Controlled synthesis of iron oxide NPs derived from conventionally and ultrasonically prepared iron(III) coordination polymer: Potential remediation and catalytic degradation of methylene blue

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Abstract:

Coordination polymers acquired much interest due to their powerful applications. Herein, coordination polymer of the formula [Fe(PZDC)Cl(H2O)]n has been prepared conventionally and ultrasonically. The structure was investigated using elemental analysis, IR and X-ray diffraction (XRD). The ultrasonic-assisted synthesis steers the formation of the crystalline coordination polymer while the conventional method leads to the amorphous phase. Calcination of the synthesized coordination polymers was made in glass tubes (length ¼ 200 mm and width ¼ 15 mm) under air at variable temperatures. Depending on the calcination conditions, different iron oxide phases/polymorphs were produced. Maghemite; γ-Fe2O3 was formed by heat-treatment at 350 ◦C for 1 h regardless of the synthesis way of the precursor. X-ray single phase of hematite; α-Fe2O3 was obtained by calcination of the conventionally prepared precursor at 450 ◦C for 1 h. Nitrogen adsorption-desorption isotherms showed that, the specific surface areas of the γ-Fe2O3 (conventionally produced precursor), γ-Fe2O3 (ultrasonically formed precursor) and α-Fe2O3 are 125, 132 and 30.5 m2g-1, respectively. Magnetic measurements showed that the best properties are exhibited by γ-Fe2O3 NPs synthesized from the conventionally prepared precursor; highest values of saturation magnetization (Ms), remanent magnetization (Mr) and coercivity (Hc) are obtained. On the other hand γ-Fe2O3 showed the lowest magnetic properties. The activity of prepared coordination polymers and iron oxide phases for removal of methylene blue (MB) was tested. α-Fe2O3 (conventionally formed precursor) showed the highest adsorption efficiency (~22%). On the other side, the coordination polymer (conventionally prepared) exhibited the best removal efficiency of methylene blue in a Fenton-like process. Degradation efficiency of 97.2% was achieved in a very short time (15 min).

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