Investigating the surface characteristics of chemically modified and unmodified rice husk ash; bottom-up approach for adsorptive removal of water contaminants

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ABSTRACT

Rice ash (RHA) can be found in many agricultural countries yet the material is not utilized in its full capacity. In this research, it is attempted to chemically modify RHA and to investigate the surface chemistry of the materials considering their potential use in the removal of pollutants from water. RHA is chemically modified using acetic acid to increase the presence of –COOH functional groups on the surface. Both RHA and modified rice husk ash (MRHA) are analyzed using Fourier transform infrared spectrometry, zero point charge (pHzpc) analysis, zeta potential measurement, specific surface area, particle size measurements, and quantitative determination of –COOH, to determine the changes in surface. All the studies confirm the modification process and the amount of –COOH in MRHA increases by 0.104 meq/g compared to RHA. The pHzpc is lowered from 8.3 to 6.5 after modification. Zeta potential is increased from $−44.50$ to $−36.21$ mV while the specific surface area is increased from 0.52 to 2.81 m$^2$/g. Adsorption studies using Cu$^{2+}$ ions as the target pollutant show 99% removal efficiency after modification compared to 95% removal efficiency before modification in 3 h reaction period. The increment in sorption efficiency may be attributed to the changes in specific surface area, –COOH groups and pHzpc. Possibilities of simultaneous removal of different pollutants using a mixture of RHA and MRHA are discussed.

Keywords: Acetic acid; Adsorption; Chemical modification; Functional groups; Rice husk ash

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