

ERADICATION OF TURBIDITY USING NATURAL COAGULANT

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Civil Engineering
By

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**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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DEPARTMENT OF CIVIL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **MOGILI AKHIL (37200042)** and **D.SAI PRANAY (Reg.No.37200017)** who carried out the project entitled "**ERADICATION OF TURBIDITY USING NATURAL COAGULANT**" under our supervision from October 2020 to April 2021.

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Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

We **MOGILI AKHIL (Reg.No.37200042)** and **D.SAI PRANAY (Reg.No.37200017)** hereby declare that the Project Report entitled **“ERADICATION OF TURBIDITY USING NATURAL COAGULANT”** done by us under the guidance of **Mrs.S.VANITHA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

1.

2.

SIGNATURE OF THE CANDIDATES

DATE:

PLACE:

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ABSTRACT

Turbidity is a characteristic impurity of groundwater. Turbid water is not suitable for drinking purposes. The main objective of this study is to reduce water turbidity using natural coagulant, extracted from pine cones, *Moringa oleifera* seeds, *Tamarindus indica* Seeds. Coagulant activity is affected by various factors such as coagulant dose, water turbidity, pH, extract density and settling time. The cost of water treatment is increasing and the quality of river water is not stable due to suspended and colloidal particle load caused by land development and high storm runoff during the rainy seasons.

During the rainy seasons the turbidity level increases and the need for water treatment chemicals increase as well, which leads to high cost of treatment which the water treatment companies cannot sustain. As a result, the drinking water that reaches the consumer is not properly treated. Therefore, it is of great importance to find a natural alternative for water coagulant to treat the turbidity

This study is focusing on pine cones, *Moringa oleifera* seeds, *Tamarindus indica* Seeds to find the active constituents which are responsible about the coagulation mechanism and improving the coagulation property. This will help in producing this alternative locally as pine cones, *Moringaoleifera* seeds, *Tamarindus indica* Seeds this study help us to find best natural coagulants for turbid water.

KEYWORDS: Environmental science, *Moringa oleifera*, water treatment, natural coagulant, river water, alternatives, Turbidity, bioactive constituents.

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LIST OF SYMBOLS & ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ML	MILI LITRE
C	DEGREE CENTIGRADE
GM	GRAMS
PH	NIL
NTU	NEPHELOMETRIC TURBIDITY UNITS

CHAPTER 1

INTRODUCTION

1.1 GENERAL

Ground water is often contaminated by suspended solid particles. Purification of such turbid water generally requires the use of coagulants. A number of inorganic and synthetic polymeric coagulants are available for water treatment. Inorganic coagulants such as alums are widely used for removing turbidity from water. Synthetic polymers have also found application in water treatment. However, these coagulants generate non-biodegradable sludge, which cannot be recycled easily.

Moreover, traces of polymeric coagulants left in water, may engender serious health hazards. Therefore, the inorganic and synthetic coagulants cannot provide an environment friendly and sustainable solution for turbid water treatment. Water supply is a basic need required for living creatures and human being specifically. In this world the amount of resources available to living creatures are limited. About 75% of the present world population lives in the developing countries of the world.

About 1.2 billion people still lack safe drinking water and more than 6 million children die from diarrhoea in developing countries every year. Over the past few years natural coagulants have gained interest among researchers for treatment of turbid water. These coagulants can be extracted either from different plant or animal sources. However, natural coagulants obtained from plant sources such as *Moringa Oleifera*, Maize, and *Cactus Latifaria*, pine cones etc., are more widely studied by researchers.

Feculent water can be treated effectively by utilizing these natural coagulants, with ease of regeneration and lower stress on environment. Water turbidity is a major issue associated with ground water and it is not suitable for drinking purposes.

Further, drinking of turbid water is causing several health issues among people. Safe drinking water is essential to the health and welfare of a community, and water from all sources must have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer.

The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity. Current operational procedures at many treatment works in developing countries are based on arbitrary guidelines, particularly in relation to the dosage of chemicals. Besides that, there is also the problem of inadequate number of skilled workers and inadequate laboratory facilities to monitor process performances required to operate the plants.

Many coagulants are widely used in conventional water treatment processes for potable water production. These coagulants can be classified into inorganic coagulant, synthetic organic polymer, and naturally occurring coagulant. Naturally occurring coagulants are usually presumed safe for human health while there is a fear by using aluminum salts that may induce Alzheimer's disease.

Some studies on natural coagulants have been carried out and various natural coagulants were produced or extracted from microorganisms, animals or plants. In previous studies, researchers have employed coagulant extracts immediately after preparing, without alteration [11]. However, in this work we not only have prepared the coagulant extract but also concentrated it. The aim of this step was to investigate the effect of coagulant density over water treatment efficiency. Since, only an optimized protein concentration in coagulant extract, can remove turbidity from water effectively. Therefore, it is critically important that coagulant extract is concentrated to an optimum density. Apart from coagulant density, a number of other parameters like coagulation dose, initial water turbidity, and Ph affect the coagulation process and activity of coagulant.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY

Chee Ming Choo and Kiat Wei Tok (2018) has said that oleochemical processing industry uses crude palm oil as the main source of process feedstocks. Physical–chemical treatment methods such as coagulation and flocculation processes are widely used to pre-treat oleochemical effluent followed by biological treatment to meet Standard A/B as required by the Department of Environment (DOE). Established chemicals that are used include aluminium sulphate and iron chloride as coagulants while the aluminium chloride, iron salts, and polyelectrolytes are used as flocculants. The industry is in constant effort to look into alternative chemicals that are friendly to both human and environment. Natural coagulants such as wheat germ and chitosan are proposed to treat the effluent. The investigations related to the removal rate of turbidity and chemical oxygen demand (COD) between natural and chemical coagulants were carried out. The effluent samples were analysed with the aluminium content. The results showed that the optimum dosage of wheat germ, chitosan, aluminium sulphate and iron chloride were: 2000, 20, 167 and 169 mg/L respectively. The turbidity reduction efficiency percentage using the wheat germ, chitosan, aluminium sulphate and iron chloride were reported at 80.2 ± 30.2 , 78.8 ± 32.9 , 96.2 ± 2.0 and $90.3 \pm 3.9\%$ respectively. The COD reduction efficiency by using wheat germ, chitosan, aluminium sulphate, and iron chloride were reported at 11.4 ± 5.8 , 15.7 ± 6.6 , 15.7 ± 3.1 and $15.9 \pm 3.3\%$ respectively. The findings showed that the effluent samples from natural coagulation process contains of lower aluminium concentration (0.1 ± 0.1 and 0.2 ± 0.1 mg/L) as compared to effluent samples from chemical coagulation process with the aluminium concentration of 2.4 ± 0.4 and 5.5 ± 0.3 mg/L. Thus, the use of wheat germ and chitosan are less hazardous to human health and environment.

Dhivya . S and Ramesh . S. T. et al (2017) has said that Present study investigates the coagulation ability of *Plantago ovata* (*P. ovata*) seed extracts for turbidity removal. The active coagulant agents were successfully extracted from *P. ovata* seeds using different solvents such as distilled water (PO-DW), tap water (PO-TW), NaCl (PO-NaCl), and ammonium acetate (PO-AA). Experiments were conducted in batch mode for initial turbidity such as 500 NTU (high), 150 NTU (medium), and 50 NTU (low). Results demonstrated that *P. ovata* extracts are less efficient in low turbidities, while PO-NaCl was found to provide high coagulation activity in all initial turbidity concentrations compared to other extracts. PO-NaCl was able to remove 98.2, 94.9, and 80.2% of turbidity from water having in initial turbidities of 500, 150, and 50 NTU, respectively. Coagulation activity of the extract was the best when the extraction was performed for 50 min at room temperature. Jar test procedure with the coagulation time of 1 min and flocculation time of 30 min was optimized, irrespective of the initial turbidity. The optimum settling time for 500, 150, and 50 NTU water samples were 20, 30, and 90 min, respectively. PO-NaCl was used in different pH turbid solutions and it was found to be working very efficiently in alkaline conditions. The coagulation efficiency of the coagulant stored in refrigerator was higher than that stored at room temperature. Thus, the natural coagulants extracted from *P. ovata* seeds revealed to be effective for turbidity removal.

