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Activated carbon-doped with iron oxide nanoparticles (Fe_2O_3 NPs) preparation: Controlling size, shapes and purity

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Inspired by the intensively studies of activated carbon used as high performance adsorbent materials, we prepared iron oxide nanoparticles (Fe_2O_3 NPs) and produced activated carbon doped with iron oxide nanoparticle (GAC-Fe_2O_3 NPs). The synthesis method was a facile chemical precipitation using sodium hydroxide (NaOH) as precipitant agent. The impact of varying the molar ratio of reactant and precipitant (1:1, 1:1.5, 1:2) and of varying precipitating temperature (50, 70, 90 °C) were explored. Production yield of synthesized Fe_2O_3 NPs and GAC-Fe_2O_3 NPs were also reported. The physical and chemical characteristic of the synthesized samples were examined by transmission electron microscope (TEM), Brunauer–Emmett–Teller analysis (BET), thermogravimetry analysis (TGA), Fourier transform infra-red (FT-IR) and ultraviolet-visible spectrophotometer. The smallest synthesized Fe_2O_3 NPs of 10 nm (approximate size) with specific surface area of 110 m2/g were obtained for preparing with the $FeCl_3$:NaOH molar ratio of 1:1 at 70 °C and with the $FeCl_3$:NaOH molar ratio of 1:1.5 at 90 °C. With higher $FeCl_3$:NaOH molar ratio and higher precipitating temperature, the synthesized Fe_2O_3 NPs formed more rugby shape with finer surface. By the chemical characteristic, we observed the impurity about 5-10 wt.% devoted for sodium salt due to insufficient purification. Minimal Fe_2O_3 NPs coated on activated carbon were about 75 wt.% for the synthesis at molar ratio of the $FeCl_3$:NaOH 1:1.5 and 70 °C. The Fe_2O_3 NPs production yield was about 45-60% and 75-80% for the synthesized Fe_2O_3 NPs and Fe_2O_3 NPs doped activated carbon, respectively.

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