

Eco-Friendly Pulp Extraction for Paper Production Using Groundnut Shells

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Abstract:- This study presents a sustainable approach to paper production by utilizing groundnut shells, an agricultural residue, as a raw material. Through a modified Kraft process, cellulose was extracted effectively, achieving a recovery rate of 76.18%. The resulting pulp demonstrated properties similar to those derived from traditional hardwood and bamboo sources, validating groundnut shells as a viable alternative. This research highlights the potential of agricultural waste in promoting cost-effective and eco-friendly paper manufacturing.

I. INTRODUCTION

Paper, an essential material, has its roots in ancient China, evolving over centuries into a versatile product for communication, packaging, and industrial applications. Traditional paper production relies on wood, raising environmental concerns due to deforestation. Agricultural residues such as groundnut shells offer an eco-friendly alternative due to their high cellulose content. Cellulose, a biopolymer abundant in nature, forms the structural backbone of plants and can be extracted for paper manufacturing. Groundnut shells, a by-product of peanut processing, consist primarily of cellulose, lignin, and ash, making them suitable for producing paper pulp. Using groundnut shells as a raw material reduces agricultural waste and environmental impact while offering a cost-effective solution for paper production.

II. MATERIALS AND METHODS

➤ Raw Materials

Groundnut shells, collected from oil mills and agricultural waste, serve as the primary raw material. Their chemical composition includes:

- **Cellulose:** A fibrous component critical for pulp production.
- **Lignin:** A complex polymer contributing to plant rigidity.
- **Ash:** Inorganic residues.

➤ Chemicals Used

The following chemicals were employed:

- Sodium hydroxide (NaOH)
- Sodium hypochlorite (NaClO)
- Sodium sulfide (Na₂S)
- Sodium carbonate (Na₂CO₃)

➤ C. Process Flow Sheet

• Steps:

- ✓ **Raw Material Collection:** Groundnut shells were sourced from processing units.
- ✓ **Pre-Treatment:** Shells were washed to remove impurities, dried, and blended to increase surface area.
- ✓ **Cooking Process:**
 - ✓ A cooking liquor was prepared using NaOH, Na₂SO₄, and Na₂CO₃ in a ratio of 58.6%, 27.1%, and 14.3%, respectively.
 - ✓ Groundnut shells were heated in the liquor at 90°C for 4.5–5.5 hours to dissolve lignin and extract cellulose.
- ✓ **Separation of Cellulose:** The pulp (brown stock) was separated from the black liquor using filtration.
- ✓ **Washing:** Residual lignin was removed through repeated washing with water.
- ✓ **Bleaching:** Sodium hypochlorite was used to whiten the pulp.
- ✓ **Drying:** The bleached cellulose was dried at 80°C for 30 minutes to produce paper-grade pulp.

➤ Experimental Observations

- **Yield:** From 20 grams of groundnut shells, 18 grams of pulp were obtained, corresponding to a 76.18% recovery rate.
- **Properties:** The cellulose pulp exhibited physical and chemical characteristics similar to conventional sources such as hardwood and bamboo.

III. CONCLUSION

This study demonstrates that groundnut shells can serve as a sustainable and cost-effective alternative for paper pulp production. With a cellulose recovery rate exceeding 75%, this method aligns with environmental goals by utilizing agricultural waste. Groundnut shell-derived pulp possesses comparable qualities to conventional materials, making it suitable for widespread application in paper manufacturing.

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