Gaikwad .V.T & Munavalli .G.R (2019) has said that Kernel of *Moringa oleifera* and *Strychnos potatorum* (Nirmali) seeds has the potential for turbidity removal. However, potential of seed kernel naturally dried in trees and that of sun-dried and oven-dried seeds and other parts, such as coat and wing of *Moringa oleifera*, has not been explored. In the present study, various forms of kernel and parts of *Moringa oleifera* seed were used to assess the removal of turbidity aided with/without coagulant aid and ballasting agent. Low (< 12 NTU), medium ($> 13 \leq 24$ NTU) and high turbidity ($\geq 25 \leq 35$ NTU) water samples were used in the present study. Micro-sand and powdered activated carbon (PAC) were used as ballasting agents along with Aloe Vera as a coagulant aid/natural polymer. The kernel from seeds naturally dried in *Moringa oleifera* tree was found to possess more coagulant property. The optimum dose of

Moringa oleifera for medium and high turbidity was found to be 50 mg/L and 100 mg/L, respectively, with turbidity removal of 90.46% and 88.57%. The optimum dose of Strychnos potatorum was 0.2 mg/L, 0.6 mg/L, and 0.8 mg/L for low, medium and high turbidity, with turbidity removal as 71.42, 64.28 and 57.14%, respectively. Aloe Vera acts as a coagulant aid with the natural coagulants and increases turbidity removal. Ballasting agents micro-sand and PAC, with Aloe Vera and coagulants, increase turbidity removal and reduce the settling time.

Hans Kristianto and Henni Rahman et al (2019) has said that, Coagulation is a well-known technology applied in water and wastewater treatment. Inorganic salts, such as alum, ferrous sulfate, and polyaluminum chloride, are usually used. It is widely known that utilization of these inorganic coagulants poses several disadvantages, such as high coagulant cost and high sludge volume that increase water treatment expenses. The use of alum also poses health risk to human as it may cause degenerative diseases. In order to minimize these disadvantages, the use of various coagulants from natural resources has been recently proposed. In this research, study was performed on the extraction and use of a potential natural coagulant (*Leucaena leucocephala*) seed kernel as natural coagulant. *Leucaena* seed kernel was extracted at various NaCl concentrations (0–5 mol L⁻¹). Extract with highest protein content obtained at NaCl concentration of 3 mol L⁻¹ was further used to treat a synthetic wastewater model substance (Congo red solution) at various pH (2–10) and dosage (2–40 mL L⁻¹). This natural coagulant successfully removed 99.9% of the color at pH 3 and dosage 10 mL L⁻¹, with only half sludge volume discharged when compared to alum. The result suggests that *leucaena* is a promising natural coagulant for water and wastewater treatment.

Kumara . I and Quaff .A.R. (2018) has said that a novel cellulose and chitosan based natural biopolymer or coagulant aids with a commercial coagulant (ferric chloride FeCl₃) have been used for the removal of arsenite As from synthetic tap water at 2 mg/L of initial arsenic concentration by coagulation–flocculation method. The maximum As removal efficiency of 69.25% was obtained without coagulant aids at 40 mg/L

concentration of FeCl₃. The addition of cellulose and chitosan with FeCl₃ enhanced the removal efficiency of As. The percentage of As removal reached 84.62 and 74.87% at the concentration of 1 and 1.5 mg/L for cellulose and chitosan, respectively, with 25 mg/L of fixed FeCl₃ concentration. Comparable As removal efficiencies were obtained using cellulose, chitosan, and FeCl₃. Moreover, As removal efficiency of cellulose was significantly found greater ($p < 0.01$) than chitosan and comparable to that of FeCl₃ ($p < 0.01$). In addition, the maximum percentage of As removal was found at the pH range of 6–8.

Lassoued Ben Miled . G and Djjobbi . B et al (2018) has said that A systematic study of the influence of operating conditions on clarification process efficiency using Tunisian cactus cladodes powder (*Opuntia ficus indica*) was performed. A model of turbid water, using fibrous clay such as palygorskite, ranging from 50 to 500 NTU was investigated. The turbidity removal ability was assessed by the use of standard jar test measurements. A screening experimental design 37//16 was implemented to screen 7 experimental input factors at 3 levels each in 16 experimental runs. Initial turbidity, pH, particle size and mass of sorbent-coagulant added, as well as the type of cactus treatment, the stirring speed and the settling time on turbidity removal were tested. With Starks screening matrix, this work demonstrated that turbidity removal is affected by 5 input factors: initial turbidity, settling time, powder size, slow stirring and pH. Cladode powder acts positively on the turbidity removal.

Tahereh Zarei Mahmoudabadi et al (2017) has said that, In terms of health, dyes have carcinogenic, mutagenic and toxic properties and can have adverse effects on health and the environment. Therefore, sewage containing to dyes must be purified before being discharged into the environment. The current study aimed to investigate the effectiveness of *Alcea rosea* root extract in Disperse red 60 and Reactive blue 19 dyes removal from synthetic sewage. In this study, the effect of different indices including pH (5–11), *Alcea rosea* concentration (50–300 mg/L) and initial dye concentration (10–80 mg/L) was investigated. During the tests, the coagulant was stirred with rapid mixing at a speed of 250 rpm for 2 min. In the following, the speed (30–60 rpm) and the time (10–

25 min) were used for slow mixing and after mixing the effect of settling time (10–60 min) and temperature (20–70) on removal efficiency of Disperse and Reactive dyes was investigated. The results showed that the maximum of removal efficiency of Disperse and Reactive dyes in optimum conditions including (pH = 11, coagulant concentration = 200 and 250 mg/L, dye concentration 40 and 20 mg/L, speed 60 rpm, during 15 min with settling time 60 min and temperature 60 °C obtained 86% and 68%, respectively. According to the result, the Alcea rosea coagulant has the best ability in removing dyes from aqueous solutions and sewage, especially Disperse dyes. Disperse dye is much eliminated in the coagulation process due to its lower solubility, higher suspending materials and less required solved chemical oxygen demand to the total chemical oxygen demand (SCOD/TCOD).

Tan Chu Shan and Manaf Al Matar et al (2016) has said that *Moringa oleifera* (MO) is a multipurpose tree with considerable potential and its cultivation is currently being actively promoted in many developing countries. Seeds of this tropical tree contain water-soluble, positively charged proteins that act as an effective coagulant for water and wastewater treatment. Based on this, water quality of “Sungai baluk” river was examined before and after the treatment using MO seed. MO seed exhibited high efficiency in the reduction and prevention of the bacterial growth in both wastewater and “Sungai baluk” river samples. The turbidity was removed up to 85–94% and dissolved oxygen (DO) was improved from 2.58 ± 0.01 to 4.00 ± 0.00 mg/L. The chemical oxygen demand (COD) and biological oxygen demand (BOD) were increased after the treatment from 99.5 ± 0.71 to 164.0 ± 2.83 mg/L for COD and from 48.00 ± 0.42 to 76.65 ± 2.33 mg/L for BOD, respectively. Nevertheless, there was no significant alteration of pH, conductivity, salinity and total dissolved solid after the treatment. Heavy metals such as Fe were fully eliminated, whereas Cu and Cd were successfully removed by up to 98%. The reduction of Pb was also achieved by up to 78.1%. Overall, 1% of MO seed cake was enough to remove heavy metals from the water samples. This preliminary laboratory result confirms the great potential of MO seed in wastewater treatment applications.

Trina Dutta and Sangita Bhattacharjee (2015) has said that, as Arsenic contamination in drinking water has become a matter of severe concern, researchers across the globe have been trying to develop an efficient yet economic method for removal of arsenic from water. Authors of this paper investigated combined treatment methodology namely, coagulation followed by microfiltration (MF) to remove arsenic below permissible level of 10 ppb. Simulated solutions of arsenate and arsenite salts (100 ppb) were prepared. A 95.83 % reduction of arsenic for arsenate solution and 91.99 % reduction of arsenic in case of arsenite solution were achieved in suitable pH range (8–10) when the solution was subjected to coagulation using ferric chloride coagulant, followed by MF using 0.45 μm polyethersulphone membrane. In search of more cost effective and eco-friendly yet viable route, authors explored the effectiveness of crushed Shelled Moringa oleifera Seed (SMOS) as a natural coagulant. A 91.01 % decontamination of arsenic for arsenate solution and 70.61 % for arsenite solution were achieved in suitable pH range 7–9. This alternative method of coagulation, bio-adsorption (amino acid-arsenic interaction) followed by MF achieved in appreciable arsenic removal efficiency compared to inorganic Ferric Chloride, a synthetic coagulant. The sludge generated in case of ferric chloride was found to be toxic and highly corrosive compared to that obtained with Moringa oleifera seeds.

