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Effect of Ramp Rate on the Preparation of Activated Carbon from Saudi Date Tree Fronds (Agro Waste) by Physical Activation Method

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Abstract : Saudi Arabia is the major date producer in the world. In order to maximize the production from date tree, pruning of the date trees is required annually. Large amount of this agriculture waste material (palm tree fronds) is available in Saudi Arabia and considered as an ideal source as a precursor for production of activated carbon (AC). The single step procedure for the preparation of micro porous activated carbon (AC) from Saudi date tree fronds using mixture of gases (N2 and CO2) is carried out at carbonization/activation temperature at 850°C and at different ramp rates of 10, 20 and 30 degree per minute. Alloy 330 horizontal reactor is used for tube furnace. Flow rate of nitrogen and carbon dioxide gases are kept at 150 ml/min and 50 ml/min respectively during the preparation. Characterization results reveal that the BET surface area, pore volume, and average pore diameter of the resulting activated carbon generally decreases with the increase in ramp rate. The activated carbon prepared at a ramp rate of 10 degrees/minute attains larger surface area and can offer higher potential to produce activated carbon of greater adsorption capacity from agriculture wastes such as date fronds. The BET surface areas of the activated carbons prepared at a ramp rate of 10, 20 and 30 degree/minute after 30 minutes activation time are 1094, 1020 and 515 m2/g, respectively. Scanning electron microscopy (SEM) for surface morphology, and FTIR for functional groups was carried out that also verified the same trend. Moreover, by increasing the ramp rate from 10 and 20 degrees/min the yield remains same, i.e. 18%, whereas at a ramp rate of 30 degrees/min the yield increases from 18 to 20%. Thus, it is feasible to produce high-quality micro porous activated carbon from date frond agro waste using N2 carbonization followed by physical activation with CO2 and N2 mixture. This micro porous activated carbon can be used as adsorbent of heavy metals from wastewater, NOx SOx emission adsorption from ambient air and electricity generation plants, purification of gases, sewage treatment and many other applications.

Keywords : activated carbon, date tree fronds, agricultural waste, applied chemistry
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