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Use of Natural Coagulants from Fruit Peels for Wastewater Treatment in the Industrial Area of Mahasamund District, Chhattisgarh (India)

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Abstract

The increasing demand for sustainable and cost-effective wastewater treatment has led to the exploration of natural coagulants as an alternative to conventional chemical-based therapies. Fruit peels, an abundant agricultural waste, have emerged as a promising natural coagulant due to their rich composition of bioactive compounds, including polysaccharides, proteins, and fiber, which facilitate coagulation and flocculation processes. This study investigates the effectiveness of fruit peels such as those of bananas, oranges, pineapples, and apples, in wastewater treatment. Experimental results demonstrate their ability to reduce turbidity, suspended solids, and organic contaminants while being biodegradable and environmentally friendly. The use of fruit peels enhances water purification efficiency and promotes waste valorization, making it a sustainable approach for wastewater treatment, particularly in resource-limited areas. This study highlights the potential of fruit peels as a green and economical alternative to synthetic coagulants, contributing to sustainable water management solutions.

Keywords: Wastewater Treatment, Fruit Peels, Cost-Effective, Bananas, Oranges, Pineapples.

1. INTRODUCTION

Water is an important constituent of life on Earth. Because of the latest advances in life, the level of purity is degrading day by day, mainly by the addition of several particles, ions, etc. These particles represent transport vehicles for undesirable chemical contaminants and potentially disease-causing microbial pathogens. The removal of these particle materials becomes important to protect public health. The key test to water quality is to test the level of Turbidity. It is the cloudiness or haziness of a fluid caused by a large number of individual particles which are usually invisible by our naked eyes. The more is the level of turbidity of water, the less it is fit for Public use [1-4]. There are numerous methods to remove turbidity, but it would be quite impending and cost-effective if some eco-friendly bio-waste like banana peel is used as an alternative to chemical means. India is the largest producer of bananas and according to FAO sources 21.77 million metric tons of bananas are cultivated annually only in India. The peels of bananas are usually discarded as waste all over the world, which are mainly composed of natural polysaccharides. They also have great medicinal value like anti-fungal and antibiotic properties [5].Banana peel is mainly composed of fiber and lignin whose percentage value changes for stages of maturity. It also contains 6-9% dry matter of protein and 20-30% fiber (measured as NDF). Green

plantain peels contain 40% starch that is transformed into sugars after ripening. Green banana peels contain much less starch (about 15%) when green than plantain peels, while ripe banana peels contain up to 30% free sugars. They also contain lots of vitamins, minerals, and fiber that have proved beneficial for skin care and healing the wound, they also have been used as a substrate for the production of fungal biomass. Besides medicinal properties, it also possesses good natural adsorbent of heavy metals like Chromium, copper, and some dyes from wastewater because of which it is very useful for purification and refining processes [6-11]. Mahasamund district is situated in Chhattisgarh state. At a place called Birkoni, we have tried to complete our research work on purifying the dirty water that is discharged from the industrial area. For research, we first went there and collected water and sent it for experiment and when the experiment was done, we saw that no metallic compound of any kind is found in it. Whatever is found is not that harmful to our body and can be used usefully for plants. Therefore, we thought why not make good use of this wastewater and for this, we started research work on it when we started our study, we saw that along with water, a lot of dust and mud, sand, and sodium chloride-like things are found in it. Then we saw that it is present in water in very large quantities and how can we remove it. We expressed concern on this subject and that is why we made it the subject of our research. Then we saw that when it is found in large quantities, then by which method and how much should it be removed? For this, we thought of a way. We thought of choosing a method that can remove its impurity easily and at a low cost and the common people can also use it. Then we thought of many types of experiments and out of all those methods we adopted the biological method, because we felt that it would prove to be more effective not only for the common man but also for our atmosphere and environment. That is why we have tried to remove its impurity using the biological method.

2. METHODS

Preparation of Synthetic Turbid Water

Turbid water was synthetically prepared by adding bentonite powder to 1 liter of distilled water. The resulting bentonite solution was suspended for 1-2 days after vigorous shaking followed by slow mixing to obtain a uniform dispersion of Bentonite particles. Bentonite is a natural coagulant that contains essential components like aluminum, iron, clay, etc. It is economically available and can be easily used as a natural coagulant.