Zarei Mahmoudabadi . T et al (2016) has said that, Reactive dyes have carcinogenic potential due to the presence of benzene rings. Therefore, in order to avoid health and environmental hazards, dyes of the wastewater must be removed before discharging to the environment. This study aimed to evaluate the effectiveness of Plantago major seed extract as a natural coagulant in removal of Reactive Blue 19 dye from industrial wastewater. In this experimental study, the effects of different factors, including Ph (5–11), coagulant dose (0.02–2 g/L), dye concentration (10–100 mg/L), settling time (15–90 min), and temperature (26–76 °C), were tested. The results showed that pH, coagulation dose, initial concentration of dye, settling time, and optimal degrees of temperature were, respectively, 9, 1.2 g/L, 40 mg/L, 60 min, and 56 °C for removal of Reactive Blue 19 dye using the extract of Plantago major seed. In these conditions, the highest removal efficiency was 35%, 54.5%, 60.66%, 64%, and 69% respectively. In the

conditions that all parameters were in optimal mode, the removal rate was about 70%. Based on the results of this study, although the removal rate of Reactive Blue 19 dye by *Plantago major* seed extract, even in optimal conditions, was lower than advanced oxidation methods. This material can be used as a natural coagulant to remove this dye from aqueous solutions and industrial wastewater. In addition, in order to increase the efficiency of this substance, further studies to upgrade and optimize these parameters is essential.

CHAPTER 3

AIM & SCOPE

3.1 AIM

To collect the samples of ground water from the selected parts of Krishna river area of Bhavanipuram, Vijayawada, Andhra Pradesh. And test the samples with natural coagulants and then know their quality of water and turbidity, pH, and drinking purpose.

3.2 OBJECTIVE

- To analyze the physical and chemical parameters of groundwater samples in the selected part of Krishna river area of Bhavanipuram, Vijayawada, Andhra Pradesh.
- To determine and reduce the water turbidity and pH by using natural coagulants.

3.3 SCOPE

- To reduce the turbidity of ground water naturally.
- To reduce the pH value of the water sample.
- To conclude the best natural coagulant.

CHAPTER 4

MATERIAL AND METHODOLOGY

4.1 STUDY AREA

Krishna district forms part of Andhra Pradesh. Vijayawada, also known as Bezawada is a city in the Indian state of Andhra Pradesh. Located 275 km east of Hyderabad and 454 km north of Chennai. It lies on the banks of River Krishna surrounded by the hills of Eastern Ghats known as Indrakeeladri Hills in Krishna District. It geographically lies on the center spot of Andhra Pradesh. The city has been described as the commercial and educational capital of Andhra Pradesh, second largest city in Andhra Pradesh and is one of the rapidly growing urban areas in India.

Krishna River, formerly Kistna, river of south-central India. One of India's longest rivers, it has a total course of about 800 miles. The river rises in western Maharashtra state in the Western Ghats range near the town of Mahabaleshwar, not far from the coast of the Arabian Sea. It flows east to Wai and then in a generally southeasterly direction past Sangli to the border of Karnataka state. There the river turns east and flows in an irregular course across north-central Karnataka and then to the southeast and into southwestern Telangana state. It then veers southeast and then northeast, forming a portion of the border with Andhra Pradesh state. Turning east it flows into Andhra Pradesh to its delta head at Vijayawada, and from there flows southeast and then south until it enters the Bay of Bengal.

The Krishna River is the fourth-biggest river in terms of water inflows and river basin area in India, after the Ganga, Godavari and Brahmaputra. The river is almost 1,288 kilometres (800 mi) long. The river is also called Krishnaveni. It is one of the major sources of irrigation for Maharashtra, Karnataka, Telangana and Andhra Pradesh. The Krishna river originates in the Western Ghats near Mahabaleshwar at an elevation of about 1,300 metres (4,300 ft), in the state of Maharashtra in central India. It

is one of the longest rivers in India. The Krishna River is around 1,400 kilometres (870 mi) in length (282 kilometres (175 mi) in Maharashtra). It is one of the most suitable arable basins in the world as 75.6 % area of the Krishna basin is under cultivation because of availability of water.

The river's source is at Mahabaleshwar near Jor village in the extreme north of Wai Taluka, Satara District, Maharashtra in the west and empties into the Bay of Bengal at Hamasaladeevi (near Koduru) in Andhra Pradesh, on the east coast. The latitude of Vijayawada, Andhra Pradesh, India is 16.515099, and the longitude is 80.632095. It flows through the state of Karnataka before entering Telangana State. The delta of this river is one of the most fertile regions in India and was the home to ancient Satavahana and Ikshvaku Sun Dynasty kings. Vijayawada is the largest city on the Krishna.

