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Study of *Trigonella Foenum-Graecum* (Fenugreek Seeds) & *Carica Papaya L* (Papaya Seeds) As A Natural Coagulant for Treatment of River Water

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Abstract - *The usefulness of substances like alum and ferric chloride as chemical coagulants is well known. However, there are numerous drawbacks to using it, including high operational expenses, adverse consequences on human health, the formation of vast volumes of sludge, and the fact that it drastically affects the pH of treated water. To avoid the stated difficulties, it is preferable to substitute these chemical coagulants with natural-based coagulants derived from plants. All physicochemical parameters, including pH, EC, TDS, turbidity, acidity, alkalinity, chloride content, hardness, DO, and COD, were measured before and after adding Trigonella Foenum-*Graecum *(fenugreek seeds) and Carica Papaya L (papaya seeds) powder to the river water for treatment. The water's characteristics, such as pH, turbidity, hardness, DO, and COD, were preserved after treatment. It removes turbidity about 70%, & decreases COD near about 60-65%.*

***Key Words*: Natural Coagulation, Coagulants, *Trigonella Foenum-Graecum*, *Carica Papaya L,* River Water, etc.**

1.INTRODUCTION

One of the necessary components for life is water. Water is a necessity for all living things to survive. Water is utilised for many things, such as drinking, cooking, irrigating, and manufacturing. Although more than 70% of the surface of the Earth is covered by water, less than 1% of that resource is available as fresh water, and even that is not distributed equally over the globe*. (S. Shaharom et al., 2019)*.

Natural coagulation is the process of lowering water turbidity by using a naturally occurring, plant-based coagulant known as a "natural coagulant" during the coagulation-flocculation stage of wastewater treatment. *(Ang et al., 2020)*. The coagulation procedure for treating water can use a natural substance called a plant-based coagulant. This research was done to find out whether plant-based substances could be used as coagulants to remediate surface water.

(Muhamad et al., 2020).

Two types of locally available plant-based materials were selected as natural coagulants are *Trigonella Foenum-Graecum* (Fenugreek Seeds) & *Carica Papaya L* (Papaya Seeds). Processes for coagulation and flocculation are frequently employed in the treatment of water and wastewater. Its primary goals are to eliminate colloidal particles that are suspended in water and to lessen turbidity. *(Hariz Amran et al., 2018).* Due to their advantages and the fact that they generally alleviate the problems that go along with utilising chemical coagulants, natural coagulants have gained popularity over the past few years. Plant-based natural coagulants, which can be derived from diverse plant components, carry out coagulation either by polymer bridging or charge neutralisation.*(Hariz Amran et al., 2018).*

There is a great desire to identify an alternative coagulant, preferably a natural coagulant, due to the numerous issues caused by utilising the synthetic coagulants, such as the widely used aluminium sulphate. Normal assumptions about the safety of naturally occurring coagulants for humans. *(Binayke & Jadhav, 2013).* The use of natural coagulants is a viable remedy due to widespread worries about the negative effects. In order to determine whether plant-based natural coagulants could take the place of chemical coagulants in the treatment of water, this study was carried out. *(Muda et al., n.d.).*

A chemical found in fenugreek seeds possesses coagulation properties and is water soluble, making it suitable for cleaning water and wastewater. Fenugreek seeds which belongs from *Pea Family (Faaceae)*, contain a chemical that is water soluble and has coagulation capabilities such as mixture of pectic polysaccharide, non-polysaccharide, and natural electrolytes, particularly divalent cation types such as Ca^{+2} and Mg^{+2}, suitable for wastewater and water treatment.

Carica Papaya L belong's from *Caricaceae Family* and also collected from the farmer who kept it for the cultivation. Papaya seeds act as a coagulant by forming bonds with particles that are negatively charged (such as silt, clay, bacteria, and toxins) thanks to the presence of positively charged proteins. The resulting flocs settle and produce pure water by adsorption and charge neutralization.

