

## STUDY ON USE OF BANANA PITH POWDER AND MORINGA SEED POWDER IN WASTEWATER TREATMENT- A REVIEW

Dr. M. B. Chougule<sup>1</sup>, E. M. Karimkhan<sup>2</sup>, H. P. Bade<sup>3</sup>

<sup>1</sup>Professor, Civil Engineering Department, D.K.T.E. Society's Textile and Engineering Institute, Ichalkaranji, Maharashtra, India.

<sup>2,3</sup>Final Year B.Tech. student, Civil Engineering Department D.K.T.E. Society's Textile and Engineering Institute, Ichalkaranji, Maharashtra, India.

### ABSTRACT

The rapid industrialization and urbanization have led to a significant increase in wastewater generation, posing a threat to environmental and human health. Conventional wastewater treatment methods are often expensive, energy-intensive, and chemical-dependent. This study explores an innovative, eco-friendly, and cost-effective approach using banana pith powder and moringa seed powder for wastewater treatment. The main requirement of coagulants like banana pith powder and moringa seed powder is to be able to purify and treat wastewater efficiently. From ancient times seeds, leaves, roots, barks, fruit peels and vegetable peels obtained from the plant has been used for the purification process. Natural coagulants show numerous advantages which consist of a decrease in accumulation of sludge, lesser cost, control differences in the pH of purified water, nontoxic and environment friendly. Scholars used various coagulants that have been studied comprises okra (lady's finger), nirmali plant, moringa oleifera, banana pith juice, tamarind powder has also performed investigational analysis on performing of these various coagulants in purifying water. Banana plants can be extensively analyzed and used as adsorbents to eliminate different contaminants. Banana fruit is consumed highly and creates roughly 40% of the total weight of the fresh fruit and one of the key wastes produced in enormous quantities is banana peel. Banana skin is abundant in organic complexes such as cellulose, hemicellulose, pectin elements, chlorophyll pigments, and other complexes of small molecular weight. Various experimental works carried out show that banana peels are great traces of galacturonic acid, pectin (10-21 %), lignin (6-12 %), cellulose (7.6- 9.6 %), and hemicelluloses (6.4-9.4 %). This paper focuses on reviews on the research work carried on analysing effectiveness of banana pith powder and moringa seed powder in coagulation process using jar test and on physicochemical properties of wastewater and to investigate suitable filtration system to make the water useful for domestic purposes.

**Keywords:** banana pith powder, moringa seed powder, coagulation, filtration

### 1. INTRODUCTION

The concept of Coagulation of wastewater is quite old, but it was done using other chemicals unlike banana pith powder which comes naturally. As it is still a new trend in wastewater treatment, we are eager to know how it is designed & what are the challenges of coagulation using our natural materials & how to overcome them.

### 2. METHODOLOGY

First stage in the research is to study the properties of banana pith powder and moringa seed powder. Further step is to analyse the effectiveness of banana pith powder and moringa seed powder in coagulation process using jar test and on physicochemical properties of wastewater. The final step is to investigate suitable filtration system to make the water useful for domestic purposes. Figure 1 shows the proposed methodology in the research.

