE-PAC 2010 was dosed by using a micro syringe.

2.2.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. After conducting the Jar Tests on the raw waters the samples were collected for estimation of coliform organisms in pre sterilized pre autoclaved glass bottles with 40 % free space above water sample for air.

2.3.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.

2.4.Test Conditions

Measured volumes [1000 ± 10mL] 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.

3. COLIFORM REMOVAL STUDIES

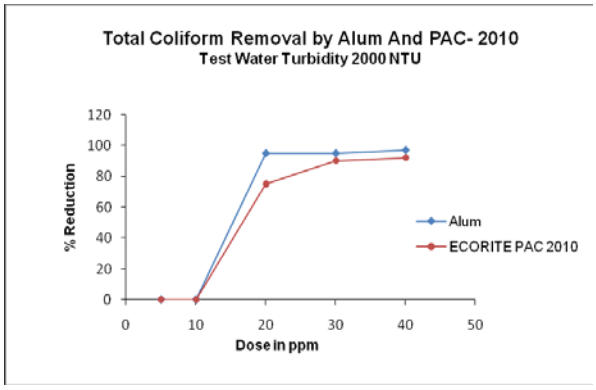
Studies on coliform removal were conducted on on Kanhan river water of three different turbidities, viz. 2000 NTU (Nephelometric Turbidity Units), 900 NTU and 250 NTU. The dose of the coagulants applied to the test waters was in the range of 5 ppm (parts per million) to 45 ppm. Membrane Filter Technique was used to find out the total coliform and feacal coliform count.

3.1.Analytical Method

The analytical estimations were done as per the procedures described in the 20th Edition of Standard Methods [12].Total and feacal coliform organisms were analysed by Membrane Filter Technique and are expressed as CFU/100 mL Membrane Filter (MF) Technique is highly reproducible, can be used to test relatively large volumes of sample and yields numerical results more rapidly than the multiple tube procedure. This technique is extremely useful in monitoring drinking water as well as variety of natural waters.

In this method the membrane filter assembly, membrane filters with 0.45 micron pore size, nutrient agars for the growth of coliform organisms and incubator for incubation were used. The membrane filter assembly consists of Millipore Standard Hydrosol filter holder. Most of the components of this assembly are made up of stainless steel. These are locking ring, fine mesh stainless steel screen for supporting the filter membrane and funnel assembly. It was sterilized in autoclave for 15 minutes at 120° C. After filtering the requisite amount of sample the filter paper was placed on the nutrient agar medium (present in petri dish previously sterilized and set with agar medium) with the

help of sterile forceps and the incubated at 37° C for 24 hours. All the organisms which produced a dark red colony with metallic sheen within 24 hours incubation were considered as the members of coliform group and were counted. The results obtained for total and feacal coliform removal at 2000 NTU, 900 NTU and 250 NTU with alum and PAC-2010 are presented graphically in Fig. (1) to Fig (3).



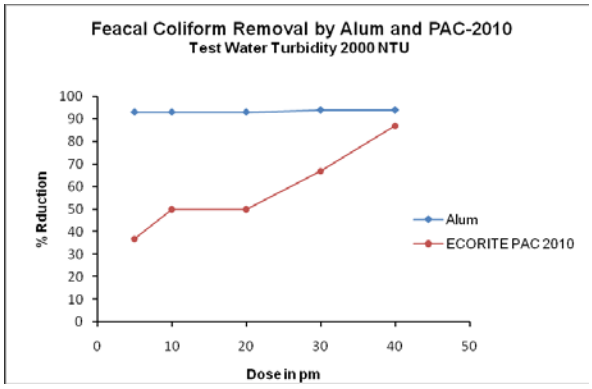
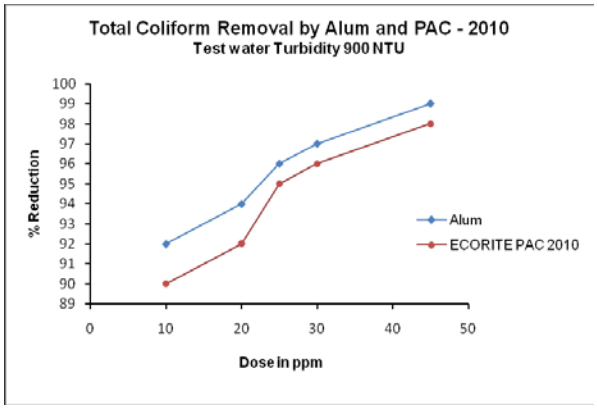


