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Treatment of Wastewater by Using Jackfruit Seeds

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Abstract : The treatment of wastewater using jackfruit seeds was investigated to evaluate their potential as a natural and cost-effective adsorbent. Jackfruit seeds were collected, processed, and characterized before being applied to synthetic and real wastewater samples. Various parameters such as pH, contact time, adsorbent dosage, and initial pollutant concentration were analyzed to determine the efficiency of the treatment. The results showed that jackfruit seed powders significantly reduced levels of contaminants, including organic matter and heavy metals, demonstrating effective adsorption capabilities. This study concluded that jackfruit seeds could serve as a sustainable and eco-friendly alternative for wastewater treatment applications.

IndexTerms **- Jackfruit Seeds, pH, Dosage, Eco-friendly, Powders.**

I. INTRODUCTION

Wastewater treatment is essential to reduce pollutants and protect both human health and environment. Conventional treatment methods, though effective, can be costly and may involve the use of chemical with environmental drawbacks. As a sustainable alternative, researchers are exploring the use of natural and low-cost materials such as agricultural by-products for wastewater purification. One such promising material is jackfruit seeds.

Jackfruit seeds, often discarded as waste, are rich in starch, proteins, and functional groups that can be bind with contaminates. Studies have shown that processed jackfruit seed powder can effectively adsorb heavy metals, dyes, and other pollutants from wastewater through mechanisms such as adsorption and flocculation. This eco-friendly method not only supports waste valorization but also offers a cost-effective solution for wastewater management, especially in developing regions.

II. OBJECTIVES OF THE STUDY

- To study the characteristics of textile wastewater and sewage wastewater.
- To analysis the wastewaters before filtration and after filtration by using jackfruit seeds powders.
- To compare the results with CPCB (Central Pollution Control Board) standards.

III. METHODOLOGY AND MATERIALS

3.1 Methodology

- Collected and washed jackfruit seeds.
- Dried at high temperature under atmosphere.

3.2 Sample

Jackfruit seeds were collected in Neyveli Township, Sewage wastewater was collected behind the pump house at Thillai Kaali Amman in Chidambaram and Textile wastewater was collected from RK Exports in cuddalore.

3.3 Jackfruit seed's powder

Jackfruit seed powder is a fine, processed from of jackfruit seeds (Artocarpus heterophyllus), which are typically by-products consumption. These seeds, once cleaned, dried, and ground into powder, offer a range of beneficial properties due to their rich composition of starch, proteins, dietary fibers, and bioactive compounds. The powder from increases the surface area of the seeds, enhancing their adsorptive properties and making them more effective in capturing contaminants like dyes, heavy metals, and other pollutants from wastewater. Jackfruit seed powder contains functional groups (such as hydroxyl and carboxyl groups) and lignocellulosic materials that contribute to its ability to bind pollutants through adsorption and coagulation

mechanisms. This makes it a sustainable, low-cost, and eco-friendly alternative to conventional chemical treatment methods, offering an innovative solution for wastewater management.

Fig: 1.1 Jackfruit seed

Fig: 1.2 Jackfruit seed's powder

3.4 Sewage Wastewater

Sewage wastewater treatment is a crucial process aimed at removing contaminants from domestic, commercial, and industrial wastewater before it is safely released back into the environment or reused. Sewage wastewater typically contains a mixture of organic matter, suspended solids, nutrients, pathogens, and chemical pollutants, which can pose serious risks to human health and the environment if left untreated. The primary goal of sewage wastewater treatment is to reduce the pollutant load, making the water safe for discharge into natural water bodies. The treatment process generally involves multiple stages, including physical, biological, and chemical methods. These stages are designed to remove solid waste, degrade organic pollutants, eliminate harmful microorganisms, and reduces chemical contaminants such as nitrogen, phosphorous, and heavy metals. In recent years, there has been an increased emphasis on sustainable and cost-effective treatment solutions. Techniques such as the use of natural bio-adsorbents, like jackfruit seed powder, have gained attention as eco-friendly alternatives to conventional chemical treatments.

3.5 Textile Wastewater

The textile industry is one largest consumers of water and one of the majors contributes to water pollution worldwide. During various stages of textile production, such as dyeing, printing, washing, and finishing large volumes of water are used, resulting in the generation of wastewater loaded with pollutants. Textile wastewater typically contains a complex mixture of dyes, chemicals, salts, suspended solids, heavy metals, and high levels of chemical oxygen demand (COD), making it highly toxic and challenging to treat. Textile wastewater can cause severe environmental issues, including water body contamination, soil degradation, and harmful effects on aquatic life and human health. Therefore, effective treatment of textile wastewater is essential to minimize its ecological impact and comply with environmental regulations. Various treatment methods are employed to treat textile wastewater, including physical (filtration, sedimentation), chemical (coagulation-flocculation, oxidation), and biological processes (aerobic and anaerobic digestion). Recently, advanced techniques such as membrane filtration, adsorption using natural materials, and advanced oxidation processes.

