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Porosity and Surface Chemistry of Functionalized Carbonaceous Materials from Date Palm Leaflets

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Abstract : Date palm leaflets were utilized as a precursor for activated carbon (AC) preparation using KOH activation. AC produced was oxidized using nitric acid producing oxidized activated carbon (OAC). OAC that possesses acidic surface was surface functionalized to produce basic activated carbons using linear diamine compounds (ethylene diamine and propylene diamine). OAC was also functionalized to produce hydrophobic activated carbons using ethylamine (EA) and aniline (AN). Dehydrated carbon was also prepared from date palm leaflets using sulfuric acid dehydration/ oxidation and was surface functionalized in the same way as AC. Nitric acid oxidation was not necessary for DC as it is acidic carbon. The surface area of AC is high (823 m2/g) with microporosity domination, however, after oxidation and surface functionalization, both the surface area and surface microporosity decrease tremendously. DC surface area was low (15 m2/g) with mesoporosity domination. Surface functionalization has decreased the surface area of activated carbons. FTIR spectra show that -COOH group on DC and OAC almost disappeared after surface functionalization. The surface chemistry of all carbons produced was tested for pHzpc, basic sites, boehm titration, thermogravimetric analysis and zeta potential measurement. Scanning electron microscopy and energy dispersive spectroscopy in addition to CHN elemental analysis were also carried out. DC and OAC possess low pHzpc and high surface functionality, however, basic and hydrophobic carbons possess high pHzpc and low surface functionality. The different behavior of carbons is related to their different surface chemistry. Methylene blue adsorption was found to be faster on hydrophobic carbons based on AC and DC. The Larger adsorption capacity of methylene blue was found for hydrophobic carbons. Dominating adsorption forces of methylene blue varies from carbon to another depending on its surface nature. Sorption forces include hydrophobic forces, H-bonding, electrostatic interactions and van der Waals forces.

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