International Journal of Enhanced Research in Management & Computer Applications
ISSN: 2319-7471, Vol. 13, Issue 4, April-2024, Impact Factor: 8.285
Presented at "ICRETETM-2024", Organized by GSMCOE, Pune, on 22nd - 23rd April 2024

# Optimization of Plant Based Natural Coagulant and Synthetic Coagulant for Water Treatment

**Poonam Nandihali[1], Anant Vadnere[2], Prathamesh Pisal[3], Pooja Sarode[4], Pragati Karwade[5]**

[1]Assistant Professor, Civil Engineering, Genba Sopanrao Moze College of Engineering Balewadi Pune 45, India
[2,3,4,5]Student, Civil Engineering, Genba Sopanrao Moze College of Engineering Balewadi Pune -45, India

ABSTRACT

**Raw water is frequently treated to make it safe for consumption. Water from ground sources, such as mountain springs, is typically of high quality, and disinfection is usually sufficient. However, suspended particles are critical if the water is from a surface source such as a river, lake, or dam. Suspended particles can be removed with chemical coagulants, whether natural or synthetic. In this study, we used a combination of natural and synthetic coagulants to investigate the effects of various dosages. The combination of banana peel and alum stock solutions produced the best overall results, and the resulting water was safe to drink. The comparative test results revealed that alum, with its residual and health implications, can be successfully replaced, partially or completely, with natural coagulants.**

**Keywords: Banana peel Natural coagulant, synthetic coagulants, alkalinity, flocculation**

## INTRODUCTION

The world contains a lot of water (about 71%), yet freshwater accounts for only 2.5%. Surface water requires more treatment than groundwater due to its higher concentration of impurities, suggesting that it must be extensively treated before being used as a communal water source. Coagulation and flocculation can be performed using either natural or artificial coagulants. Plant-based natural coagulants, as opposed to chemical coagulants, are safer, more ecologically friendly, and less hazardous overall. Natural coagulants have been demonstrated to create not only significantly less sludge volume (up to five times less), but also higher nutritional sludge value, lowering the expense of handling and transporting huge amounts of sludge to the treatment facility. Banana pith powder has been used successfully as a natural coagulant to purify river water, lowering turbidity, suspended particles, and heavy metals (Diver et al., 2023). Based on this, we selected a concept and tested its physiochemical properties with banana peel powder to compare water quality metrics (pH, turbidity, alkalinity, TDS, and hardness) between plant-based natural coagulants and synthetic ones.

### Study Area

Samples for this study were collected from the river Indrayani at the Alandi location in Pune, as shown on the map below.
S1- Indrayani river (Alandi)


**Fig no. 2: Alandi location**

**Fig no. 3: Indrayani River water sample**

**Preparations of adsorbent**

The adsorbent material used in this investigation is banana peel. Raw banana peels available from Balewadi near GSMCOE were collected and cleaned with tap water to remove dirt and dust particles, followed by distilled water and kept it for sundry for few days to remove moisture content completely, and then cut and kept it on dry cloth, cut it in small pieces, kept in oven dried at 105 c for 24 – 48 hours, grinding of coagulant into fine powder, and then stored in air dried container as required.

**Fig no. 4: Banana peel**

**Fig no. 5: Potassium alum dodecahydrate, Hi-LR**

## MATERIALS AND METHODOLOGY

Suspended particles settle very slowly or in some cases do not settle at all. The sedimentation step is usually preceded by a chemical process known as coagulation. Coagulants with charges opposite to those of the suspended solids are added to the water to neutralize the negative charges. Chemicals (coagulants) are added to the water to bring the no settling particles together into larger, heavier masses of solids called floc. Coagulation is usually accomplished in two stages: rapid mixing and slow mixing. Rapid mixing serves to disperse the coagulants evenly throughout the water and to ensure a complete chemical reaction in contrast slow mixing ensures water is stirred to encourage floc particles to clump together. The polysaccharides in the powdered banana peel cause the suspended particles to clump together and sink to the bottom, making the liquid clearer. It's important to remember that although banana peels can be useful natural coagulants, their

effectiveness can vary depending on several variables, including the type of water being treated and the level of contaminants present. The liquid becomes clearer as a result of the suspended particles clumping together and sinking to the bottom due to the polysaccharides in the powdered banana peel. It's important to remember that although banana peels can be useful natural coagulants, their effectiveness can vary based on several variables, including the kind of water being treated and the level of contaminants present.

**Analysis of sample:** Sample is collected from river water Indrayani for analysis of five physiochemical parameters i.e. pH, Turbidity, Alkalinity, TDS, and Hardness by preparing seven samples to check as per the standards, and it has confirmed that it is meeting the requirement for potable water as per Is 10500-2012.