2. MATERIAL AND METHODOLOGY

2.1 Materials

I. River Water Collection

The water sample for the treatment is collected from the Krishna Ghat Kurundwad. It is situated on the banks of Krishna - Panchaganga river (16.6875° N, 74.6005° E.)

Fig - 1 River Water from 'Krishna Ghat Kurundwad'

ll. Natural Coagulants Used for Study

- ***Trigonella Foenum-Graecum*** **(Fenugreek Seeds)**

These seeds are brought from the grocery shop. The seeds are oven dried in the DOT's Environment Laboratory at 30°c for 24 hours. After that the powder is made using the grinder.

Fig - 2 Trigonella Foenum-Graecum (Fenugreek Seeds)

Fig - 3 Trigonella Foenum-Graecum in Powder Form

- ***Carica Papaya L*** **(Papaya Seeds)**

The papaya seeds were collected from farmer who kept it for the cultivation. It is washed and oven dried for 24 hours and fine powder is made for the treatment.

Fig - 4 Carica Papaya L (Papaya Seeds)

Fig - 5 Carica Papaya L in Powder Form

2.2 Methodology Adopted

l. Physicochemical Characteristics Study of River Water Before Treatment

- **pH:** pH stands for potential of hydrogen, i.e. H+ ion concentration present in the water which represents the nature of water i.e. acidic or basic state. The pH scale determines whether water is basic (alkaline) or acidic. From 0 (extremely acidic) to 14 (basic alkalinity), the pH scale is logarithmic (very alkaline).

- **Electrical Conductivity:** Since dissolved solids split into positively and negatively charged ions, water's conductivity is a measure of how well it can carry an electric current.

- **Alkalinity:** Natural water is typically alkaline because the bicarbonates are presence which creates the reactions in the soils that the water percolates through. It represents the buffering power of the water and measures its ability to neutralize acids. It may also be to blame, because it protects or acts as a buffer against abrupt pH changes, alkalinity is essential for fish and other aquatic life.

- **Acidity:** The quantitative ability of water or solution to neutralize an alkali is known as its acidity. In plain English, this means that pH is a gauge of an aqueous solution's acidity or basicity. Acidic solutions are those with a pH under 7, and basic or alkaline solutions are those with a pH above 7. Low pH can cause copper in your household plumbing to leach into the water, leaving green stains on porcelain surfaces like bathroom sinks. Another possibility is that the water itself has a blue color.

- **Hardness:** Hardness is an inherent property of water that can improve its flavour and consumer acceptability for drinking. Water's hardness is caused by calcium and magnesium minerals, which are found naturally in water. Poor soap lathering and scum are typical indicators of hard water. There are two types of hardness: temporary (carbonate) and permanent (non-

carbonate). Water that has become temporarily hard can be easily made soft by boiling it.

- **Dissolved Oxygen:** The volume of oxygen in the atmosphere (O2) that has been dissolved in water is known as dissolved oxygen. By aeration (rapid movement), diffusion from the surrounding air, and as a waste product from photosynthesis, enters in water. The majority of aquatic organisms require dissolved oxygen in order to survive and develop. Some organisms, like catfish, worms, and dragonflies, can survive in slightly lower concentrations of DO than others, such as fish and stoneflies, which require high concentrations of DO. Insufficient oxygen levels in water can cause adult and juvenile deaths, poor growth, failed egg or larval survival, and a shift in the species that live in a particular water body. When oxygen levels in a body of water fall below 3 mg/L, the aquatic system's circulatory fluid balance is disturbed, which impairs cell function and ultimately results in death.

