SUSTAINABLE PRODUCTION OF ACTIVATED CARBON FROM WASTE COCONUT SHELLS AND ITS APPLICATION IN WASTE WATER TREATMENT

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INTRODUCTION

Water pollution due to industrialization and improper waste disposal introduces toxic metals like lead, cadmium, and mercury into natural water sources, posing serious environmental and health risks. Conventional removal methods, such as precipitation and ion exchange, have drawbacks like secondary pollution and high costs. Activated carbon (AC) emerges as a superior alternative due to its sustainable production from coconut shells, offering high adsorption capacity and recyclability without generating additional pollutants. This approach supports environmental sustainability by repurposing waste materials and reducing energy consumption in water treatment processes.

ABSTRACT

The carbonized shells was chemically characterized during activation and the subsequent products was analyzedwith FTIR by our team at First Technical University, Nigeria. The treatment processes was carried out with the best product and utilized under various conditions including varied pH, contact time and amount of product used with the corresponding results analyzed with UV spectrophotometer to emphasize optimal conditions.

MATERIALS & METHODS

The study utilized coconut shells as a carbon precursor and calcium chloride ($CaCl_2$) as an activating agent to produce activated carbon. Coconut shells were cleaned, dried, and thermally treated at 250°C to remove moisture and volatile components. After blending and sieving, carbonization was conducted at 650°C in an oxygen-limited environment. Chemical activation involved mixing $CaCl_2$ with carbonized biochar, followed by sonication and washing. FTIR analysis characterized functional groups, crucial for adsorption properties. UV-spectrophotometry calibrated with copper sulfate solutions measured adsorption efficiency under varied conditions: activated carbon quantity, pH, metal concentration, and contact time. These methods aimed to optimize activated carbon performance in removing toxic metals from wastewater.

RESULTS & DISCUSSION

The activated carbon exhibited low ash content (0.76%) and high carbon content (72.4%), indicating suitability for effective adsorption without interference from minerals. FTIR analysis identified functional groups like hydroxyl (-OH) and carbonyl (C=O), crucial for adsorption capacity. UV spectroscopy calibration showed a strong linear relationship (R^2 = 0.9985) between absorbance and $CuSO_4$ concentration, validating its use in quantifying metal ions in treated wastewater. Optimal conditions for $CuSO_4$ removal included acidic pH (pH 3) and higher amounts of activated carbon (3 grams), with extended contact time (30 minutes) enhancing efficiency. The study recommends utilizing waste coconut shells for sustainable activated carbon production and underscores the material's versatility in treating wastewater with varying heavy metal concentrations.

Figure 4.3: UV Calibration Curve for the CuSO4 Solutions

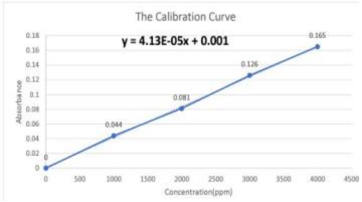

Figure 4.4: Different Contact times and its corresponding percentage removal

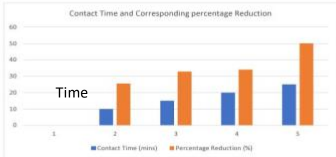

Figure 4.5: Varied amount of Activated Carbon and its corresponding percentage removal