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Characterization of rice hull magnetic activated carbon and a rotary drum type magnetic separator with ferromagnetic mesh filters

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We have developed rice hull magnetic activated carbon (RH-MAC) and studied its adsorption properties for heavy and valuable metal ions in water and magnetic separation properties using a rotary drum type magnetic separator with ferromagnetic mesh filters. RH-MAC was synthesized by impregnating rice hull with an iron nitrate solution and heat-treatments in nitrogen and carbon dioxide atmosphere. In those processes, a lot of meso-pores and nano-size magnetite were generated inside the activated carbon. The magnetization of RH-MAC increased with increasing concentration of iron nitrate solution. The maximum magnetization of RH-MAC3 made from 1.6 mol/L iron nitrate solution reached 22.2 Am^2/kg at 1 T. RH-MAC had excellent properties for metal ions especially for Cd and Rb ions. To evaluate the magnetic separation properties for RH-MAC, a rotary drum type magnetic separator with the multiple magnetic mesh filters wrapped around a permanent magnet drum was used. It was conformed that capacity rate of RH-MAC increased by multiplying magnetic mesh filters, and the capture rate of RH-MAC3 reached 94% at the flow rate about 900 ml/min with 0.5T and the capture rate reached 98.2% by using triple magnetic mesh filter at the flow rates of 250 ml/min. We also simulated the magnetic particle trajectory by the finite element method for magnetic separation. The simulation results qualitatively matched up to the experimental results. To realize a high speed water processing, we proposed a high magnetic field rotary drum type magnetic separator using a superconducting magnet.

Keywords: Rice hull magnetic activated carbon, High gradient magnetic separation