Fruit Peels as a Natural Adsorbent

That is why we have tried to remove its impurity using the biological method. For that, we first started collecting fruits. We saw that due to the acidity of some fruits, many types of pollution and impurities can be removed from their peels. So we tried to experiment with their peels. For this, we collected all the peels, but we collected them separately, like banana peels.Orange peel, pineapple peel, all these peels separately and dried them in the sun. After drying in the sun, we saw that some moisture remains in it. Then we made its powder. After making the powder, we saw that some more moisture or moisture is still left in it. Then we completely removed the moisture from it through the dryer and then we collected its separate powders. Now we see that its powder has been collected. Then we needed to collect water and we collected water from around this industrial area after collecting, collected all the water separately and stored it. After storing, we saw that our sample had been collected and now we can study and experiment with it. When we collected and stored samples of different waters, we now needed to find out which

impurities were present in them in greater quantity. Then we saw that there was silt and mud in it whose formula Is $C_{16}H_{18}O_8$Now our main aim was to remove it.

3. OBSERVATION

3.1 Effect of Dosage

When we collected and stored samples of different waters, we now needed to find out which impurities were present in them in greater quantity. Then we saw that there was silt and mud in it whose formula Is $C_{16}H_{18}O_8$. Now our main aim was to remove it. Then we thought about which method we could remove it, so for this, we first took banana peel powder, which we mixed up to 20 grams in 100 ml water. After getting 20 grams, we mixed it well and kept it at room temperature. When we kept it at room temperature, then we kept stirring it from time to time and after half an hour we saw that a lump-like substance settled at the bottom. Then we saw that the lump which is present in this water settled in the form of a lump along with the banana peel powder and the mud also settled down in the form of scum. Hence it is capable of removing sodium chloride up to 68% and sludge up to 80%. If we repeat this with banana peel then on getting 30 grams of powder, sodium chloride is 74 and sludge is 94%, and on getting 40 grams of banana peel powder, sodium chloride amount and sludge can be removed up to 96%. Then we see that sodium chloride is 84 and sludge is up to 96% and when we get 50 grams of banana peel powder.Similarly, we took the powder of peel of orange and made a solution of it. After making the solution, mix 20 grams of powder in 100 ml of water, mix it well, and leave it for half an hour. After leaving it for half an hour, we saw that there is 71% sodium chloride and 88% sludge. Then we thought of increasing the amount of peel by 30gm and removing 77% of sodium chloride and 94% of mud. When 40gm of orange peel was used Then we saw that Sodium Chloride was removed up to about 83% the mud was also been removed to about 96%.Now we do this experiment with the peel of the apple. When we mix 20 grams of the powder of the peel of the apple in 100 ml of water and leave it for half an hour, its pH remains 3.6. Now if we see the percentage of water in it, it is 71% and that of the mud is about 88%. After that, we see that sodium chloride has been removed to about 83%. The mud has also been removed to about 96%.Now we take pineapple peel powder and mix 20 grams of powder in 100 ml of water. After mixing it well, leave it for half an hour and see the pH of the water, it is 3.5. Now if we see the percentage of sodium chloride in it, 70% of sodium chloride has been removed and the mud is removed up to about 80%. If we repeat this with peel then on getting 30 grams of powder, sodium chloride is 76% and sludge is 86%. Then we see that sodium chloride is 82% and sludge is up to 92% when we get 40 grams of pineapple peel powder.

3.2 Graphical Representation

Material Name	**100 mlL+ 20 gm**	**100 mL+ 30 gm**	**100 mL+ 40 gm**	**100 mL + 50 gm**

Banana Peel	NaCl- 68% Removal $C_{16}H_{18}O_8$- 80% Removal pH- 4.4	NaCl - 74% Mud - 94% pH - 4.1	NaCl - 80% Mud - 96% pH - 3.8	NaCl - 84% Mud - 96% pH - 3.8
Orange Peel	NaCl- 71% $C_{16}H_{18}O_8$- 88% pH- 3.3	NaCl - 77% Mud - 94% pH - 3.0	NaCl - 83% Mud - 96% pH - 2.8	NaCl – 92% Mud – 96% pH - 2.8
Apple peel	NaCl- 71% $C_{16}H_{18}O_8$- 88% pH- 3.6	NaCl - 77% Mud - 94% pH - 3.2	NaCl - 80% Mud - 96% pH - 2.8	NaCl –90% Mud –96% pH - 2.4
Pineapple peel	NaCl- 76% $C_{16}H_{18}O_8$- 80% pH- 3.8	NaCl - 76% Mud - 86% pH - 3.4	NaCl - 82% Mud - 92% pH - 3.1	NaCl –82% Mud –92%

