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Use of Aloe-Vera Gel as a Coagulant in the treatment of Drinking Water

¹Prof. Supekar G. S., ²Sahil Gholap, ³Sahil Jori, ⁴Ruchit Shah, ⁵Wakachaure Shivani
^{1 2 3 4 5}Civil Department, Jaihind College of Engineering, Kuran Junnar
Email: Supekar01@gmail.com, sahil177sg@gmail.com

Peer Review Information	Abstract
<p><i>Submission: 1 Sept 2025</i></p> <p><i>Revision: 28 Sept 2025</i></p> <p><i>Acceptance: 12 Oct 2025</i></p> <p>Keywords</p> <p><i>Polyaluminium Chloride, Aloe Vera Gel, Alum, Turbidity, PH.</i></p>	<p>Water is connected to each and every living forms of life on earth. An adequate, clean, reliable, accessible and safe drinking water supply has to be made available for various users. There are inequalities in access to safe drinking water in all over the world. Impure water is the root cause for many diseases especially in developing countries. Millions of people fall sick each year because of drinking contaminated water. In many regions of the world mostly in villages where Aloe-vera is easily available, can be used to filter turbid water. Polyaluminium Chloride is used worldwide in the developing countries to treat the water in the process of coagulation and flocculation. Continuous use of Polyaluminium Chloride in the treatment of water can cause many diseases. Therefore, it has become a need to treat the water by using some natural coagulants. The main aim of the project was to reduce the turbidity by replacing polyaluminium Chloride with aloevera. The objective behind selecting aloevera was that alovera is a plant mostly found in villages.</p>

INTRODUCTION

Aloe-vera can be used as a natural coagulant to treat drinking water. It can also be used to purify water by reducing the concentration of certain metals and phosphates. Aloe vera is a herb with succulent leaves that are arranged in a rosette. The leaves are grey to green and sometimes have white spots on their surfaces. They have sharp, pinkish spines along their edges and are the source of the colourless gel found in many commercial and medicinal products. Aloe-vera can be used to treat drinking water as a natural coagulant and to remove pollutants: Coagulant: Aloe-vera can be used as a natural coagulant to improve the quality of drinking water. In one study, aloe-vera powder (AV-Powder) and aloe-vera liquid (AV-H2O) reduced turbidity by 28.23% and 87.84%, respectively. Pollutant removal: Aloe -vera can be used to remove pollutants such as dyes, metals, and turbidity. Aloe-vera is

biodegradable, safe, and abundant in many regions. It can be used in various processes, including adsorption, coagulation-flocculation, and degradation. Wastewater treatment: Aloe-vera materials can be used to treat wastewater sludge. They can promote sludge settling and good solid-liquid separation. Polyaluminium chloride (PAC) is a chemical used in water treatment to clarify water and remove contaminants. PAC is a coagulant that clumps together suspended matter and contaminants to form floc, which can then be removed by filters. PAC is considered one of the most efficient water treatment chemicals available. It can be used in a wide range of pH and temperatures. PAC is used in both potable water and wastewater treatment, as well as in swimming pools. PAC is also used in the papermaking industry to increase drainage rates, reduce cationic demand, and increase sizing efficiency. Safety: Prolonged inhalation of high

concentrations of PAC can damage the respiratory system. Ingestion can cause gastrointestinal symptoms, and prolonged skin contact can cause dryness. **Dosing:** The dose rate of PAC needs to be accurately controlled to ensure effective treatment. High doses of PAC can cause treated water to have high turbidity and color levels. **Polyaluminium Chloride (PAC)** is widely used in both potable water and wastewater treatment because it provides high coagulation efficiency and it has the widest pH and temperature application ranges compared to other water treatment chemicals.



Fig. 1: Aloe-Vera Plant

LITERATURE REVIEW

1. Utkarsh V Surwase ^{etal} (2020)

Impure water is the root cause for many diseases especially in developing countries. In many regions of the world mostly in villages where aloe vera is easily available, can be used to filter turbid water. Aloe vera is a plant which belongs to Asphodelaceae liliaceae family. There are two types of coagulants inorganic coagulants and organic coagulants. Alum is used worldwide in the developing countries to treat the water in the process of coagulation and flocculation. Continuous use of Alum in the treatment of water can cause neurological diseases like Alzheimer's disease. Therefore it has become a need to treat the water by using some natural coagulants. Natural coagulants are the coagulants which extracted from natural plants or animals. In this paper natural coagulant Aloe Vera gel has been used as a coagulant to treat the water. Waste water sample was used. Hardness and turbidity and the effect of variation of dosage and pH were studied on turbidity. The optimal dosage of each coagulant was determined in the beginning and this dosage was further used to find optimal pHs. Turbidity, pH, hardness and TDS of all samples are noted down and recorded. So this study is mainly focused on decreasing alum dose with use of Aloe Vera gel.

