

# Use of *Aloe Vera* as Coagulant aid in Turbidity Removal

Gulmire Amruta

*M.Tech. Student in Environmental Engineering, Department of Civil Engineering,  
Walchand College of Engineering,  
Sangli, Maharashtra, India*

G.R. Munavalli

*Associate Professor, Department of Civil Engineering,  
Walchand College of Engineering,  
Sangli, Maharashtra, India*

## Abstract

Water is an important resource for the survival of life. This study focused on developing an efficient and cost-effective processing technique by using *Aloe Vera* gel to produce natural coagulant for use in drinking water treatment. In this study *Aloe Vera* gel is used as coagulant aid with alum for turbidity removal. *Aloe Vera* plant contains around 75 nutrients and 200 active compounds including minerals, amino acids, enzymes and vitamins. Use of *Aloe Vera* gel as coagulant aid with alum can effectively reduce the amount of alum required. For high turbid water removal efficiency was found to be 76-81% and for low turbid water it was found 60-65%. Also it was found that *Aloe Vera* has less effect on other water quality parameters like pH, EC, hardness. Use of *Aloe Vera* gel with alum as a coagulant aid can be new alternative for drinking water treatment.

**Keywords:** *Aloe Vera*, coagulation, coagulant aid, turbidity, water

## Introduction

Water is a precious and essential natural resource, unevenly distributed on our planet. Freshwater represents only 2.5% of global supplies of water. About 70% of this freshwater quantity are either trapped under ice caps, or disseminated in the form of humidity or steam. Less than 1% of the world's freshwater, about 0.007% of planet's waters, are easily accessible to the various uses for development [1]. In the field of water, our country is faced with two main and major problems which are: quantity and quality of the drinking water and evacuation of sewage or waste water. Also, water treatment is very expensive for developing countries and requires the use of synthetic products which are not without impact on consumer health [4].

The use of natural resources in the process of water treatment, thus constitutes a potential promising way to reduce on one hand, the high costs and environmental impacts due to the use of synthetic products used previously, and secondly allow as many people as possible access to drinking water. This will constitute therefore a major economic issue for developing countries [2]. In conventional method of coagulation and

flocculation alum, ferric chloride, ferrous sulphate were used as coagulant for effective removal of turbidity. But in one of the research it is found that continuous use of alum has caused several problems affecting human health. It is found that aluminium is one of the causes for Alzheimer's syndrome [5]. So this study is mainly focused on decreasing alum dose with use of *Aloe Vera* gel.

*Aloe Vera* specifically refers to the *Aloe barbadensis* Miller plant. *Aloe Vera* is the oldest medicinal plant ever known and the most applied medicinal plant worldwide. This is a perennial tropical plant that can be cultivated in drought prone areas. In India, it is scattered in the wild, along the coast of southern India. It is a stemless or very short-stemmed succulent plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surfaces [3]. *Aloe Vera* plant requires very less water for its growth as it contains 98% of water in its leaves. It contains around 75 nutrients and 200 active compounds including minerals, amino acids, enzymes and vitamins [4].

In this study, in order to expand the range of natural flocculants used in water clarification properties of *Aloe Vera* gel were analyzed. This study also focuses on use of *Aloe Vera* gel as coagulant aid with alum for the treatment of low and high turbid water.

## Materials and Methods

### Preparation of *Aloe Vera* gel

*Aloe Vera* leaves were collected from campus of Walchand College of Engineering, Sangli. The leaves were washed under the tap water to remove the dirt. Thick green cover or epidermis was carefully separated from the gel part. Then the gel part was blended in mixer to form liquid and preserved in glass bottles in refrigerator. 1% dilution of *Aloe Vera* was made by using 1 ml *Aloe Vera* gel in 100 ml distilled water similarly different percentage of *Aloe Vera* solutions were made.

### Preparation of artificial turbid water

For the experimental study, artificial turbid water prepared in laboratory was used. High turbid (70-90NTU) and low turbid (20-30 NTU) water was created by adding Fullers earth to water. The synthetic water thus prepared was having turbidity in the range 20-90NTU.

