



## COAGULATION PERFORMANCE EVALUATION OF NATURAL AND SYNTHETIC COAGULANTS IN WASTE WATER TREATMENT

M. Senthil Kumar<sup>1</sup>, G. V. T. Gopala Krishna<sup>2</sup> and V. Sivasankar<sup>3</sup>

<sup>1</sup>Department of Civil Engineering, Sethu Institute of Technology, Kariapatti, India

<sup>2</sup>Department of Civil Engineering, PSNA College of Engineering, Dindigul, India

<sup>3</sup>Department of Chemistry, Pachaiyappa's College, Chennai, India

Email: [Senthilenvtce@gmail.com](mailto:Senthilenvtce@gmail.com)

### ABSTRACT

The current method uses various chemicals which significantly synthesize byproducts which may pollute the environment and may deteriorate the ecosystem at a slow rate. Our study is using various natural and synthetic materials for the process of coagulation which will be eco-friendly and efficient. In this study attempts the investigation of the coagulation performance of some natural & synthetic materials to remove the suspended particles in waste water. The removal of suspended particles as a function of time, dose & initial turbidity are explored. The attempt on turbidity removal followed by the removal of Total Dissolved Solids (TDS) has been envisaged. The removal of TDS by continuous flow column techniques is planned using TiO<sub>2</sub> mixed sand. Effluents from Textile Industry & Sewage Water are planned to be treated by adopting the above removal techniques. The synthetic coagulant which we had a higher coagulation efficiency and can be used for treating higher turbidity effluents.

**Keywords:** synthesize, natural and synthetic material, turbidity.

### INTRODUCTION

Indiscriminate disposal of water with suspended solids have lead to higher amount of pollution to the natural water bodies. With the increase in polluted water by domestic and industrial usage of water in enormous amount, the current scenario of water coagulation does not cope up with it. When surface water is used for drinking water production, turbidity removal is an essential part in the treatment process. It is generally achieved by coagulation process with metal salts followed by aggregation of particles through flocculation and separation through sedimentation and filtration.

### Objectives of the study

The objectives of the study are

- To use various natural cum Eco-friendly materials for the treatment.
- To remove the suspended impurities from wastewater.
- To remove the Total Dissolved Solids (TDS) from waste water.
- To find the optimum coagulant dosage.
- To study the coagulation efficiency of natural & synthetic coagulants in pond water and dye effluent.
- To check the water quality standards as per WHO.

### METHODOLOGY

#### Coagulation study in natural coagulants natural coagulants used

The application of natural materials for clarifying turbid waters of rivers is an ancient and home-based practice in tropical developing countries where these natural materials act a primary coagulants.

The coagulants used under this study are

- Amla seeds (Ribes Uva-crispa), Tamarind shell (Tamarindus Indica), Thulasi (Ocimum Teluiflorem), Papaya seeds (Carica Papaya), Groundnut Shell, Jambul (Syzygium Cumini), Custard Apple (Annona Recticulat), Dates Seed, Tamrind Seed (Tamarindus Indica), Indian Gooseberry (Pshyllanthus Emblica)

#### Coagulation method

The stock solution prepared by using foundry sand is used for the study of coagulation performance of natural coagulants. About 500mg is to the stock solution. The stirring is done with the help of a Jar Test Apparatus. The initially the stirring speed of about 80rpm is set for about 5minutes. Further to get proper mixing the stirring is set at a slower speed of about 40rpm. The slower stirring is maintained for 25minutes. After this process the settling time of about 1hour is allowed. The settling is influenced only by gravity and is left un-disturbed during the settling time. After the settling time the turbidity is noted.



Figure-1. Jar test apparatus.

### Coagulation study of synthetic coagulants preparation of stock solution

The stock solution which is used for the study of synthetic coagulants is prepared by using Kaolin. Kaolinite is a clay mineral, part of the group of industrial minerals, with the chemical composition  $Al_2Si_2O_5(OH)_4$ , 10g of Kaolin was added in 1L of distilled water. This is mixed with the help of the Jar Test Apparatus. Initially the mixture is stirred at a higher speed of 80rpm for 5 min. Further to get a perfect mixture it is stirred at a slower speed of 40rpm for 25 min.

### Coagulation performance evaluation in domestic waste water

Domestic waste water accumulated in a pond was collected for the study. Samples were collected from the pond such that the sample exhibits the property the property of the whole pond without exhibiting property of a particular area of the pond. Samples were collected from seven different positions in the pond.

### Coagulation method

About 300ml of the domestic waste water collected from the pond is taken in the beaker. 5ml of the prepared supernatant iron oxide solution is mixed with it and stirred well. NaOH is added to the mixture in drops and is stirred well to evenly distribute the NaOH in the mixture. Precipitation will take place and the suspended particles will be settled.

### Coagulation performance evaluation in dye effluent sampling method

The Dye effluent is collected from the dye industry. The dye effluent was collected from the tank in which the effluent from the industry was stored. Sampling was done at five positions in the tank so as to get the whole property of the tank. By this sampling from different positions, the sample collected will exhibit the property of the whole tank.