- **Chemical Oxygen Demand:** The Chemical Oxygen Demand (COD) formula calculates the amount of oxygen needed to oxidize the organic material present in a water body at a specific temperature and time. COD is an essential indicator of water quality because it offers a baseline for determining the impact that wastewater discharge will have on the environment. Higher COD levels signify the presence of more oxidizable organic matter in the sample, and as this material degrades, the water body will once more experience low oxygen conditions. The proportion of organic material in the water that can be broken down by environmental microorganisms is shown by the BOD to COD ratio.

ll. Coagulation Study Using Jar Test

The following methodology is adopted

- The sample was taken from Krisha - Panchaganga Ghat in Kurundwad. The sample is taken from the water's surface at a depth of 1 m using an airtight sampling bottle.
- The natural coagulants were gathered and dried in an oven for 24 hours at 30°C.
- After that, it is ground into a fine powder.
- Before performing the jar test, the sample was subjected to preliminary physicochemical characteristics.
- After that, the coagulant dosage, which will be used to treat the water sample utilising jar test equipment, is decided upon: 0.2gm, 0.4gm, 0.6gm, 0.8gm, & 1gm.
- The sample is rotated at a speed of around 100 rpm for 4 to 5 minutes while the coagulant is mixed.
- Reduce the speed of the stirring to 25 to 35 rpm, and continue mixing for up to 15 to 20 minutes. The slower mixing speed increases particle collisions, resulting in larger flocs.
- Following that, the optimal conditions are determined by plotting the residual turbidity versus the coagulant dose.
- Based on the results, the ideal dosage is decided.
- Let the containers to settle for 30 to 45 minutes after turning off the machinery.

3. OBSERVATIONS

Fig - 6 Jar Test Using Natural Coagulant TRIGONELLA FOENUM – GRAECUM (Fenugreek Seeds)

Table - 1 Trigonella Foenum - Graecum (Fenugreek Seeds) Powder Coagulation in River Water Sample

DOSAGE OF *TRIGONELLA FOENUM – GRAECUM*						
TESTS	**0 gm**	**0.2 gm**	**0.4 gm**	**0.6 gm**	**0.8 gm**	**1.0 gm**
pH	7.693	6.865	6.865	6.866	6.867	6.867
EC	394	471	484	497	511	524
TDS	207	250	242	248	255	262
Turbidity	13	4	10	12	14	16
Acidity	30	35	37	40	43	49
Alkalinity	90	60	60	55	50	50
Chloride	25	32.5	33	33.5	34	35
Hardness	67.5	62.5	65.5	69	71.5	75
DO	4.4	8	7.9	7.5	7.2	6.9
COD	320	128	156	182	203	296

Table - 2 Optimum Dosage of Trigonella Foenum - Graecum (Fenugreek seed) Powder in River Water Sample.

TESTS	BEFORE	AFTER
pH	7.693	6.865
EC	394	471
TDS	207	250
Turbidity	13	4
Acidity	30	35
Alkalinity	90	60
Chloride	25	32.5
Hardness	67.5	62.5
DO	4.4	8
COD	320	128

Chart - 1 Graphical Representation of Optimum Dosage of Trigonella Foenum -Graecum (Fenugreek seed) Powder in River Water Sample

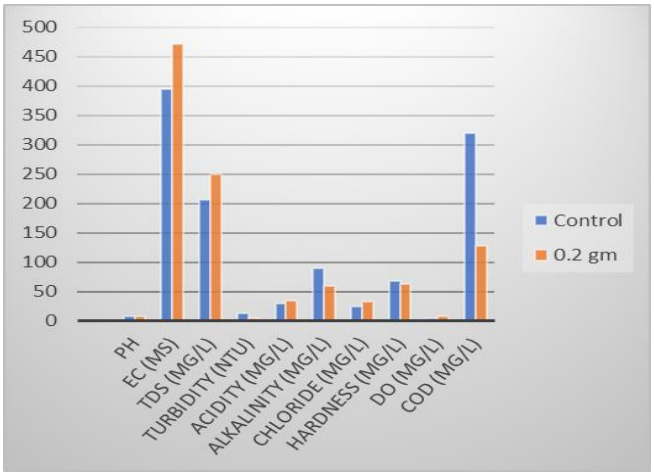


Fig - 7 Jar Test Using Natural Coagulant CARICA PAPAYA L (Papaya Seeds)

Table - 3 Carica Papaya L (Papaya Seeds) Powder Coagulation in River Water Sample