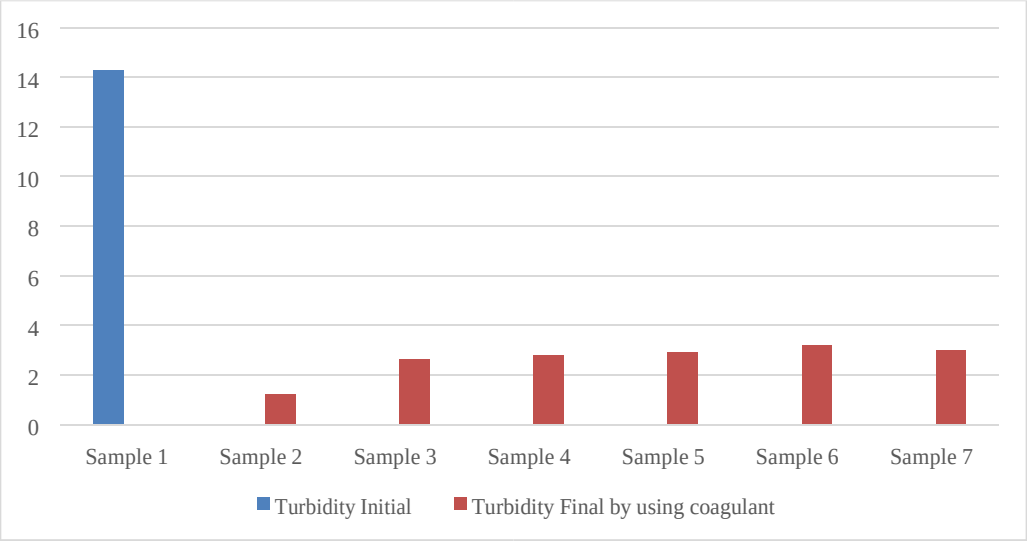
## RESULT & DISCUSSIONS

Coagulation is an important phase in the water treatment process that ensures the availability of safe drinking water. Traditional coagulants, such as manmade compounds (e.g., aluminum sulfate or ferric chloride), can harm the environment and health. As a result, there is a growing interest in developing more sustainable and environmentally friendly coagulants, particularly those derived from plants. To effectively treat water, it's important to maximize the use of plant-based natural and synthetic coagulants.

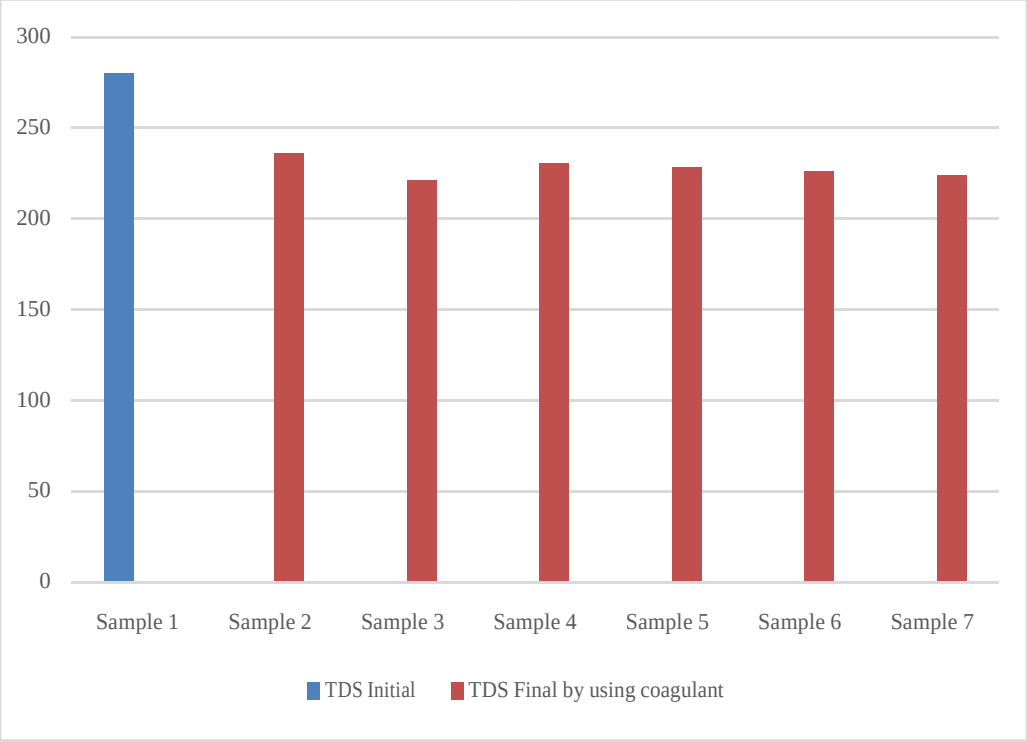
**Table 1: Details of the experiment conducted on the Indrayani river sample**