2. Obulam. Bhaskar Prasad Redd (2022)

The coagulation–flocculation–sedimentation process is widely used for the removal of

suspended solids and water turbidity reduction. The most common coagulants used to conduct this process are aluminum sulfate and ferric sulfate. In this paper, the use of Aloe vera as a natural-based coagulant for drinking water treatment was tested. The bio-coagulant was used in two different forms: powder as well as a liquid; the latter was extracted with distilled water used as a solvent. The obtained results showed that the use of the natural coagulant (Aloe vera) in both powder (AV-Powder) and liquid (AV- H₂O) forms reduced the water turbidity at natural pH by 28.23% and 87.84%, respectively. Moreover, it was found that the use of the two previous forms of bio-coagulant for drinking water treatment had no significant influence on the following three parameters: pH, alkalinity, and hardness. The study of the effect of pH on the process performance using Aloe vera as a bio-coagulant demonstrated that the maximum turbidity removal efficiency accounted for 53.53% and 88.23% using AV-Powder and AV-H₂O, respectively, at optimal pH 6. Based on the characteristics of Aloe vera, the change in the quality of water and improvement while experimenting we will observe it. The tests on water analysis are done on improving the quality of water.

Methodology

1. pH

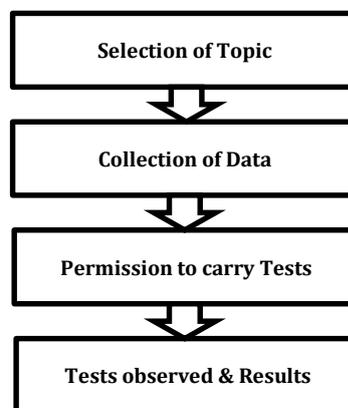


Fig. 2: Flow Chart

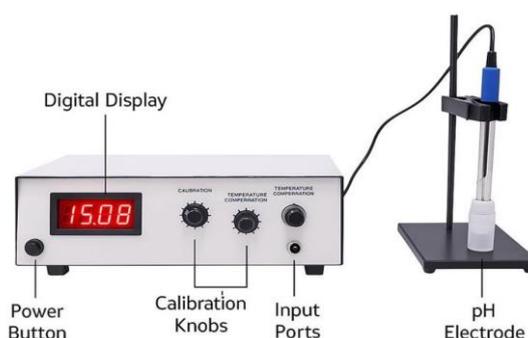


Fig. 3: Setup of pH meter

Procedure

Determination of pH of the Water Sample

1. After the calibration of pH meter bring the instrument to standby mode.
 2. Remove the electrode(s) from the second buffer solution, rinse thoroughly with distilled water, blot dry and immerse in water sample in a beaker.
 3. After establishing equilibrium between electrode(s) and sample (to ensure this stir gently and wait for at least 1 minute) measure the pH of sample when reading is constant.
 4. If the sample temperature is different from the temperature of 16 Experiments standard buffer than temperature of pH meter must be adjusted using temperature compensation before recording the pH of the sample.
 5. Note and record pH and temperature. Rinse electrode(s) and immerse in standard buffer until the next measurement. Repeat the pH measurement to get atleast two concordant readings. On completing experiment return back the electrode(s) to storage solution after rinsing with distilled water.
- c) Range- pH is a measure of how acidic/basic water is. The range goes from 0 - 14, with 7 being neutral. pHs of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base.