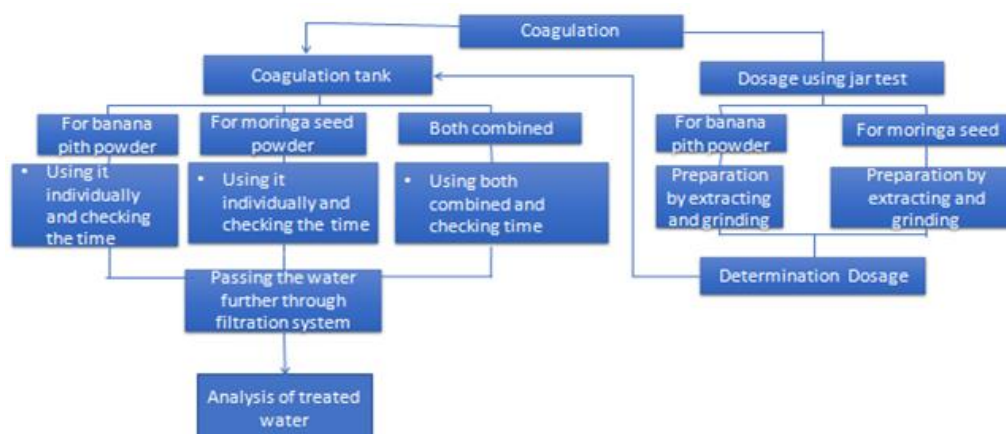


Figure 1: Proposed methodology in the research.

### 3. LITERATURE REVIEW

1.1 Removal of Heavy Metals and Dyes Using Low-Cost Adsorbents from Aqueous Medium. Author- Geetha K.S and Belagali S.L. The use of commercially activated carbon can be replaced by the inexpensive and effective low-cost adsorbents. There is need for more studies to understand better process of low-cost adsorbents and to demonstrate the technology effectively. Various low-cost adsorbents show a high degree of removal efficiency for heavy metals and dyes. If low –cost adsorbents perform well in removing heavy metal complexes and dyes at low cost, they can be adopted and used widely in industries, not only to minimize cost but also to improve profit. As metals are nondegradable and dyes are highly complex, these two degrade very slowly. The wastewater from industries like, metal plating, mining operations, tanneries, chloralkali and radiator manufacturing, smelting, alloy industries, textile industry, dye industries effluents need the treatment. The main techniques which have been utilized to reduce the heavy metal ions content and dyes of effluents include lime precipitation, ion exchange, adsorption onto activated carbon, membrane processing and electrolytic methods. These methods have been found to be limited. Since they often involve high capital and operational costs and may be associated with the generation of secondary waste, which are the present treatment problems. But adsorption is very cheap, effective compared to other methods. In this research article the efforts have been taken to develop new adsorbents and improving the existing adsorbents to have alternative materials to activated carbon.

1.2 Study on the Effectiveness of Banana Peel Coagulant in Turbidity Reduction of Synthetic Wastewater. Author - M. Priyatharishini , N. M. Mokhtar , R. A. Kristanti. The results obtained from the present study show the feasibility of locally available banana peel as natural coagulant on the turbidity reduction of synthetic household wastewater. The optimum pH for effective coagulation process using banana peel extract was found to be at acidic pH which was less than pH 3. Coagulation is an effective, simple and widely practiced water treatment method. However, the usage of chemical coagulant pose detrimental effect on living organism and human health as well as producing large amount of toxic sludge. This study describes the utilization of banana peel as a natural coagulant for the treatment of household wastewater. The natural coagulant extracted from banana peel was prepared by using simple extraction method. Synthetic wastewater was used in this study to imitate the medium strength household wastewater. The parameters investigated in this study were pH of wastewater, coagulant dosage, and solvent of extraction. The effectiveness of the natural coagulant was evaluated based on the reduction of turbidity during the treatment process. The treatment of synthetic wastewater using banana peel coagulant was found to be the most effective at pH 1 and dosage of 100 mg/l whereas the most effective solvent to extract this type of fruit waste is sodium hydroxide (NaOH). In present work, it can be concluded that the banana peel coagulant was highly feasible in removing turbidity of the synthetic wastewater with removal efficiency of 88% under optimum condition.