**Reagents and materials**

The alum used for experiment was aluminum sulphate (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O). 5% strength alum in liquid form was used. It was prepared by dissolving 50 gm. of alum in 1000ml of distilled water. *Aloe Vera* was diluted to various percentage (1%, 4%, 5%, 7% up to 20%) and then suitable *Aloe Vera* dose was given. 1% *Aloe Vera* solution was prepared by diluting 1ml of *Aloe Vera* gel in 100ml of distilled water.

The coagulation and flocculation processes were performed using the jar test apparatus. Initially jar tests were carried out by using alum as a coagulant for high and low turbid water. Then by using *Aloe Vera* gel as coagulant aid with alum was used for the turbidity removal. Along with turbidity pH, electrical conductivity, hardness these water parameters were also analyzed.

**Jar Test Operations**

Jar test is the most widely used experimental methods for coagulation- flocculation. Before operating the jar test, the sample was mixed homogenously. Different Alum and aloe vera doses were given to the beakers. The beakers were agitated at various speed which consist of rapid mixing ( 200-300rpm) for 2min slow mixing (30-40) for 15 min and then settling time of 30 min. After settling, sample was withdrawn using pipette from the middle of supernatant and then residual turbidity was measured.

**Results and discussions**

**Effect of alum as coagulant in turbidity removal**

Experiments were carried out using alum as coagulant for high and low turbid water. Alum dose was varied in the range of 5- 70mg/l. In results it was found that for effective turbidity removal alum dose required was high. The maximum removal efficiency was found 91% for high turbid and 70% for low turbid water for alum dose of 30 mg/l and 50mg/l respectively. Fig 1 shows the effect of alum dose on high and low turbid water.

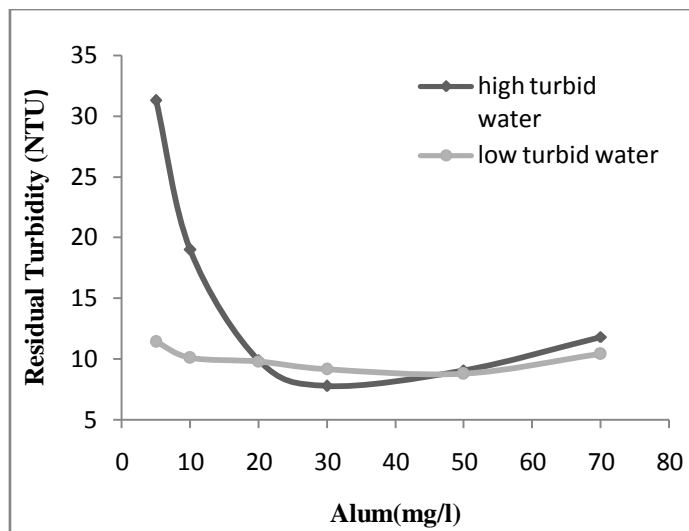


Figure 1: Effect of alum on turbidity

**Effect of different percentage of *Aloe Vera* gel on turbidity:**

Jar tests were carried out for different percentage of dilution of *Aloe Vera* gel such as 1%, 4%, 5%, 7%, 10%, 13%, 16%, 20% . For both high turbid water and low turbid water the alum dose was kept constant of 10mg/l, 40ml/l of *Aloe Vera* dose was given from each of diluted solution made. For both the high and low turbid water 7% dilution of *Aloe Vera* gel was found to be effective. For high turbid water removal efficiency found was between 75-80% and for low turbid water removal efficiency found was between 58-62%. Following graph shows the variation of different percentage of *Aloe Vera* gel on high and low turbid water.