DOSAGE OF *TRIGONELLA FOENUM – GRAECUM*						
TESTS	**0 gm**	**0.2 gm**	**0.4 gm**	**0.6 gm**	**0.8 gm**	**1.0 gm**
pH	7.693	6.316	6.294	6.211	6.147	6.054
EC	394	500	548	595	644	691
TDS	207	250	274	298	322	345
Turbidity	13	5	9	12	15	16
Acidity	30	35	37	39	48	56
Alkalinity	90	30	30	35	40	40
Chloride	25	20	20.5	21	21.5	22.5
Hardness	67.5	62.5	65.5	69	71.5	75
DO	4.4	5	4.9	4.8	4.7	4.6
COD	320	96	184	272	360	448

Table - 4 Optimum Dosage of Carica Papaya L (Papaya Seeds) Powder in River Water Sample.

TESTS	BEFORE	AFTER
pH	7.693	6.316
EC	394	500
TDS	207	250
Turbidity	13	5
Acidity	30	35
Alkalinity	90	30
Chloride	25	20
Hardness	67.5	62.5
DO	4.4	5
COD	320	96

Chart - 2 Graphical Representation of Optimum Dosage of Carica Papaya L (Papaya Seeds) Powder in River Water Sample

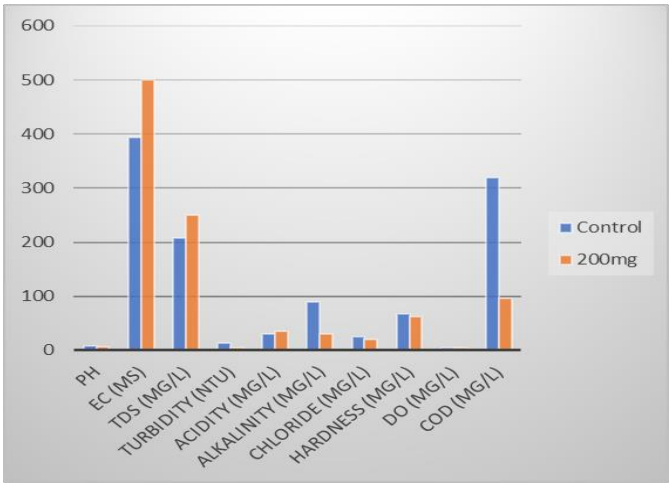
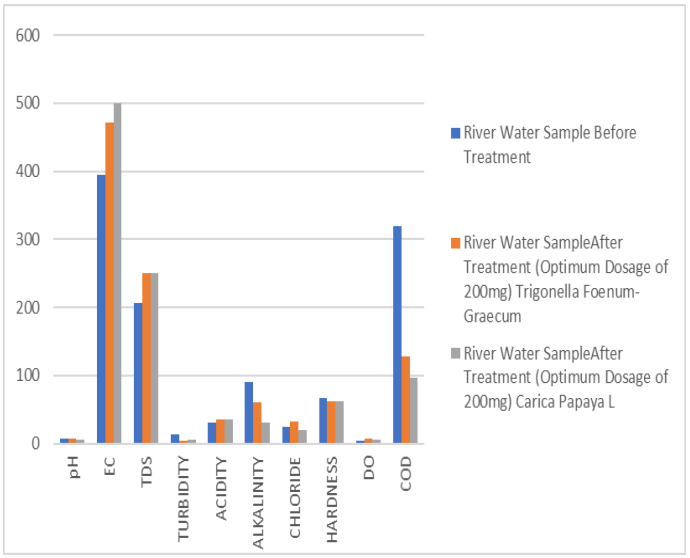


Table - 5 Comparison Between The Results Obtained By Trigoenlla Foenum Graecum & Carica Papaya L At The Optimum Dosage Of 200 Mg

TESTS	River Water Sample Before Treatment	River Water Sample After Treatment (Optimum Dosage of 200mg)	
		Trigonella Foenum-Graecum	Carica Papaya L
pH	7.693	6.865	6.316
EC	394	471	500
TDS	207	250	250
Turbidity	13	8	5
Acidity	30	35	35
Alkalinity	90	60	30
Chloride	25	32.5	20
Hardness	67.5	62.5	62.5
DO	4.4	8	5
COD	320	128	96