Fig. 1- TOTAL AND FEACAL COLIFORM REMOVAL BY ALUM AND PAC- 2010 AT 2000 NTU TURBIDITY



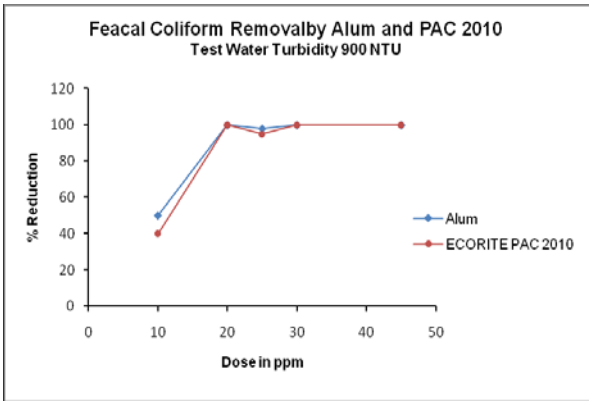
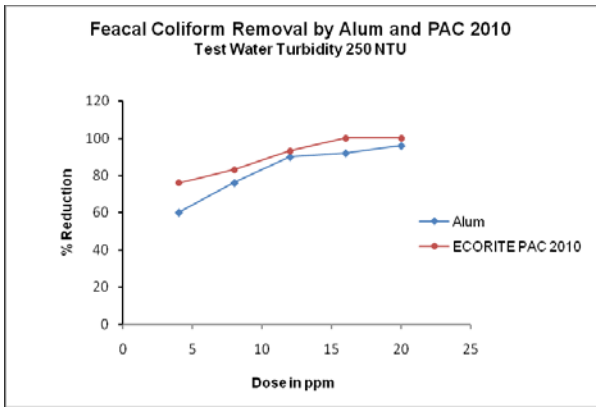


Fig. 2- TOTAL AND FEACAL COLIFORM REMOVAL BY ALUM AND PAC AT 900 NTU TURBIDITY



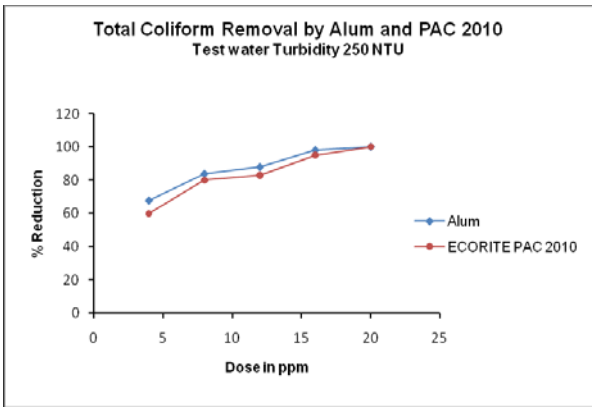


Fig. 3- TOTAL AND FEACAL COLIFORM REMOVAL BY ALUM AND PAC- 2010 AT 250 NTU TURBIDITY

4. STUDY OF SLUDGE VOLUME

Studies on sludge volume generation were conducted on Kanhan river water of 950 NTU turbidity and synthetic water prepared from black cotton soil of 1000 NTU turbidity. The sludge volume generated by alum and ECORITE PAC-2010 was compared by studying their performance on test waters.

4.1.Analytical Method

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. 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. The results obtained for sludge volume reduction at 1000 NTU with alum and PAC-2010 are presented graphically in Fig. (4).

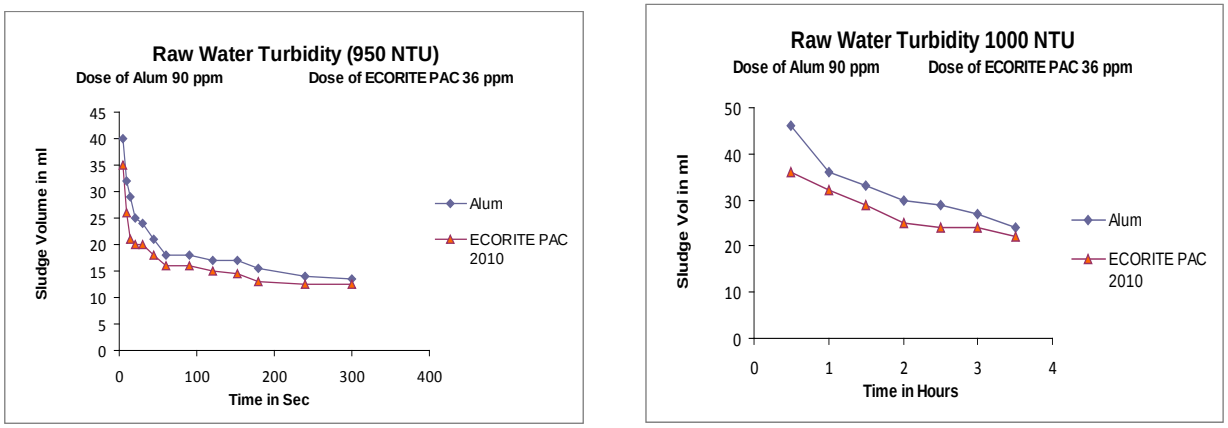


Fig.4- SLUDGE VOLUME PRODUCED BY ALUM AND ECORITE PAC 2010 AT 950 AND 1000 NTU TURBIDITY

5.RESULTS AND CONCLUSIONS

Both coagulants ECORITE PAC-2010 and alum remove coliform organisms from the raw waters. The study shows that for the coliform removal at lower turbidity that is 250 NTU the dose required is 20 ppm to remove almost 100% of coliforms and at higher turbidities that is at 900 NTU and 2000 NTU the dose required is 45 ppm. It is observed that comparative performance of ECORITE PAC-2010 and alum show almost similar trend over different turbidity range. 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.

6.REFERENCES

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