3.6 Filtration Process

At the top layer: A layer of larger darker-colored material (possibly gravel or coarse sand 2-50mm).
At the below layer: A layer of smaller, darker-colored material (possibly finer sand 2-10mm or activated carbon).
At the middle layer 1: A layer of natural coagulant jackfruit seed 5-10mm.
At the middle layer 2: A layer of activated carbon charcoal 2-5mm.
At the bottom: A layer of even finer, lighter-colored material (possible very fine sand 0.15-0.5mm).

Fig: 1.3 Filtration layers

IV. RESULTS AND DISCUSSION

4.1 Sewage Wastewater Filtration

Fig: 1.4 Sewage wastewater before filtration

Fig: 1.5 Sewage wastewater after filtration

Table: 1.1 Before Filtration

DOSAGE (g/l)	Turbidity (NTU)	pH
0.0	7.5	8.26
0.10	7.8	8.14
0.20	8.5	8.10
0.30	8.8	8.05
0.40	6.5	7.8
0.50	7.0	8.0

Table: 1.2 After Filtration

DOSAGE (g/l)	Turbidity (NTU)	pH
0.0	9.1	6.5
0.10	9.8	7.0
0.20	10.2	8.5
0.30	10.5	8.20
0.40	9.5	8.35
0.50	10.0	9.0

4.2 Textile Wastewater

Fig: 1.6 Textile Wastewater Before Filtration

Fig: 1.7 Textile Wastewater After Filtration

Table: 1.3 Before Filtration

DOSAGE (g/l)	Turbidity (NTU)	pH
0.0	7.2	8.68
0.10	7.5	8.50
0.20	7.7	8.45
0.30	7.9	8.20
0.40	7.4	8.0
0.50	7.8	8.10

Table: 1.2 After Filtration

DOSAGE (g/l)	Turbidity (NTU)	pH
0.0	8.0	6.4
0.10	8.5	6.5
0.20	8.9	7.0
0.30	9.5	7.8
0.40	8.3	7.5
0.50	9.0	8.0

4.3 Comparison of CPCB standards in irrigation and gardening

SI NO	Parameters	Sewage Wastewater		Textile Wastewater		CPCB Irrigation and gardening	Permissible limit	remarks
		Before filtration	After filtration	Before filtration	After filtration			
1	Hardness (mg/l)	382	320	374	345	300	600	Within limit
2	COD (mg/l)	884	720	940	550	250	1000	Within limit
3	BOD (mg/l)	107	70	109	103	30	100	Within limit
4	Acidity (mg/l)	8.45	7.25	7.8	6.85	6.5-8.5	5.8-9.5	Within limit
5	Alkalinity (mg/l)	560	250	530	260	200	600	Within limit

Table: 1.5 Comparison of various physio-chemical parameters with CPCB irrigation and gardening standards

4.4 Discussion

The table presents data comparing sewage and textile filtration wastewater before and after filtration.

- All measured physio-chemical parameters post-filtration fall within the CPCB permissible limits for irrigation and gardening.
- Filtration resulted in improved water quality for both sewage and textile effluents.
- Notably, parameters such as BOD and COD, which were significantly above permissible levels before filtration, reduced effectively post-filtration.
- The filtration process appears to be efficient in reducing pollutants to acceptable levels for safe reuse.

V. CONCLUSIONS

- The study concludes that the filtration process with jackfruit powder layers treatment process is effective in significantly enhancing the quality of both sewage and textile wastewater.
- Post-filtration analysis reveals that key physio-chemical parameters namely hardness, COD, BOD, acidity, and alkalinity are reduced to levels that comply with CPCB (Central Pollution Control Board) permissible standards for irrigation and gardening.
- The filtration process demonstrates a strong potential for removing harmful substances, making treated wastewater safer and more environmentally friendly for reuse.
- This confirms that both industrial (textile) and domestic (sewage) effluents can be reliably treated through proper filtration systems for non-potable applications, such as agricultural irrigation and landscape gardening.
- The results support the ides that filtration is a viable and sustainable solution to wastewater treatment challenges, especially in regions facing water scarcity or resource management issues.
- Implementation of such treatment technologies can contribute toward conservation of freshwater resources, reduction of environmental pollution, and the promotion of circular water use practices.

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