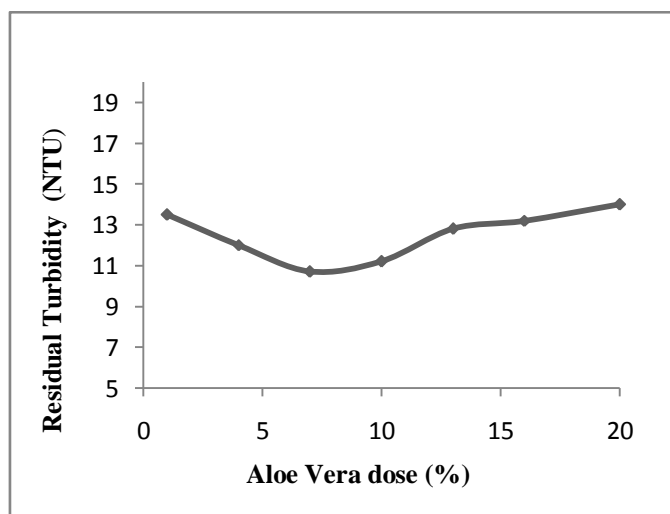


Figure 2: Turbidity removal for high turbid water (25NTU) with 10mg/l constant alum dose.

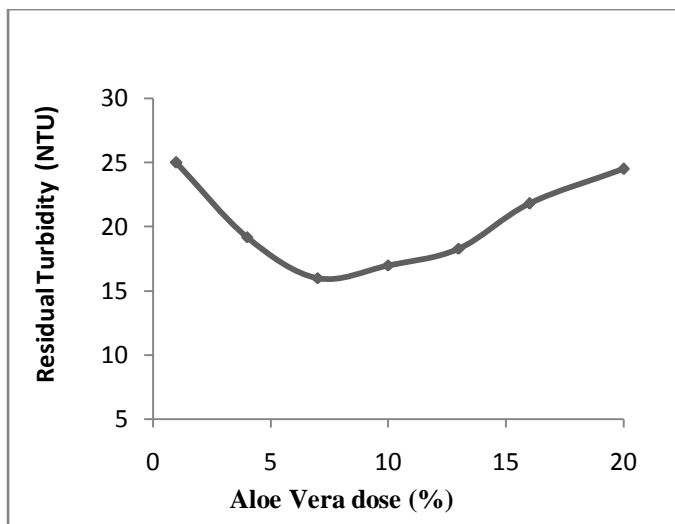


Figure3:Turbidity removal for high turbid water (70NTU) with 10mg/l constant alum dose.

**Effect of *Aloe Veragel* as coagulant aid with alum for turbidity removal**

From the above results it was shown that 7% dilution of *Aloe Veragel* was found to be effective. Jar tests were performed for the 10 mg/l of constant alum dose and various doses of *Aloe Veragel* for high turbid and low turbid water. In results it was found that for 10mg/l of alum dose and 40ml/l of *Aloe Veradose* maximum turbidity removal efficiency was achieved. For high turbid water it varied between range of 76-81% and low turbid water it varies between 60-65%. In fig 4 and fig 5 the effect of *Aloe Veragel* on high and low turbid water was given below.

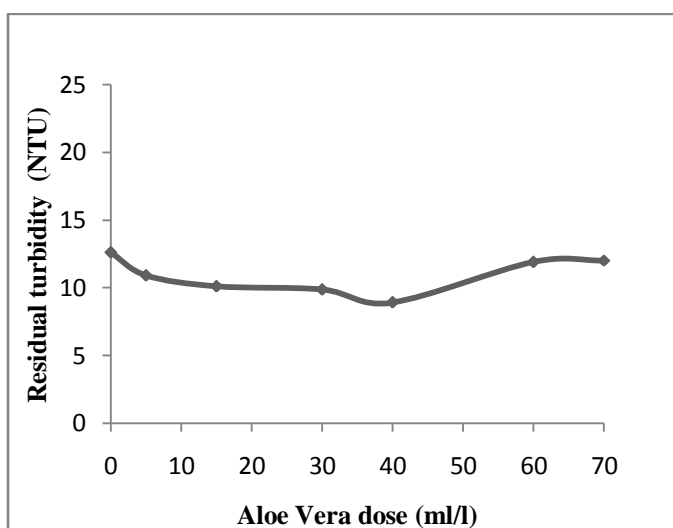


Figure4:Effect of *Aloe Veradose* on low turbid water (25NTU) with 10mg/l constant alum dose