Chart - 3 Graphical Representation of Comparison between Optimum Dosage of Coagulant For Treating River Water



4. RESULT AND DISCUSSION

1) **pH:** When Trigonella Foenum-Graecum (Fenugreek Seeds) are used as natural coagulant it shows better results after the treatment. The pH of the Sample is 7.693 prior to treatment, and it is 6.865 following the coagulation procedure at a dosage of 0.2 gm. While Carica Papaya L (Papaya Seeds) is used in the powdered form as an alternative to synthetic coagulant it gives effective outcomes after the process. Before the treatment, the pH of the Sample is 7.693, and after coagulation at a dosage of 0.2 gm, it is 6.316.

2) **EC:** Electric Conductivity is the term related to water which pass the electric flow through it. Natural coagulants doesn't contribute for reduction of electric conductivity of water because it contains organic matter which carries electric flow through it.The presence of organic matter in the form of a natural coagulant causes an increase in electric conductivity. So, the EC gets increased up to 20-30%.

3) **TDS:** It is the term which contains all the organic and inorganic dissolved matters present in the liquid. TDS increases with the increasing dosage of coagulant. TDS increases because we are adding the coagulants which is already in powdered form increases the solids present in liquid.TDS is slightly higher than that of untreated water sample. It is increased near about 20%.

4) **Turbidity:** Turbidity is the term that related to water which contains large amount of particles which causes cloudiness to water and also affects the quality and

clarity of water. It decreases near about 40-60% at the effective dosage of 200 mg/l.

5) **Acidity:** When acidity parameter taken into consideration coagulation process doesn't play any important role in removal of acidity. It gets increased up to 17% after addition of coagulant.

6) **Alkalinity:** When natural coagulation process is employed on river water sample, it reduces alkalinity near about 30-70 after treatment.

7) **Chloride Content:** Chloride content present in water increases the waters electric conductivity which leads the water to make it corrosive in nature. When *Trigonella Foenum - Graecum* is used the chloride content increases up to 30% on the other hand in case of *Carica Papaya L* it gets reduced up to 20%.

8) **Hardness:** Hardness of water cannot be removed just by coagulation process, it needs to be boiling if they contain bicarbonates of calcium & magnesium. If water contains bicarbonates of chlorides & sulphates, they cannot be removed just by boiling. When natural coagulants are introduced to river water it reduces the hardness near about 10%.

9) **DO:** When concerning about dissolved oxygen it is the most important factor in treating water. It helps to oxidize the organic matter present in water sample. The freshness of water also depends on the oxygen content in it. After coagulation process DO gets increases up to 80%.

10) **COD:** It is the term where the decomposition of organic matter is done chemically in presence of oxygen. COD removal is improved, with a reduction of almost 60-70% following the treatment.

5. CONCLUSION

A powder made from the seeds of *Trigonella Foenum-Graecum* (fenugreek seeds) and *Carica Papaya L* (papaya seeds) was used to reduce the turbidity of the water. Powder made from the seeds of *Trigonella Foenum-Graecum* (fenugreek seeds) and *Carica Papaya L* (papaya seeds) has considerable coagulant qualities. It maintains the pH. TDS is moderately higher than that of the sample of untreated water. *Trigonella Foenum-Graecum* (Fenugreek Seeds) exhibits more effective outcomes than *Carica Papaya L* (Papaya Seeds) in lowering turbidity. *Trigonella Foenum-Graecum* (Fenugreek Seeds) is not as effective in removing alkalinity as *Carica Papaya L* (Papaya Seeds). *Carica Papaya L* (Papaya Seeds) contributes significantly more than *Trigonella Foenum-Graecum* (Fenugreek Seeds) in removing COD from the sample, but both help to raise the DO in water following the treatment.

When both the coagulants are taken into consideration *CaricaPapaya L* Shows better results than *Trigonella Foenum-Graecum,* because it forms a gelatinous layer over it which has coagulation properties that helps in maintaining the physicochemical parameters within permissible limit.

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