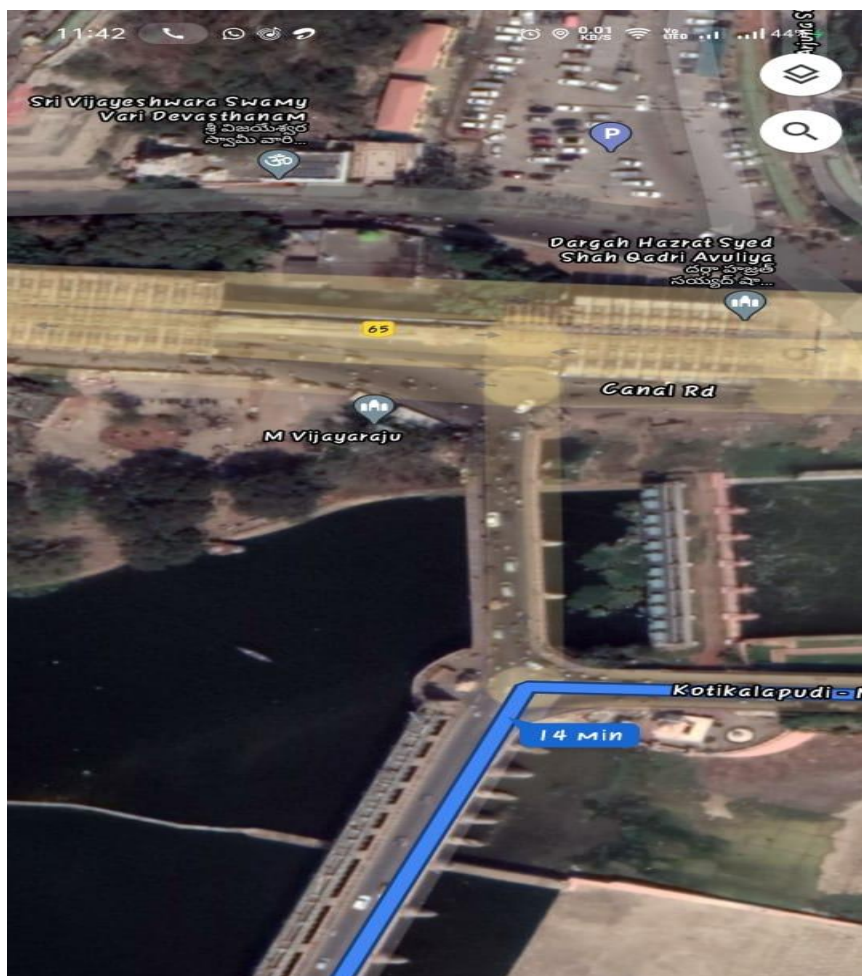


Fig 4.1 SATELLITE VIEW

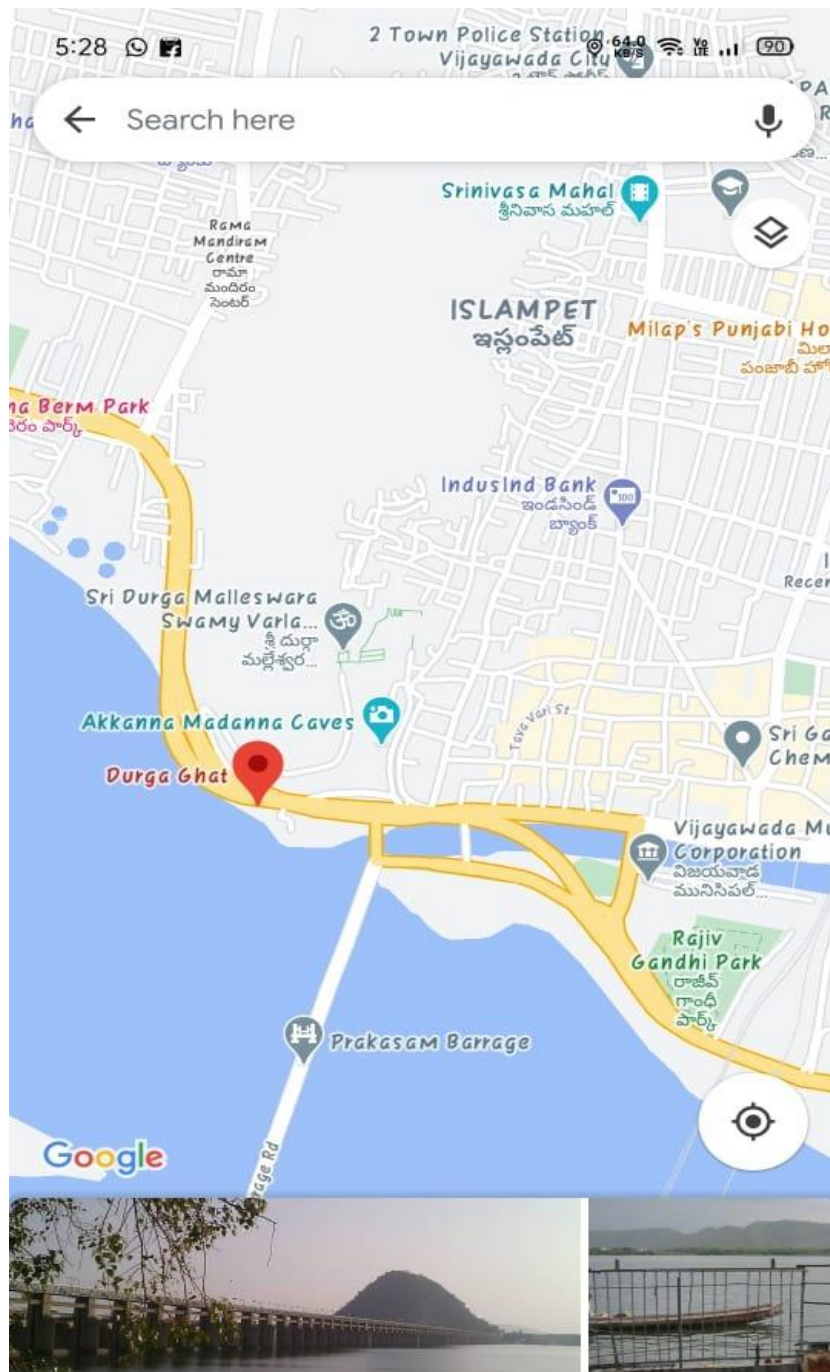


FIG 4.2 STUDY AREA

4.2 MATERIALS

4.2.1 PINE CONE:

The main function of a pine cone is to keep a pine tree's seeds safe. Pine cones close their scales to protect the seeds from cold temperatures, wind and even animals that might try to eat them. Pine cones are pretty amazing parts of the natural world when you think about it. Some types of pine trees will only open their cones under the extreme temperatures produced by forest fires. Pine cones are pretty amazing parts of the natural world when you think about it. Some types of pine trees will only open their cones under the extreme temperatures produced by forest fires. The bottoms of pine cones spiral outward in what's called the Fibonacci sequence, a commonly found pattern in nature. And some cones remain on the tree for up to ten years.



Fig 4.3 PINE CONES

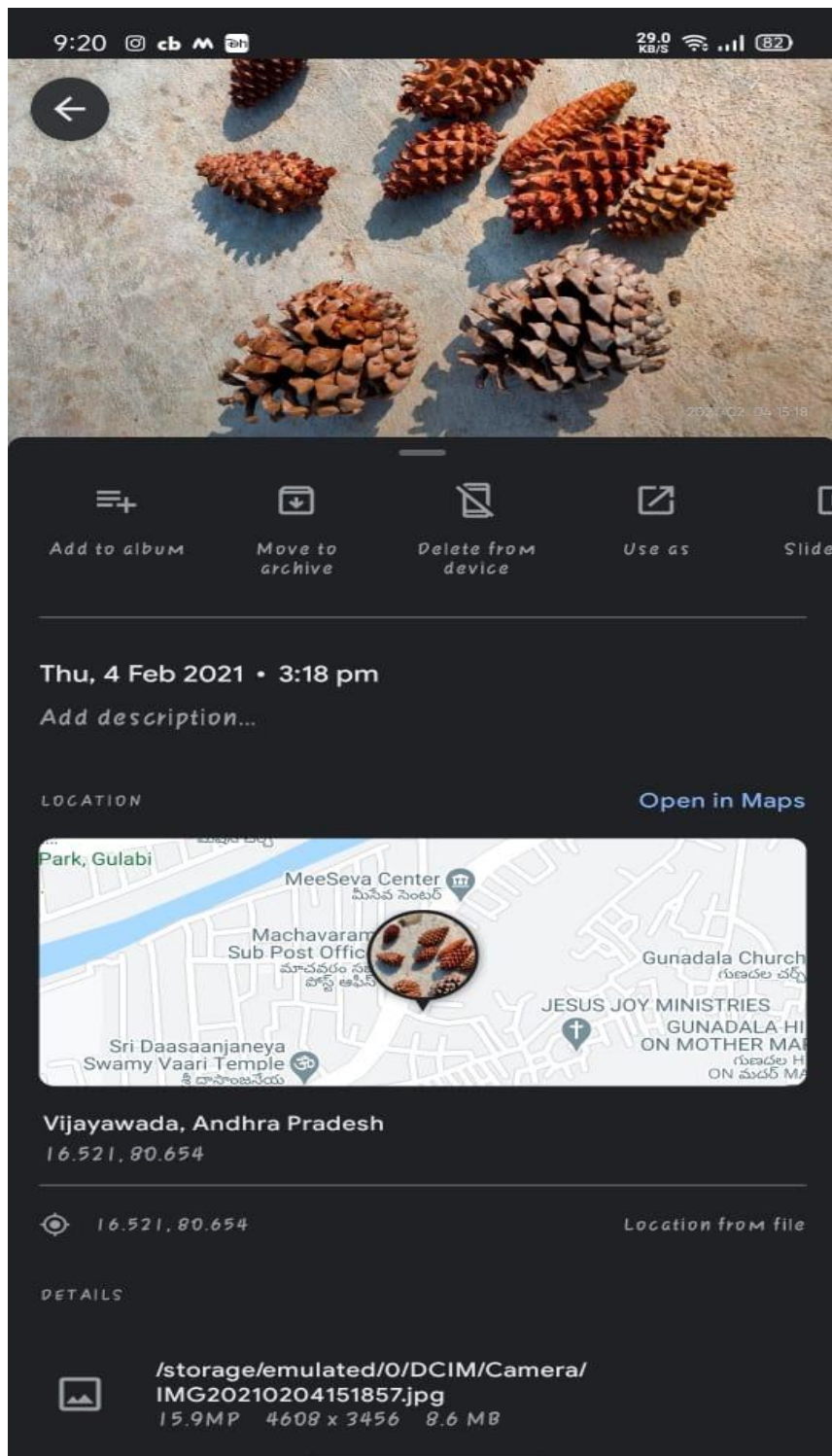


FIG 4.4:- GEO TAG FOR PINE CONES

4.2.2 *Tamarindus indica* Seed:

T. indica is used traditionally in many countries as around the world. The whole plant parts have rich nutritional value and wide usage in medicine. In traditional medicine it is used in wound healing, abdominal pain, diarrhea, dysentery, parasitic infestation, fever, malaria and respiratory problems.

Tamarind (*Tamarindus indica* L) is one of the common fruit trees found grown all over India mostly under rainfed conditions, particularly in Tamil Nadu, Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and Orissa. It is also one of the most popular avenue trees which yield useful fruits and timber besides providing shade.

Tamarind pulp has an excellent keeping quality when dried properly in and cured with salt. Pulp is rich in glucose (47.7% of total sugar); D-manose (24.5%) and D-maltose (20.4%). The sour taste of the pulp is attributed to Tartaric acid (8-18%) together with malic and citric acids (2%). The fruit is good source of phosphorus, calcium and iron. Tender leaves and flowers are also edible. Climatic: Tamarind tree has an acid climatic adaptability and can be grown in humid to dry hot regions. It is very sensitive to frost. The optimum rainfall requirement is 750-1900mm, but can thrive in region with low annual rainfall of 500-750mm.