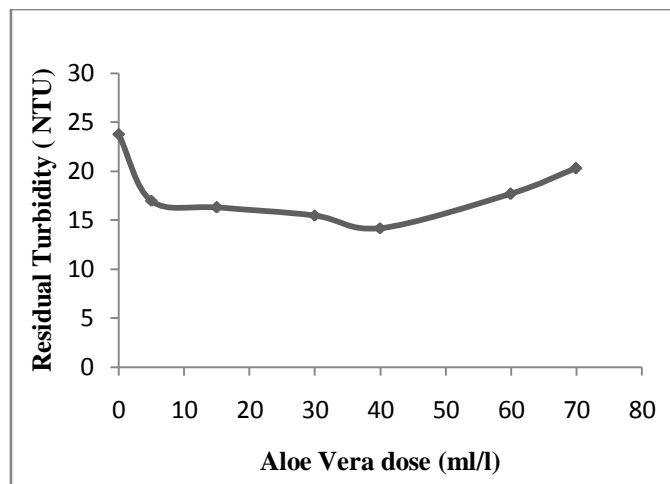


Figure5:Effect of *Aloe Veradose* on high turbid water(70NTU) with 10mg/l constant alum dose

**Post Treatment water quality parameters**

Water quality parameters such as pH, electrical conductivity, and hardness found less change on addition of *Aloe Veragel* to water. Effect of these parameters were given in table below

Sr no	Parameter	concentration
1	pH	6.5-8
2	Electrical conductivity	2.1-2.3 (ms/cm)
3	Hardness	400-500(mg/l)

**Conclusions**

The results showed that the amount of alum required was high for effective removal of turbidity.*Aloe Veracan* be used as natural flocculent for water treatment. Use of *Aloe Veragel* as coagulant aid with alum can effectively reduce the amount of alum required. Owing to various problems associated to alum, use of *Aloe Vera* gel with alum as a coagulant aid can be new alternative for drinking water treatment. For high turbid water removal efficiency was found to be 76-81% and for low turbid water it was found 60-65%. For 7% dilution of *Aloe Veragel* optimum 40ml/l of *Aloe Veradose* was found more effective. Also it was found that *Aloe Verahave* less effect on other water quality parameters like pH, EC, hardness. As a conclusion, *Aloe Veragel* is proven to be effective coagulant aid which can be used in rural areas where *Aloe Veraplant* availability is more.

**References**

[1] A. Alassane ,and P. Sessoue. “Evaluation of *Aloe Veraleaf* gel as a Natural Flocculant: Phytochemical Screening and Turbidity removal Trials of water by

Coagulation flocculation.” Research Journal of Recent Sciences, 5(1), 9-15, 2016.

- [2] E.N.Ali, S.A.Muyibi, H.M. Salleh, M. Z. Alam and M.R.M. Salleh. “ Production of Natural Coagulant from Moringa Oleifera Seed for Application in Treatment of Low Turbidity Water.” Journal Water Resource and Protection, 2, 259-266, 2010.
  
- [3] S.Rai, R.Sharma, S. S.Arora, M. Sharma and A.K. Chopra. “Concentration of the heavy metals in *Aloe Vera*L. (*Aloe barbadensis* Miller) Leaves collected from different geographical locations of India.” Annals of Biological Research, 2 (6), 575-579,2011
  
- [4] M.I.Kopytko, E.P. Villamizar, and Y.R.Picon. “Application of Natural Product (*Aloe Vera*) in Coagulation-Flocculation Procedures, for Water Treatability Study.” International Journal of Engineering Science and Innovative Technology (IJESIT), 3(3), 2014.
  
- [5] V. Rondeau, D.Commenges, H.Gadda, J. Dartigues. “ Relation between Aluminium Concentrations in drinking water and Alzheimer’s Disease, An 8 year follow-up Study.” , Oxfordn Journals, 152, 59-66, 1999.