1.3 Review on Utilization of Agriculture waste. Author- Harshit Khunt, Hardik Dholakia , Sunil Valand (2019). This Paper focuses on understanding the sustainable process which benefits environment by using agricultural waste as absorbent. The author utilized data about various low-cost absorbents. The paper highlights the importance of saw dust, coffee waste orange peel as coagulants. The objective of this work is to study sustainable process which benefit environment by using agricultural waste as adsorbent to remove organic pollutants from water. As the current worldwide trend towards more precise environmental standards, technical aptness and cost-effectiveness became key factors in the selection of adsorbents for water and wastewater treatment. Recently, various low-cost adsorbents procure from agricultural waste, industrial by-products, or natural materials, have been rigorously investigated. In this they utilize the agriculture waste i.e. Alisma plantago aquatic, rice husk, saw dust, tea and coffee waste, orange peel, peanut shells, activated carbon, dry tree leaves and barks, bagasse, fibre, leaves and peels are use as adsorbent which can offer an economical solution for wastewater treatment. Three adsorption isotherm models namely Freundlich, Langmuir and Dubinin Radushkevich were applied to analyse the equilibrium data. Equilibrium is best described by Langmuir isotherm model ( $R^2 \approx 1$ ). Isotherm studies have been used to verify the thermodynamic parameters of the process. Kinetic parameters of adsorption such as pseudo first order, second order and intraparticle diffusion rate constant were determined and fitted with second order kinetic model. Adam Bohart and Wolborska models were applied to the experimental data obtained from dynamic studies on packed bed and were observed to fit the data well with good correlations. The model parameters, including the mass transfer coefficient and kinetic parameters were estimated.

1.4 Effectiveness of Natural Coagulant in Coagulation Process: A Review. Author- Amir Hariz Amran, Nur Syamimi Zaidi , Khalida Muda , Liew Wai Loan (2019). The author states moringa oleifera contain high value of globulin and albumin protein fraction which greatly contribute to its coagulation ability. The research discovered that oil extraction is not necessary when using Moringa oleifera as natural coagulant and it performed better in removing Chlorophyll A and turbidity in high turbid water. Natural coagulant gains the advantage over chemical coagulant due to various reasons. Natural coagulants have been increasingly popular in the past few years due to its benefits and the fact that it

resolves most of the associated problems when using chemical coagulants. Plant-based natural coagulants perform coagulation either by polymer bridging or charge neutralization, it can be extracted from various plant components. Concerted research and development efforts have been conducted in discovering new plant species and constituents that can be used as natural coagulants, which further boosting the effectiveness of existing plant-based natural coagulants. The objective of this paper is to provide a mini review on studies done over the span of ten years regarding plant-based natural coagulants. This paper also includes advantages and disadvantages of natural coagulants prior to identify several potential research gaps to provide platform towards the need of further study.

1.5 Evaluation of Wastewater Treatment Using Banana Fruit Peel Powder as Natural coagulant. Author - Sri Durga Parvatham, Asha Rani. N. R. (2021). The techniques implicated are in this research are cost-effective, conventional, simple to execute, and reduce mortality and diseases caused due to water-borne diseases and this will improve public health in rural regions. The turbidity removal efficiency was found to be 68%, the removal efficiency of total hardness was found to be 31%, the removal efficiency of magnesium hardness was found to be 40%, the removal efficiency of calcium hardness was found to be 41%. Banana peel is one of the agricultural trashes that is being thrown out all over the world as a worthless raw material. They produce waste managing challenges although they have advantages such as use in compost and cosmetics production. The material can be utilized in the manufacturing of medicine, in personal care as it is having anti-fungal and antibiotic properties. Along with that, banana peels also have adsorbent properties. It is extremely helpful in purification and refining methods. To be a better coagulant than others in terms of coagulant activity (turbidity removal). Banana peel is composed of polymeric substances such as fiber (11.04%) and protein (10.14%). Banana peels can be used to filter water. Banana peels contain Sulphur, nitrogen, carboxylic acid, and other atoms that function pretty much the same way magnets do in terms of attracting heavy metals. The increase in water demand worldwide is due to the rapid increase in the population, and alternatively, there is a constant decrease in the ground and shallow water intensities due to over development. A lot of efforts are carried out to bring alternatives to the problems caused due to excessive use of water, reuse of water, and treatment of wastewater is one of the prominent solutions.

