

Effect of Dual Acid Treatment Assisted by Ultrasonication Technique on Recovered Carbon Black Derived from Waste Tire

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Structured Abstract

Background: The abundance of waste tires creates significant environmental and health problems. One way to address this is through pyrolysis, which breaks down waste tires into gas, oil, and recovered carbon black (rCB). rCB has many potential uses, but it often contains impurities that lower its quality compared to new carbon black. This study used dual-acid washing to improve rCB quality by reducing ash content and enhancing its surface properties. This improvement could make rCB more useful in various products, helping to reduce waste and pollution from tire disposal.

Methods: To treat rCB, 50 grams were sieved to ensure uniform particle size. The sieved rCB was dried at 120°C for 24 hours. Solutions of H₂SO₄ and HCl were prepared. Ten grams of the dried rCB were mixed with 1M H₂SO₄, stirred well, and the mixture was filtered. The filtered rCB was washed with hydrochloric acid until the pH was neutral (pH 7). This process was repeated using higher concentrations of H₂SO₄ (5M, 6M, and 10M) to study the effects of different acid strengths on the rCB.

Results: FTIR analysis showed that after dual acid treatment, the aromatic rings in the material stayed the same, but there were fewer carbon deposits. New oxygen-containing groups formed. Acid treatments reduced the ash content from 14.58% to 10.64% with 5M H₂SO₄, improving surface activity. BET analysis showed that the untreated rCB had a low surface area of 6.2693 m²/g, but 6M H₂SO₄ treatment increased it to 12.3895 m²/g. These results indicate that dual acid treatment enhances rCB's porosity and surface area, making it better for adsorbents and catalysts.

Conclusion: After acid treatment, FTIR showed unchanged aromatic C=C stretching in rCB, while C=O stretching decreased, indicating less carbon deposits with stronger acids. New C-O stretching indicated oxygen-containing groups formed. Ash content dropped from 14.58% to 10.64% with 5M H₂SO₄, improving surface activity. BET analysis revealed untreated rCB had low surface area (6.2693 m²/g), but 6M H₂SO₄ treatment increased it to 12.3895 m²/g. Dual acid treatment enhances rCB's porosity and surface area, making it more suitable for applications like adsorbents and catalysts.

Keywords: Recovered Carbon Black, Dual Acid Treatment, Waste Tire, Pyrolysis, Acid Washing

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