Fig 4.5 TAMARIND SEEDS

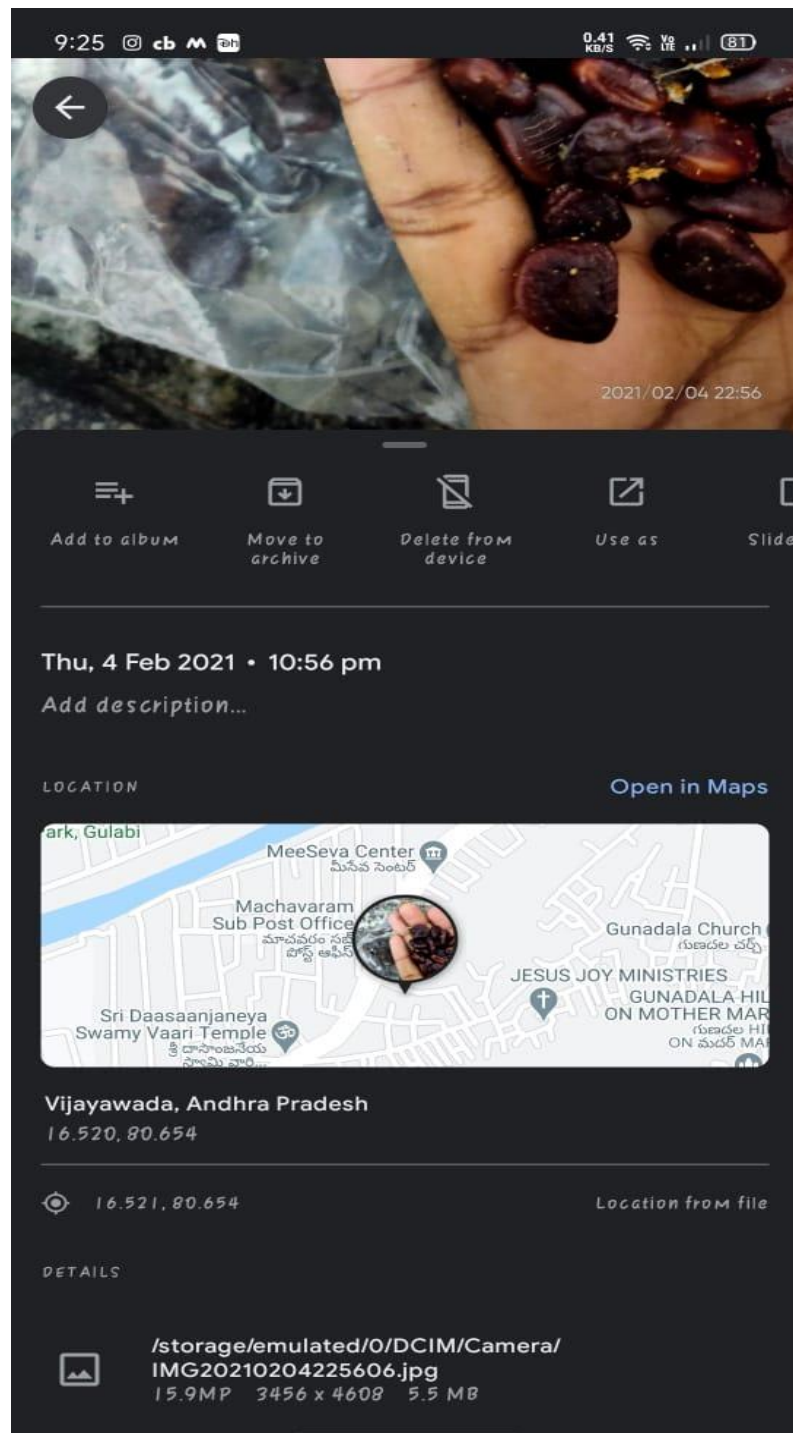


FIG 4.6 GEO TAG TAMARIND SEEDS

4.2.3 MORINGA OLEIFERA SEEDS:

Dry *Moringa oleifera* seeds used in this study. *Moringa oleifera* seeds are a promising resource for food and non-food applications, due to their content of monounsaturated fatty acids with a high monounsaturated/saturated fatty acids (MUFA/SFA) ratio, sterols and tocopherols, as well as proteins rich in sulphated amino acids.

Moringa oleifera Lam. belonging to the family Moringaceae is a handsome softwood tree, native of India, occurring wild in the sub Himalayan regions of Northern India and now grown worldwide in the tropics and sub-tropics. In India it is grown all over the subcontinent for its tender pods and also for its leaves and flowers. The pod of moringa is a very popular vegetable in South Indian cuisine and valued for their distinctly inviting flavour. The cultivation of moringa in India occurs mainly in the southern states of Tamil Nadu, Karnataka, Kerala, Andhra Pradesh as well as in central India also.

This fast-growing tree is grown for human food, livestock forage, medicine, dye, composting, and water purification. Moringa is one of the world's most nutritious crops. The leaves of Moringa have more beta-carotene than carrots, more protein than peas, more vitamin C than oranges, more calcium than milk, more potassium than bananas, and more iron than spinach.

Moringa represents an available source of essential nutrients and proteins during the all year. It's a strong immune booster. It is a mean to cure and prevent malnutrition in infants, pregnant and lactating women. Moringa produces more leaves during the rainy season which correspond to the hunger period. Moringa is easy to grow process and add into the meal (tea, relish, soup).



Fig 4.7 MORINGA SEEDS

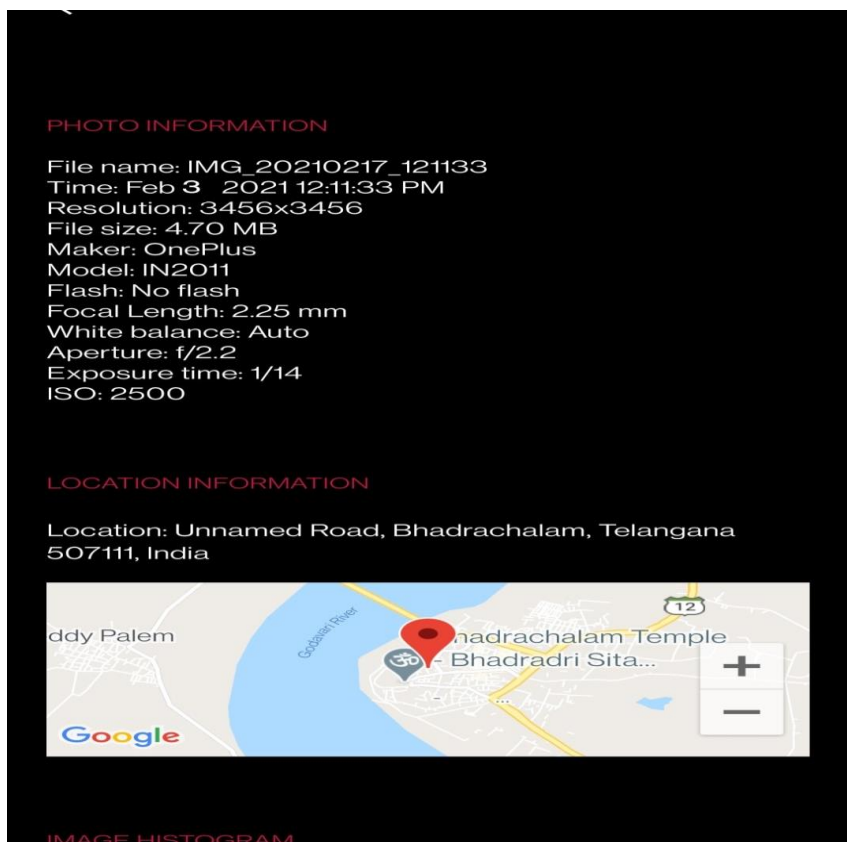


FIG 4.8 GEO LOCATION MORINGA SEEDS

4.2.4 BUBBLE AIRATOR AND CONTAINER:

Installed at the bottom of the lagoon, fine bubble aerators release tiny bubbles that slowly rise to the surface of the water. These thousands of tiny bubbles collectively have a very large surface area. As a result, they can efficiently and effectively transfer oxygen to the entirety of the water column.