2. Turbidity Meter

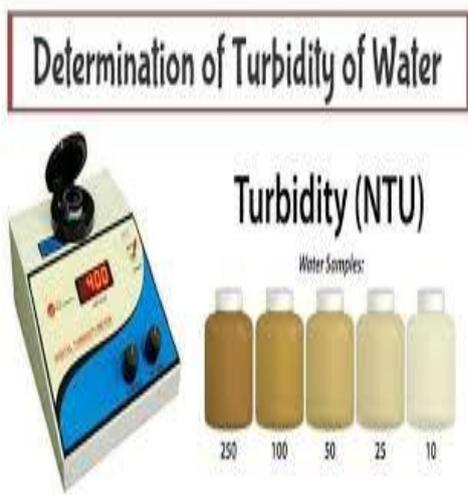


Fig 4: Turbidity Meter

Procedure :

Turbidity is the measure of the relative clarity of a liquid. It is an essential parameter for various applications, including water treatment, wastewater treatment, and industrial applications that involve the use of liquids. A turbidity meter, also known as a turbidimeter or nephelometer, is a device that measures the turbidity of liquids. This article aims to provide a comprehensive understanding of how a turbidity meter works.

Understanding Turbidity

Before delving into the specifics of the working principle of a turbidity meter, it is essential to understand turbidity itself. Turbidity is a measure of the amount of light that is scattered or absorbed by suspended particles in a liquid. It is generally measured in nephelometric turbidity units (NTU).

Turbidity can have a significant impact on various processes. For example, in the water treatment industry, high turbidity levels can decrease the efficiency of disinfection processes or increase the risk of bacterial growth. Turbidity can also have a detrimental effect on aquatic life and visibility in natural water bodies.

3. TDS Machine



Fig 5: TDS Meter

Procedure:

1. Firstly the TDS sensor should be coded and connected to the Arduino.
2. The LCD display should also be connected to the Arduino followed by the temperature sensor.
3. In this technique an I2C module for the LCD which comes with a potentiometer has been used.
4. After completion of circuits it is kept in a container to fix the components. This will help the project by protecting electronic components that may come in contact with water. We have used a cardboard box for the purpose.

4. Electrical Conductivity

Conductivity meters are an excellent tool for measuring the ability of a solution to conduct electricity. These devices are widely used in a variety of industries, including pharmaceuticals, water treatment, and agriculture. Measuring conductivity can help determine the purity or concentration of a solution, and it can also help identify impurities or contaminants. In this guide, we will provide a step-by-step approach to using a conductivity meter.

1. The Basics of Conductivity Measurement

Before we dive into the specifics of using a conductivity meter, it is essential to understand some basic concepts. Conductivity is the

measure of the ability of a substance to conduct electricity. This measurement is expressed in Siemens per meter (S/m) or milliSiemens per centimeter (mS/cm). The higher the conductivity of a solution, the easier it is for it to conduct electricity.

2. Calibrating the Conductivity Meter

Calibrating a conductivity meter is essential to ensure accurate readings. The calibration process involves testing the conductivity of standard solutions to verify the accuracy of the meter. Most meters have a calibration procedure that involves immersing the meter into a standard solution of known conductivity. The meter will then read the conductivity of the solution, and the value will be compared to the known conductivity value of the standard solution. If the meter reading is off, adjustments can be made to the meter to ensure accurate readings.

3. Preparing the Sample

Before taking measurements, it is essential to prepare the sample correctly. The sample must be thoroughly mixed to ensure that it is homogeneous. If there are any impurities or contaminants in the sample, the conductivity reading may be inaccurate. It is also essential to ensure that the sample is at the correct temperature. The temperature of the sample can affect its conductivity, so it is crucial to measure the temperature of the sample and adjust the meter accordingly.

4. Taking the Measurement

After calibrating the meter and preparing the sample, it is time to take the measurement. Ensure that the immersion probe is clean and free from any debris, and that the meter is fully submerged in the sample. Allow the meter to stabilize for a few seconds before taking the reading. Record the reading, and repeat the process at least two more times to ensure the consistency of the results.

CONCLUSION

Experiments were carried out using Polyaluminium Chloride as coagulant for treatment of drinking water. PAC dose was varied in the range of 6-11 mg/l. In results it was found that for effective turbidity removal Aloe-Vera dose required was high as compared to Polyaluminium Chloride dose. The turbidity removal efficiency 75% after using Polyaluminium chloride and Aloe-Vera together as a coagulant was satisfied. The results showed that the amount of Polyaluminium Chloride required was high for effective removal of turbidity. Aloe Vera is not as efficient as Polyaluminium Chloride but it can be used as natural flocculent for water treatment mostly in rural areas.

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