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CARBONACEOUS ADSORBENTS FROM SOLID INDUSTRIAL WASTE

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Solid carbon residue, also known as carbon black, is the carbonaceous material left after rubber degradation during the pyrolysis process. It is a potential human carcinogen, and short-term exposure to high concentrations can cause discomfort in the upper respiratory tract, leading to mechanical irritation. Industrial waste poses a significant environmental challenge, and finding effective methods to utilize and mitigate its impact is of paramount importance.

Activation is one of the methods used to modify carbonaceous materials and involves the partial oxidation of carbonized layers in its structure, using water vapor, carbon dioxide, hydroxides, or carbonates of alkali metals as activation agents.

The aim of this study was to develop and characterize adsorbent materials derived from solid industrial waste. A series of carbonaceous adsorbents were obtained from the pyrolysis residue of tires. Various techniques such as physical, chemical, and thermal treatments were employed to modify the waste materials and enhance their adsorption properties. Activation was carried out in a horizontal reactor, using water vapor as the activation agent, as well as pre-treatment with KOH, H_3PO_4, and HNO_3. The obtained adsorbents were characterized using gas adsorption, IR spectroscopy, and thermal analysis.

The pyrolysis residue of the tires presents a homogeneous substance with a black color, finely dispersed, immiscible in water. In order to assess the thermal stability of the residue, thermal analysis was performed in a dynamic air atmosphere with an airflow rate of 100 cm^3/min and a heating rate of 10°C/min. The analysis results indicate that the residue remains stable up to 320°C, and the total thermal degradation occurs at 750°C. From the adsorption isotherm data, the pore volume distribution curve was constructed as a function of radius. The obtained results allow us to characterize the morphology of the char: the specific surface area is 20 m^2/g, and the reversibility of the isotherm indicates the presence of open pores with cylindrical shape, formed as a result of agglomeration of char particles, with an effective pore radius of 11 nm. The activation of the carbonized material allowed the production of activated carbons with a specific surface area of up to 700 m^2/g.

The obtained results indicate the possibility of obtaining carbonaceous adsorbents with economic potential from solid waste generated during tire pyrolysis. This study highlights the feasibility of obtaining and characterizing adsorbent materials from solid industrial waste. The utilization of such materials not only offers a sustainable solution for waste management but also presents an opportunity to address environmental concerns and promote cleaner industrial practices.

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