Table 1: Effect of dosage for removal of NaCl and Mud

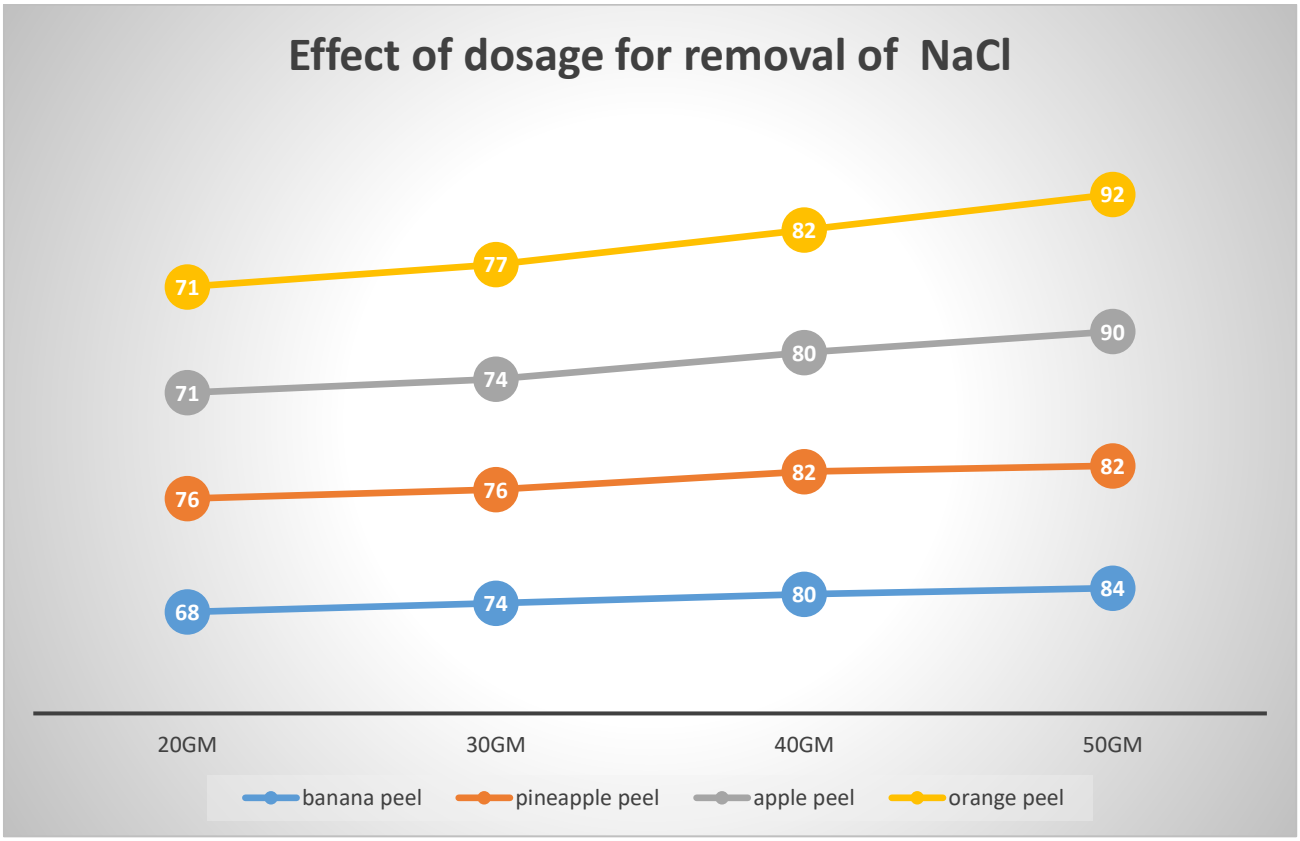

Fig.1 Effect of dosage for the removal of NaCl

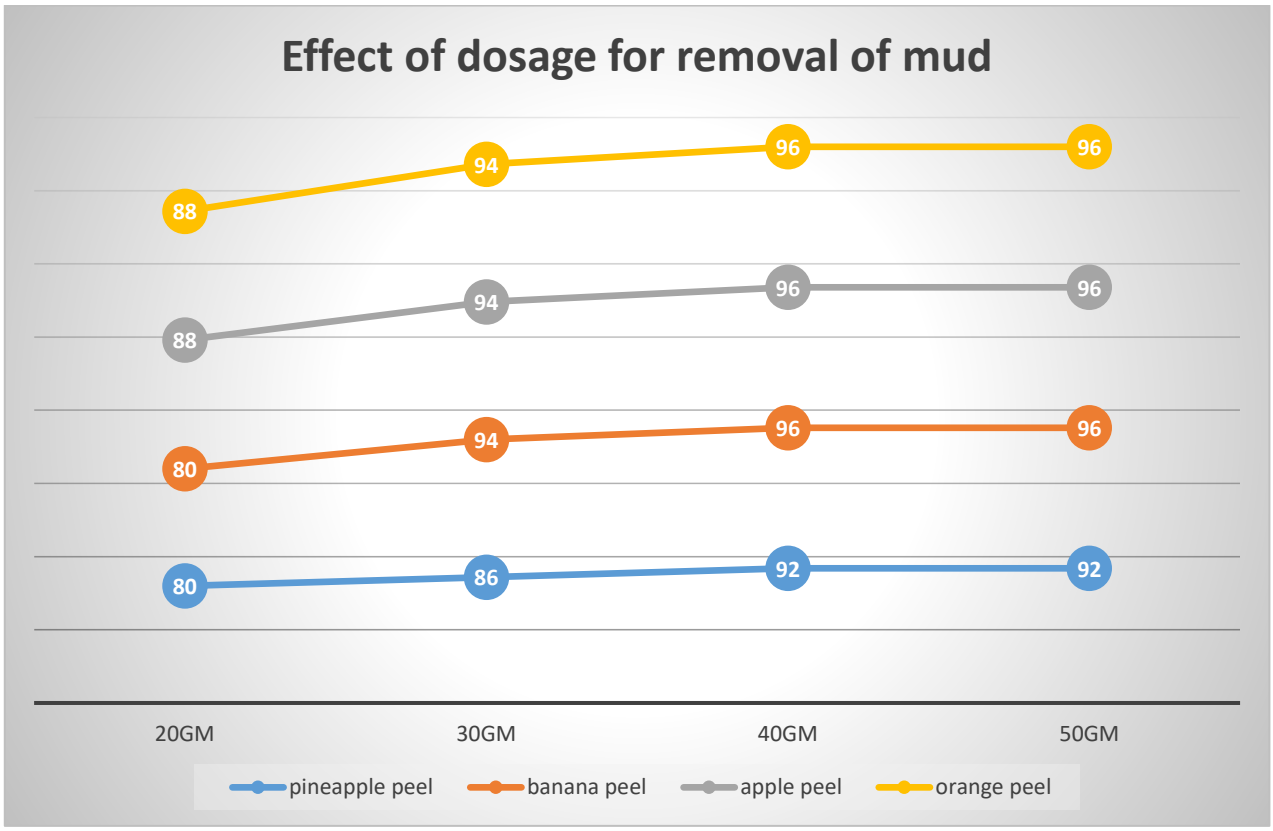

Fig.2 Effect of dosage for the removal of mud

4. RESULT AND CONCLUSION

For the removal of NaCl in wastewater, orange peel is more effective, followed by apple, banana, and pineapple peel (fig.1). As we increase the dosage, the removal of NaCl also increases. The amount of dosage 20gm in 100mL of water remove 68% of NaCl by banana peel, 71% by both apple and orange peel and 76% by pineapple peel. If we take 30gm of dosage,thenitremoves 74% by both banana and apple peel. If we increase the amountto50 gm,thenthe orange peel is most effective inremoving 92 % of NaCl. In the same way for the removal of mud in wastewater, if we increase the dosage amount,the removal of mud also increases. As we shown in fig.2, if we take 50gm of amount,almost all peels workthe same.

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