Fig 4.9 BUBBLE AIRATOR



FIG 4.10 GEO LOCATION BUBBLE AIRATOR

4.3 METHODOLOGY

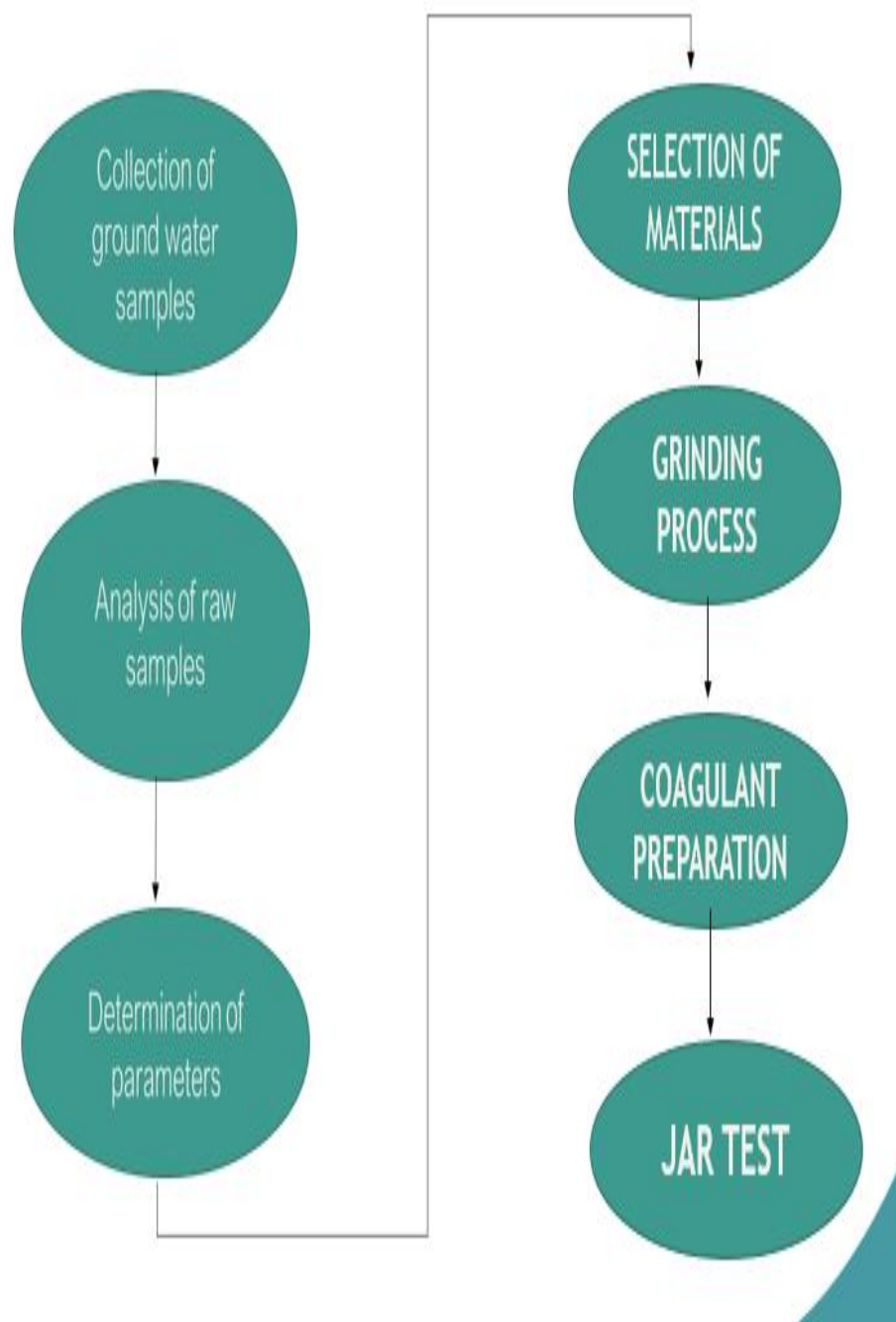


Fig 4.11 METHODOLOGY

4.3.1 COLLECTION OF GROUND WATER:

The ground water sample is collected from Krishna River from Vijayawada. There is a marked deterioration in the quality of water in the Krishna River as it approaches the Krishna Delta. Water is drawn from the river to fulfil the drinking water needs of most of the population in Vijayawada and Guntur cities, Eluru, Gudivada, and Machilipatnam besides thousands of villages in Prakasam, Guntur, Krishna and West Godavari districts.

The water from the river is diverted to these places through several canals that draw water from a reservoir at Prakasam Barrage. But the water in the reservoir is also polluted by several municipal sewerages that discharge directly into it. Latitude and longitude coordinates are: 15.754239, 80.897270. The Krishna River is a principal water source and one of the longest rivers in India. It's length exceeds 1,400 km. The river enters the Bengali Bay. It has a large religious importance and is highly respected in modern Indian society.



Fig 4.12 WATER SAMPLE

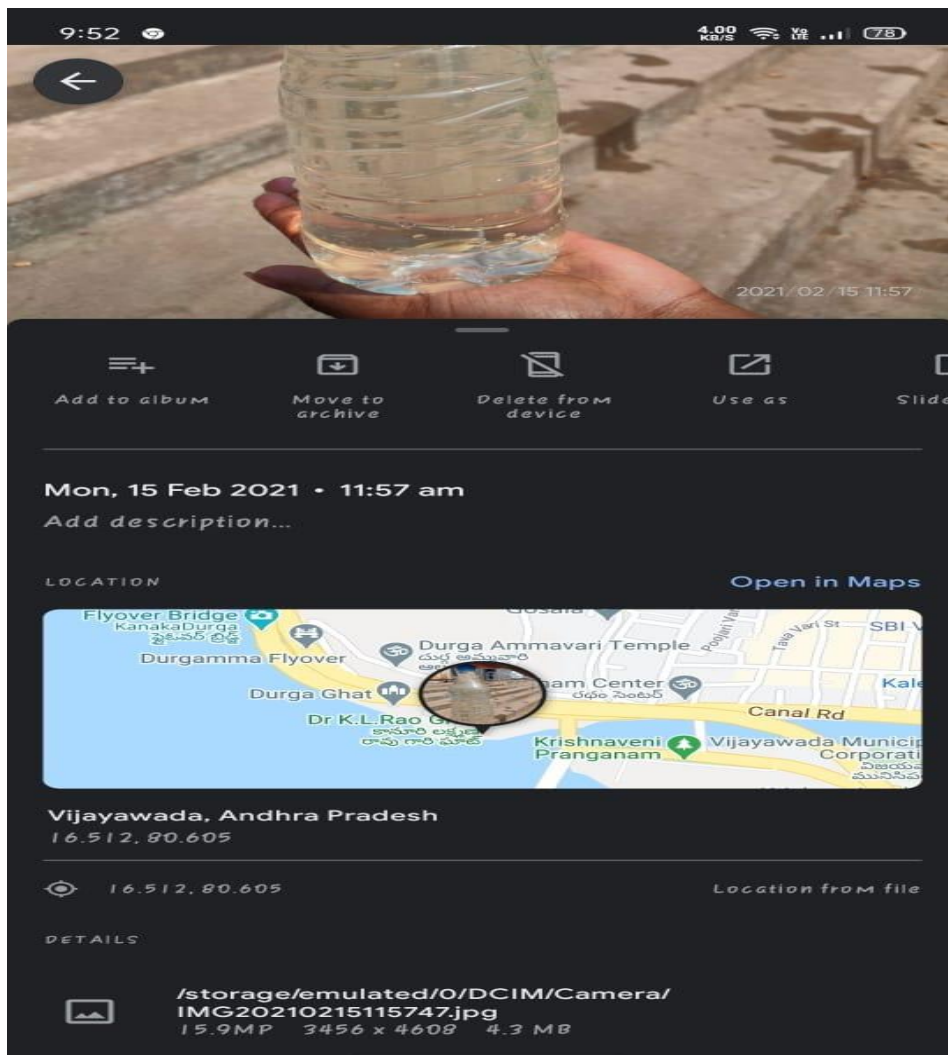


FIG 4.13 GEO LOCATION WATER SAMPLE

4.3.2 PINE CONE

4.3.2.1 PROPERTIES OF PINE CONE:

- The fascicle sheath is comprised of bud scales which can be either deciduous or persistent. The seed cone usually matures in 2 (rarely 3) years.
- It is comprised of woody cone scales with subtending bracts spirally arranged around a central axis.
- The exposed part of a closed cone is called the apophysis.

- Pine wood is medium-weight and relatively soft. Its strength and elasticity are good. As with other coniferous woods, the properties of the wood depend upon the density of the annual growth rings.
- The higher the proportion of summerwood, the heavier and harder the wood.

Coagulant preparation:

Pine cones were sunlight dried after washing with adequate tap water thrice to remove any impurities that may reduce coagulating properties of the material as. The cones were then put in oven for drying at 80 °C for 24 h. The dried cones were manually chopped off for grinding process. The chopped cone pieces were again washed with tap water and allowed to dry in oven at 200 °C for 2 h.

This biomass was first subjected to coarse grinding using hammer mill followed by ball mill for fine grinding. The ground material was then sieved to obtain particle sizes of 150 μ m (U.S. A.S.T.M), as depicted in Fig. 4. The powder was washed with distilled water till the removal of color and acidity to yield biomass with pH 7.0.

The experimental set-up used for the turbid water treatment is shown in Fig. 5. 50gm/l of pine cone powder was mixed with water and stirred at 400 rpm using magnetic stirrer for 60 min at room temperature. The suspension was allowed to settle for 30 min. The supernatant solution which contained the active coagulant was decanted off. The mother liquor was centrifuged for 2 h using Kubota 6500 centrifuge with operating conditions of 9000 rpm, and 8 °C. The supernatant solution was filtered through vacuum filter and the filtrate was initially stored at 4 °C in a refrigerator. Higher density coagulant extract was obtained by heating it at 60 °C, to evaporate the water content in it. Pine cone extract density was measured after every 30 min.



FIG NO 4.14 RINSED PINE CONE

Pine cones were sunlight dried after washing with adequate tap water thrice to remove any impurities that may reduce coagulating properties of the material as. The cones were then put in oven for drying at 80 °C for 24 h. The dried cones were manually chopped off for grinding process. The chopped cone pieces were again washed with tap water and allowed to dry in oven at 200 °C for 2 h. This biomass was first subjected to coarse grinding using hammer mill followed by ball mill for fine grinding. The ground material was then sieved to obtain particle sizes of 150 μ m (U.S. A.S.T.M), as depicted in Fig. 4. The powder was washed with distilled water till the removal of color and acidity to yield biomass with pH 7.0.