## RESULTS AND DISCUSSIONS

The natural coagulants were added to the stock solution in four various quantities so as to estimate the optimum coagulant dosage required. As the coagulants

were added and thoroughly mixed the coagulation takes place. The natural coagulant added will clog the agglomerated materials and enhances the settling of the agglomerated particles.

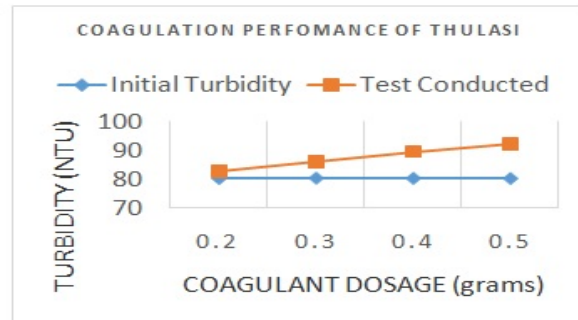


Figure-2. Treatment efficiency.

### Coagulation in synthetic coagulants coagulation observed

The coagulation observed was intensely rapid. The settling of the agglomerated particles took place very quick after the initial precipitation occurred. The precipitation occurred was due to the neutralization of synthetic coagulant by the NaOH. The settled floc is taken and studied under a Scanning Electron Microscope & X-ray Diffraction. The floc which was collected was collected from the bottom of the beaker after complete settlement had been witnessed. They were separated carefully as the clear solution above had to be used for various other test.

### SEM analysis

The above image is the SEM analysis of the settled floc of kaolin stock solution which clearly explains the morphology & percentage mass of the residual components in the floc. The graph shown is generated by the Scanning Electron Microscope which shows the percentage mass of the various components in the floc when it is incident by an electron beam.

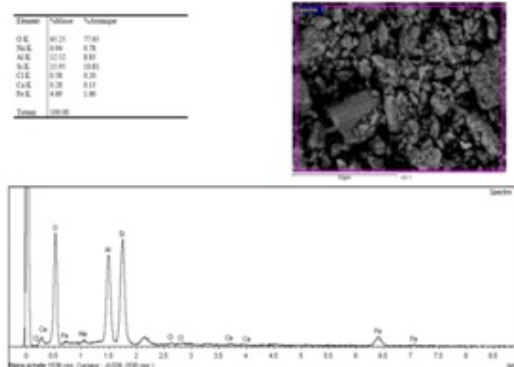


Figure-3. SEM analysis.

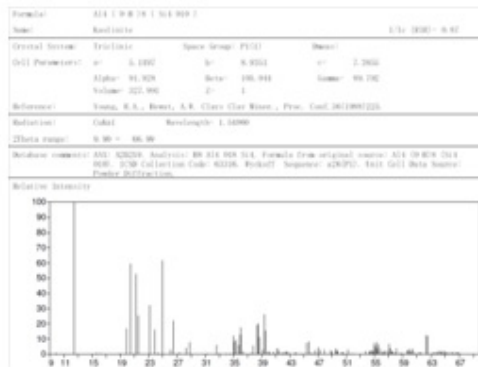


Figure-4. XRD analysis.

### Column treatment

As the Turbidity from the Dye effluent was not perfectly removed the treated water was studied in a column treatment. A column of 18mm dia and 20cm height was used for the study. Coal and TiO<sub>2</sub> were used in the column study. TiO<sub>2</sub> was chosen because of their property to act as a photo-catalyst and coal for its adsorption property.

### Analysis after column treatment

The floc had a prominent Oxygen content of 65.25% in mass. The other prominent components found in the floc were Al & Si which had a percentage mass of about 12.52 & 15.95. Oxygen which is one of the major components does not create any problem as it is to be important in component in water. Al & Si which were found also does not have to be bothered as Al & Si are components of Kaolin which was used to prepare the stock solution.



Figure-5. Column study.

### DISCUSSIONS

The prominent compositions of the floc according to the SEM analysis are Oxygen, Ferrous & Silicon. According to the XRD analysis Lead is also present in the form of Octalead iron diiron (III) flouride.

Lead limits plant chlorophyll synthesis. The human body contains approximately 120 mg of lead. About 10-20% of lead is absorbed by the intestines. The variation in the flow with respect to time of the bed shows the bed exhaustion from time to time. As the bed exhausts the quality of the treated water also withers. So the bed could be used when it discharges water with better efficiency or at least well than the initial water supplied to the bed. The bed we provided was efficient up to a period of 2 hours. The bed had to be totally replaced for better treatment. The figure shows the absorbance of the dye and the treated water. Dye was diluted under different dilutions and the absorbance was studied under a photo calorimeter. With this study done in the dye a standard graph could be plot and the treated water's efficiency can be easily studied. By this study the column treatment efficiency was studied to be 31.5%

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