1.6 Biobased materials for wastewater treatment. Author - T.T. Dele-Afolabia, M.A. Azmah Hanima, O.J. Ojo-Kupoluyid and E.O. Atoyebi. This article presents the processes of wastewater treatment using biobased materials as biosorbents, focusing on their preparation, applications as well as parameters upon which effective treatment rely. The adsorption of heavy metals and elimination of dyes were more effective in acidic conditions and large surface areas using various biofibers as biosorbents., one of the most common and challenging environmental concerns is water pollution. Water bodies are polluted by various waste sources generated majorly from effluent in textiles, food, or plastic industries, thereby rendering such water unfit for aquatic lives and even for human consumption if left untreated. Techniques to develop chemicals or biosorbents used for the removal of heavy metal ions from wastewater have been explored but lignocellulosic residues are considered cheap and readily available with excellent adsorptive attribute required for decontaminating water bodies. These residues used for biosorbents preparation are derived from natural fibers such as bagasse from sugarcane, cashew peduncle, coconut fiber, banana pith, etc.; thus, preparation and application of these biosorbents are further discussed while the influence of modification or pH adjustment and contact time are reported.

1.7 A Sustainable Banana Peel Activated Carbon for Removing Pharmaceutical Pollutants from Different Waters: Production, Characterization, and Application. Author - Osamah J. Al-sareji , Ruqayah Ali Grmasha, Mónica Meiczinger, Raed A. Al-Juboori , Viola Somogyi and Khalid S. Hashim. This work exhibits the use of banana peel, an agricultural waste, in the development of BPAC, which was revealed to be a very efficient adsorbent for amoxicillin and carbamazepine removal from different waters. After a contact period of 120 min, the absorption of pollutants from aqueous solutions reached a state of equilibrium. The kinetics investigations suggested that the pseudo-second-order model was more suitable for these contaminants he growing concerns about pharmaceutical contamination and its devastating impact on the economy and the health of humans and the environment, developing efficient approaches for removing such contaminants has become essential. Adsorption is a cost-effective technique for removing pollutants. Thus, in this work, banana peels as agro-industrial waste were utilized for synthesizing activated carbon for removing pharmaceuticals, namely amoxicillin and carbamazepine from different water matrices. The chemically activated carbon by phosphoric acid (H<sub>3</sub>PO<sub>4</sub>) was carbonized at temperatures 350 °C, 450 °C and 550 °C. The material was characterized by several techniques such as scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS), Fourier transform infrared spectroscopy (FTIR), Boehm titration, point of zero charge (pHPZC), BET surface area (SBET), the proximate and ultimate analyses, X-ray powder diffraction (XRD), and thermos-gravimetric analysis (TGA). The SEM of banana peel activated carbon (BPAC) depicted a semi-regular and heterogeneous morphology, characterized by an abundance of pores with diverse forms and sizes. Boehm titration revealed an increase

in the amounts of acidic groups by 0.711 mmol/g due to activation by H<sub>3</sub>PO<sub>4</sub>. FTIR recorded different peaks suggesting significant modifications in the spectroscopic characteristics of the BPAC surface due to the successful activation and adsorption of the pollutant molecules. The pH<sub>pzc</sub> of BPAC was calculated to be 5.005. The SBET surface area dramatically increased to 911.59 m<sup>2</sup>/g after the activation. The optimum conditions were 25 °C, a materials dosage of 1.2 g/L, a saturation time of 120 min, a pollutants mixture of 25 mg/L, and a pH of 5. Langmuir exhibits a slightly better fit than Freundlich with a low value of the residual sum of squares (SSE) and the data were better fitted to the pseudo-second-order kinetic. Furthermore, the efficacy of BPAC in eliminating pharmaceuticals from Milli Q water, lake water, and wastewater was successfully investigated over the seven cycles. The results of the present work highlighted a potential usage of agro-industrial waste in eliminating organic micropollutants while exhibiting sustainable management of this waste.

#### 4. CONCLUSION

Literature review shows that various researchers tried natural ingredients to treat the wastewater. Many of the cited articles shows that natural treatment in coagulation and wastewater treatment is always beneficial for sustainable environmental practices. Proper filtration system can be designed to make the wastewater suitable for various uses like gardening, flushing sanitary units, cleaning and other non-potable purposes.

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