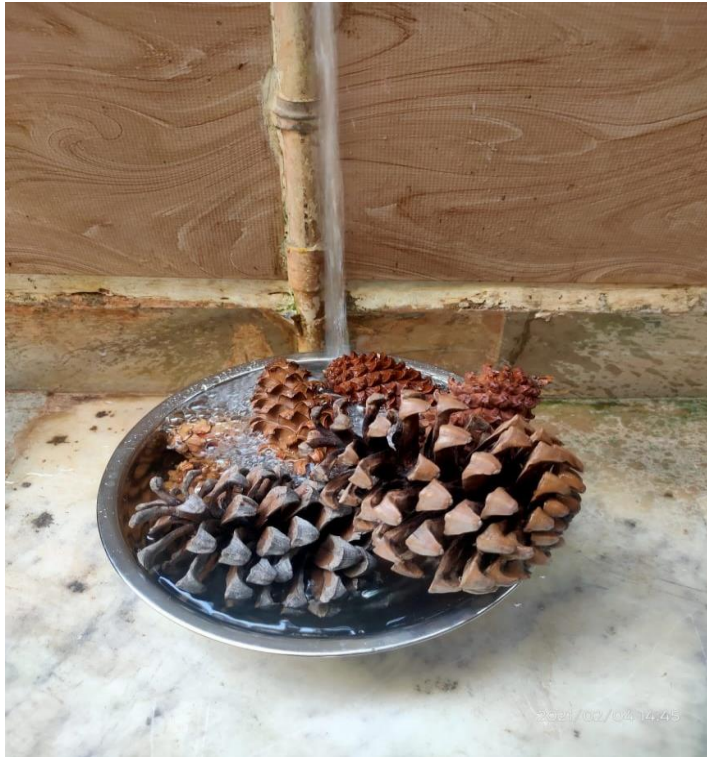


FIG NO 4.15 RINSED PINE CONE

4.3.2.2 FOCULATION PROCESS WITH PINE CONE:

The experimental pine cone powder is measured and collected. A bubble airator is placed and it is connected to a container, the strings of the bubble airator are placed in such a way that it settles into the bottom of the container the end of the strings of the bubble airator contains a tiny stone which helps in the process of floculation. The strings are placed into the container and the ground water sample which we collected from the Krishna river is poured into the container. The water sample which we have taken is 750ml, and for this 750ml of water sample 50gms of pine cone powder is added.



FIG NO 4.16 PINE CONE POWDER

SETTLING TIME OF SMAPLE:

Once the natural cogulant is added the bubble airator is started. The bubble airator produces bubbles from beneath the surface with help us to do the foculation process and helps us to reduce the turbidity and reduce the ph gradually. The bubble airator works as a rpm machine and its process is carried out for 3-4 hr inka 2 intervels of time , for every 3 hr another 50gms of pine cone powder is add and the finally resultant water is tested in the lab.

4.2.3 MORINGA OLEIFERA:

4.2.3.1 PROPERTIES OF MORINGA OLEIFERA:

Moringa oleifera seeds are a promising resource for food and non-food applications, due to their content of monounsaturated fatty acids with a high monounsaturated/saturated fatty acids (MUFA/SFA) ratio, sterols and tocopherols, as well as proteins rich in sulfated amino acids. The leaves have 7 times more vitamin C than oranges and 15 times more potassium than bananas. It also has calcium, protein, iron, and amino acids, which help your body heal and build muscle. It's also packed with

antioxidants, substances that can protect cells from damage and may boost your immune system.

Coagulant preparation:

Moringa oleifera are sunlight dried. The moringa oleifera is gently open and the seeds are separated and the seeds are collected in a bowl, after collecting the seeds this seeds are dried in sun light for 24hrs. This process is done to remove the impurities in the seeds. After the seeds are go through grinding process the seeds are grinded by put them in a small jar and with the help of a mixing jar the seeds are grinded. After that process the powered seeds are passed through a very small sieve in which the partial impurities are removed, and the final result powder is collected.

Traditionally, in Sudan, Moringa oleifera seed extracts are prepared by manually removing the dry seeds from their shells, grinding in mortar and pestle then soaking in water, and finally sieving the solution using a sieve of a particular mesh size or through a Mushin cloth the resulting extract is then used in treating water. This is considered as a low technology of Moringa oleifera seed processing because it is suitable for households and the sludge produced can be used as a bio-compost. Over the time, the removal of the seed oil either by organic solvent extraction (by using normal hexane), cold pressing, or steam extraction gained popularity after which the defatted (removal of oil) seed cake extract is used in purifying water.

This type of seed processing is considered as medium technology because it is suitable for medium to large communities and there are other by-product such as the oil which can be processed as edible oil, the seed shells can be processed to become activated carbon, and the sludge produced can be used as bio-fertilizer. Ali et al., (2010), introduced an innovative method of processing the seed by further treating the defatted seed cake extract with microfiltration to enhance more isolation of bioactive

compounds from the extract before using it to treat water. This is regarded as high technology because extracts obtained from the defatted seeds can further be purified by using ion exchange, membrane system, etc. The solid by-products from these processes can be used as animal feeds, the resulting permeate from membrane system can be freeze dried leading to longer shelf life for the seed. To date, most research focus on the use of the crude extract for treatment of water, while very few research have been done.



FIG NO 4.17 MORINGA PREPRATION

4.2.3.2 FOCULATION PROCESS MORINGA OLEIFERA:

The experimental Moringa oleifera powder is measured and collected. A bubble airator is placed and it is connected to a container , the strings of the bubble airator are placed in such a way that its settles into the bottom of the container the end of the strings of the bubble airator contains a tiny stone which helps in the process of foculation. The strings are placed into the container and the ground water sample which we collected from the krishna river is poured into the container. The water sample which we have taken is 750ml, and for this 750ml of water sample 50gms of pine cone powder is added.



FIG NO 4.18 MORINGA POWDER

SETTLING TIME OF SMAPLE:

Once the natural cogulant is added the bubble airator is started. The bubble airator produces bubbles from beneath the surface with help us to do the foculation process and helps us to reduce the turbidity and reduce the ph gradually. The bubble airator works as a rpm machine and its process is carried out for 3-4 hr in a 2 intervels of time , for every 3 hr another 50gms of Moringa oleifera powder is add and the finally resulant water smaple is placed aside for further foculation process.

4.3.4 TAMARINDUS INDICA:

4.3.4.1 PROPERTIES OF TAMARINDUS INDICA:

The study of the chemical composition as well as of the physical and engineering properties of the tamarind seed and the kernel is essential for the development of useful extracted raw materials and blended foods, in the design and operation of the processing equipment, the removal of the seed coat, grinding into powder, and for storage. Data concerning these aspects arescarce.

4.3.4.2 COGULANT PREPARATION:

Place the pieces in a small nonreactive bowl and add 1 cup boiling water. Let soak for 20 minutes, periodically mashing the tamarind with your fingers, freeing as much of the pulp as possible from the fiber (and, now and then, seeds). Pour the mashed mixture and its liquid into a strainer placed over an empty bowl. Tamarind seeds roast for 4mins (use cast iron tawa) low flame. Keep it aside for 4mins take clean towel use hammer to break . Grind well sieve the tamarind seeds powder, transfer back the remaining amount into mixer and grind again. Tamarind is the fruit of Tamarindus indica popularly used in Indian cuisine.



Fig no 4.19 TAMRID INDICA CRUSED SEEDS

4.3.4.3 FOCULATION PROCESS WITH TAMARINDUS INDICA:

The experimental Tamarindus indica powder is measured and collected. A bubble airator is placed and it is connected to a container, the strings of the bubble airator are placed in such a way that it settles into the bottom of the container the end of the strings of the bubble airator contains a tiny stone which helps in the process of foculation. The strings are placed into the container and the ground water sample which we collected from the Krishna river is poured into the container. The water sample which we have taken is 750ml, and for this 750ml of water sample 50gms of pine cone powder is added.



Fig no 4.20 TAMRID INDICA POWDER

SETTLING TIME OF SAMPLE:

For this process the water sample which we collected from the moringa oleifera added water sample is taken. Then the Tamarindus indica powder is added. 50 gms of Tamarindus indica seed powder is added to the water sample and the water sample is aerated for 3-4 hrs in two intervals of time and by adding 50gms of Tamarindus indica seed powder for every 3 hrs mark. The bubble aerator works as an rpm machine so that the flocculation process is done, the final resultant water sample is collected and tested in the lab for results.

4.3.5 JAR TEST:

The jar test is a common laboratory procedure used to determine the optimum operating conditions for water or waste water treatment. This method allows adjustments in pH, variations in coagulant or polymer dose, alternating mixing speeds, or testing of different coagulant or polymer types, on a small scale in order to predict the functioning of a large scale treatment operation.