| Sr. No. | Test | Sampel 1 | Sampel 2 | Sampel 3 | Sampel 4 | Sampel 5 | Sampel 6 | Sampel 7 |
|---|---|---|---|---|---|---|---|---|
| | | A0-B0 | A10-B0 | A0-B10 | A5-B5 | A4-B6 | A3-B7 | A2-B8 |
| | | Initial | Final | Final | Final | Final | Final | Final |
| 1. | TURBIDITY | 14.3 | 1.2 | 2.6 | 2.8 | 2.9 | 3.2 | 3 |
| 2. | TDS | 280 | 236 | 221 | 230 | 228 | 226 | 224 |
| 3. | PH | 7.84 | 7.41 | 7.7 | 7.76 | 7.75 | 7.6 | 7.72 |
| 4. | ALKALINITY | 96.4 | 102.5 | 79.1 | 83.4 | 77.8 | 78.5 | 75.2 |
| 5. | HARDNESS | 118.6 | 97.4 | 96.2 | 99.5 | 98.3 | 97.8 | 96.9 |

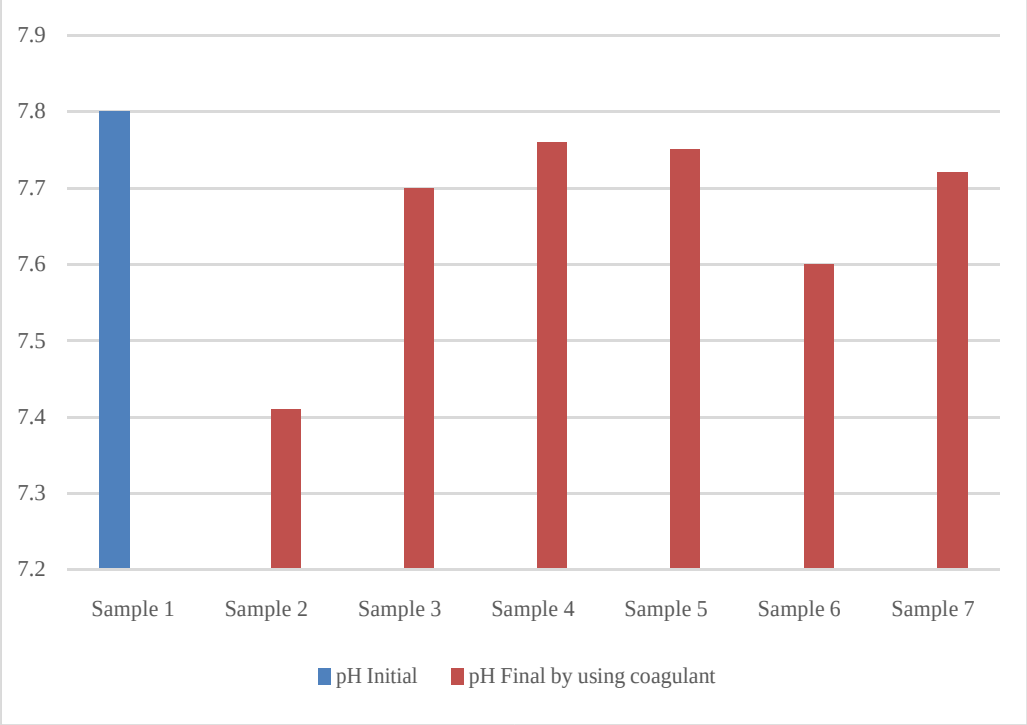
**Graphs**



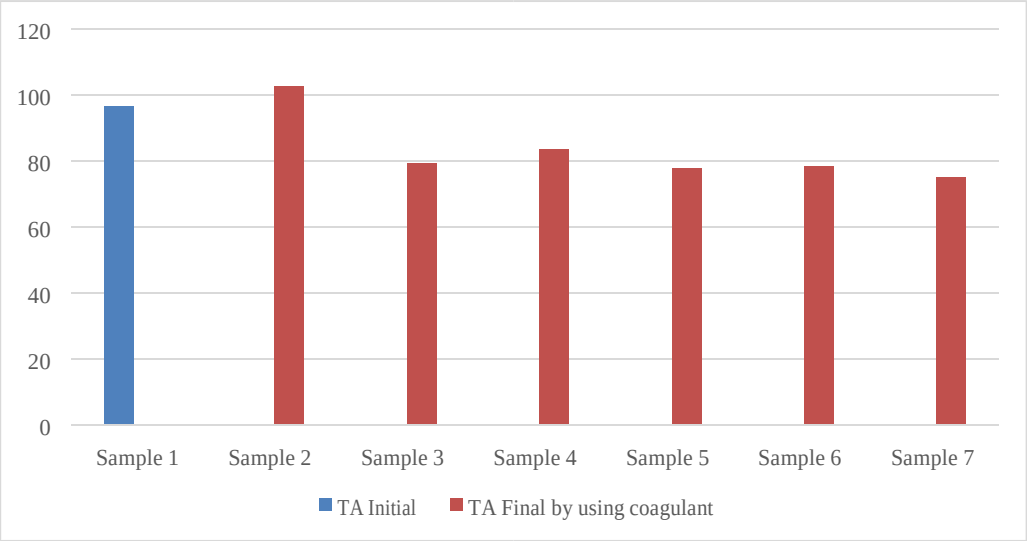

**Graph No 1 - Turbidity of River Sample (Indrayani River)**



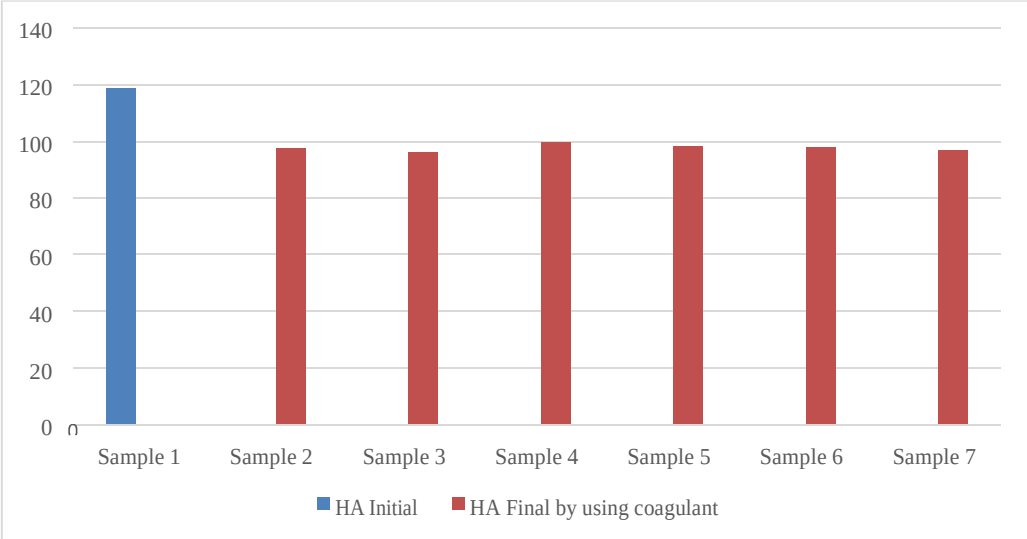

**Graph No 2 - TDS of River Sample (Indrayani River)**




**Graph No 3 - pH of River Sample (Indrayani River)**




**Graph No 4 - Alkalinity of River Sample (Indrayani River)**




**Graph No 5 - Hardness of River Sample (Indrayani River)**

## CONCLUSION

The coagulation tests using banana peel revealed that the approach efficiently eliminated turbidity from water. The ideal pH for turbidity evacuation was discovered to be 7 for banana peel, resulting in the highest turbidity expulsion. The effect of blending speed on the turbidity patterns generated by the distinctive coagulant is being investigated. The research implies that charge balance has little effect on floc formation. Regarding the aforementioned results, it is considered that the condition for conservative settings has been met. We are environmentally friendly because we use conventional coagulants. The need for land is lowered, and we have once again attained economic efficiency. During the study, the novel, common, easily accessible, and naturally beneficial material is utilized as a coagulant and flocculant.

## REFERENCES

[1]. Al-Wasify, R.S., Hamed, S.R., Ragab, S., 2023. Assessing the potential of de-oiled peanut (Arachis hypogea) seeds for surface water treatment: A sustainable alternative to chemical coagulants. Egypt.J. Aquat. Res. 49, 297–302.
[2]. Ang, W.L., Mohammad, A.W., 2020. State of the art and sustainability of natural coagulants in waterand wastewater treatment. J. Clean. Prod. 262, 121267.