4.3.5.1 JAR TEST APPARATUS:

The jar test is a common laboratory procedure used to determine the optimum operating conditions for water or wastewater treatment. This method allows adjustments in pH, variations in coagulant or polymer dose, alternating mixing speeds, or testing of different coagulant or polymer types, on a small scale in order to predict the functioning of a large scale treatment operation.

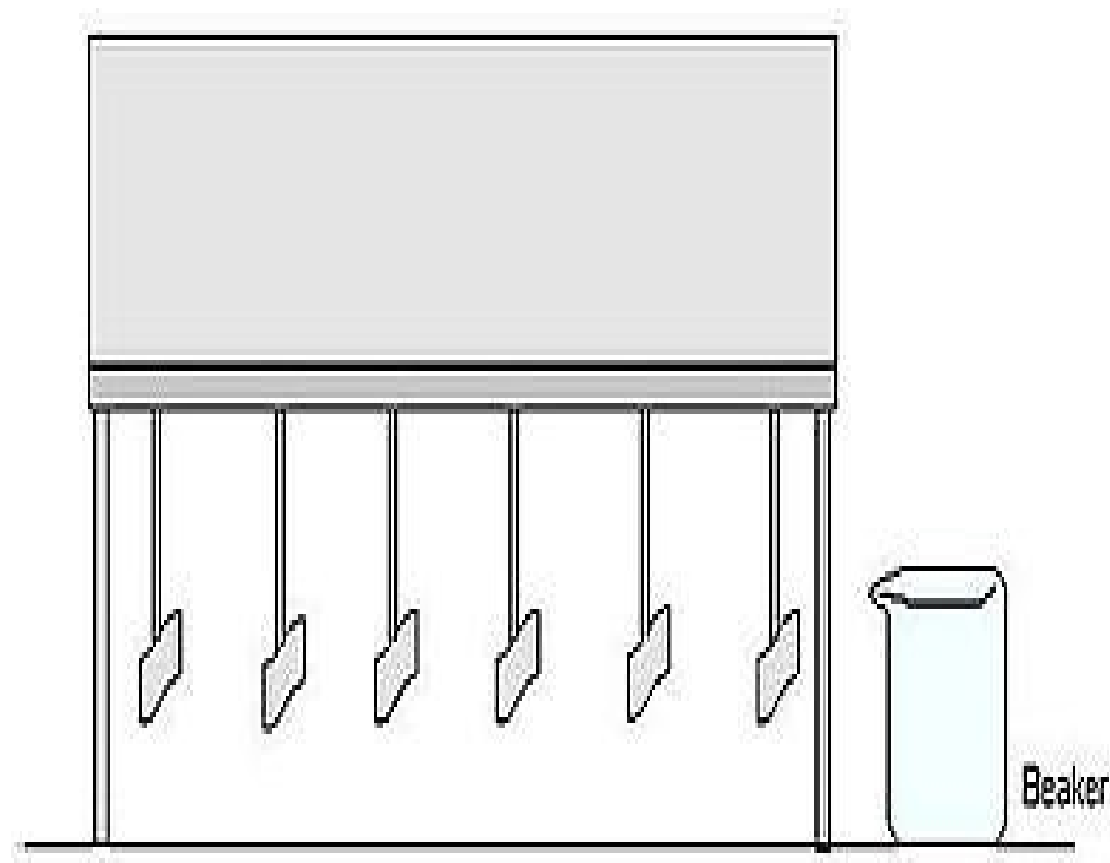


Fig 4.21 JAR TEST

4.3.5.2 JAR TEST PROCEDURE:

The jar test procedures involves the following steps:

- 1) Fill the jar testing apparatus containers with sample water. One container will be used as a control while the other 5 containers can be adjusted depending on what conditions are being tests. For example, the pH of the jars can be adjusted or variations of coagulant dosages can be added to determine optimum operating conditions. Add the coagulant to each container and stir at approximately 100 rpm for 1 minute. The rapid mix stage helps to disperse the coagulant throughout each container.
- 2) Turn off the mixers and allow the containers to settle for 30 to 45 minutes. Then measure the final turbidity in each container. Reduce the stirring speed to 25 to 35 rpm and continue mixing for 15 to 20 minutes. This slower mixing speed helps promote floc formation by enhancing particle collisions which lead to larger flocs. Residual turbidity vs. coagulant dose is then plotted and optimal conditions are determined. The values that are obtained through the experiment are correlated and adjusted in order to account for the actual treatment system.

CHAPTER 5

RESULT & DISCUSSION

5.1 RESULTS

ANALYSIS & DETERMINATION OF PARAMETERS BEFORE COAGULATION

S.NO	TEST PARAMETERS	TEST METHOD	UNITS OF MEASUREMENT	RESULT
1	Turbidity	IS 3025(PART 10) : 1984	NTU	2.9
2	Total dissolved solids	IS 3025(PART 16) :1984	mg/l	491.4
3	pH	IS 3025(PART 11) :1983	NILL	8.2
4	Iron as Fe	IS 3025(PART 2) :2004	mg/l	< 0.01
5	Total hardness as CaCO ₃	IS 3025(PART 21) :2009	mg/l	166.6

TABLE 5.1 ANALYSIS OF RAW WATER

COAGULATED SAMPLE 1 ANALYSIS

S.NO	TEST PARAMETERS	TEST METHOD	UNITS OF MEASUREMENTS	RESULT
1	Turbidity	IS 3025(PART 10) : 1984	NTU	0.3
2	pH	IS 3025(PART11) :1983	NILL	7.42

TABLE 5.2 ANALYSIS OF SAMPLE 1

COAGULATED SAMPLE 2 ANALYSIS

S.NO	TEST PARAMATERS	TEST METHOD	UNITS OF MEASUREM ENTS	RESULT
1	Turbidity	IS 3025(PART10) : 1984	NTU	0.9
2	pH	IS 3025(PART 11) :1983	NILL	7.67

TABLE 5.3 ANALYSIS OF SAMPLE 2

5.2 DISCUSSION

The presence of NOM causes many problems in drinking water and drinking water treatment processes, including (i) negative effect on water quality by causing colour, taste and odor problems, (ii) increased coagulant and disinfectant doses (which in turn results in increased sludge volumes and production of harmful by-products).

Natural organic matter (NOM) is found in all surface, ground and soil waters. An increase in the amount of NOM has been observed over the past 10-20 years in raw water supplies in several areas, which has a significant effect on drinking water treatment. The presence of NOM causes many problems in drinking water and drinking water treatment processes, including

- i. negative effect on water quality by causing colour, taste and odor problems,
- ii. increased coagulant and disinfectant doses (which in turn results in increased sludge volumes and production of harmful disinfection by-products),
- iii. promoted biological growth in distribution system, and
- iv. increased levels of complexed heavy metals and adsorbed organic pollutants.

NOM can be removed from drinking water by several treatment options, of which the most common and economically feasible processes are considered to be coagulation and flocculation followed by sedimentation/flotation and sand filtration.

Most of the NOM can be removed by coagulation, although, the hydrophobic fraction and high molar mass compounds of NOM are removed more efficiently than hydrophilic fraction and the low molar mass compounds. Thus, enhanced and/or optimized coagulation, as well as new process alternatives for the better removal of NOM by coagulation process has been suggested. In the present work, an overview of the recent research dealing with coagulation and flocculation in the removal of NOM from drinking water is presented.

It is, however, an important primary step in the water treatment process, because coagulation removes many of the particles, such as dissolved organic carbon, that make water difficult to disinfect. Because coagulation removes some of the dissolved substances, less chlorine must be added to disinfect the water. Coagulation destabilises the particles' charges.

Coagulants with charges opposite to those of the suspended solids are added to the water to neutralise the negative charges on dispersed non-settable solids such as clay and organic substances. While high-turbidity water may be safe to drink, it seems offensive to us. The EPA Interim Primary Drinking Water Regulations recommend that the turbidity of potable water be less than 1 unit and less than 5 units under special conditions.

CHAPTER 6

CONCLUSION

6.1 CONCLUSION

This study has shown the potential of pinecone, *Moringa soleifera*, *Tamarindus indica* Seed extract for the treatment of turbid water. Favorable results of coagulation activity have been observed with moderate coagulant dose, indicating that only moderate doses provide sufficient proteins.

Which can bind all the suspended particles in turbid water. Moreover, only highly acidic or basic pH values can activate the proteins in the coagulant to achieve maximum activity.

Apart from coagulant dose and pH, the optimized density of coagulant extract is very important for maximum turbidity removal. The highest coagulation efficiency of 82% was achieved by optimizing the controlling parameters. Hence, it is deduced that, pine cone extract can be used as a natural and sustain able source for purification of turbid water.

6.2 FUTURE WORK

This bio coagulants can be used as a replacement for artificial coagulants which helps us to get bio active natural drinking water.

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