[3]. Ang, W.L., Mohammad, A.W., Benamor, A., Hilal, N., 2016. Chitosan as natural coagulant in hybridcoagulation-nanofiltration membrane process for water treatment. J. Environ. Chem. Eng. 4, 4857– 4862.
[4]. Camacho, F.P., Sousa, V.S., Bergamasco, R., Ribau Teixeira, M., 2017. The use of Moringa oleiferaas a natural coagulant in surface water treatment. Chem. Eng. J. 313, 226–237.
[5]. Dayarathne, H.N.P., Angove, M.J., Aryal, R., Abuel-Naga, H., Mainali, B., 2021. Removal of naturalorganic matter from source water: Review on coagulants, dual coagulation, alternative coagulants, and mechanisms. J. Water Process Eng. 40, 101820.
[6]. Diver, D., Nhapi, I., Ruziwa, W.R., 2023. The Potential and Constraints of Replacing Conventional Chemical Coagulants with Natural Plant Extracts in Water and Wastewater Treatment. Environ. Adv.13, 100421.
[7]. Fard, M.B., Hamidi, D., Yetilmezsoy, K., Alavi, J., Hosseinpour, F., 2021. Utilization of Alyssummucilage as a natural coagulant in oily-saline wastewater treatment. J. Water Process Eng. 40, 101763.
[8]. Gandiwa, B.I., Moyo, L.B., Ncube, S., Mamvura, T.A., Mguni, L.L., Hlabangana, N., 2020. Optimisation of using a blend of plant based natural and synthetic coagulants for water treatment:(Moringa Oleifera-Cactus Opuntia-alum blend). South African J. Chem. Eng. 34, 158–164.
[9]. Iwuozor, K.O., Adeniyi, A.G., Emenike, E.C., Ojeyemi, T., Egbemhenghe, A.U., Okorie, C.J., Ayoku, B.D., Saliu, O.D., 2023. Prospects and challenges of utilizing sugarcane bagasse as a bio-coagulant precursor for water treatment. Biotechnol. Reports 39, e00805.
[10]. Lanan, F.A.B.M., Selvarajoo, A., Sethu, V., Arumugasamy, S.K., 2021. Utilisation of natural plant-based fenugreek (Trigonella foenum-graecum) coagulant and okra (Abelmoschus escluentus)flocculant for palm oil mill effluent (POME) treatment. J. Environ. Chem. Eng. 9, 104667.
[11]. Lapointe, M., Papineau, I., Peldszus, S., Peleato, N., Barbeau, B., 2021. Identifying the best coagulant for simultaneous water treatment objectives: Interactions of mononuclear and polynuclearaluminum species with different natural organic matter fractions. J. Water Process Eng. 40
[12]. Taiwo, A.S., Adenike, K., Aderonke, O., 2020. Efficacy of a natural coagulant protein from Moringa oleifera (Lam) seeds in treatment of Opa reservoir water, Ile-Ife, Nigeria. Heliyon 6, e03335. Yimer, A., Dame, B., 2021. Papaya seed extract as coagulant for potable water treatment inthe case of Tulte River for the community of Yekuset district, Ethiopia. Environ. Challenges 4, 100198.
[13]. Babu R, Chaudhuri M. Home water treatment by direct filtration with natural coagulant. J WaterHealth 2005; 3:27–30.
[14]. Beltran-Heredia J, Sanchez-Martın J, Solera-Hernandez C. Anionic surfactants removal bynatural coagulant/flocculant products. Ind Eng Chem Res 2009; 48:5085–92.
[15]. Chun-Yang Yin, Emerging usage of plant-based coagulants for water and wastewater treatment,Process Biochemistry 45 (2010) 1437–1444
[16]. Graham N, Gang F, Fowler J, Watts M. Characterisation and coagulation performance of atannin- based cationic polymer: a preliminary assessment. 2008; 327:9–16.
[17]. Huang C, Chen Y. Coagulation of colloidal particles in water by chitosan. J Chem Technol Biotechnol 1996; 66:227–32.
[18]. Jahn SAA. Using Moringa seeds as coagulants in developing countries. J Am Water WorksAssoc 1988; 80:43–50.
[19]. Marina Šc´iban *, Mile Klašnja, Mirjana Antov, Biljana Škrbic, Removal of water turbidity bynatural coagulants obtained from chestnut and acorn, Bioresource Technology 100 (2009) 6639–6643
[20]. Sen AK, Bulusu KR. Effectiveness of nirmali seed as coagulant and coagulant aid. Indian JEnviron Health 1962; 4:233–44.