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Decomposition and removal of hydrazine by Mn/MgAl-layered double hydroxides

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ABSTRACT

The layered double hydroxide (MgAl-LDH) was modified by manganese for obtaining Mn/MgAl-LDH. The obtained material was characterized by inductively coupled plasma, X-ray powder diffraction, Fourier-transform infrared spectroscopy, scanning electron microscopy and X-ray photoelectron spectroscopy. The as-synthesized Mn/MgAl-LDH was investigated for the decomposition and removal of hydrazine in a batch system. Factors affecting the decomposition and removal of hydrazine such as pH, time, initial hydrazine concentration and temperature were optimized. At the optimal pH 8, Mn/MgAl-LDH dose (100 mg), time of 90 min and temperature of 293 K, the hydrazine decomposition and removal percentage was 100% for initial concentrations of 5, 10 and 15 mg L^{-1}. Where, the pure MgAl-LDH showed 14% removal at 90 min for 10 mg L^{-1} of hydrazine compared to Mn/MgAl-LDH. The decomposition of hydrazine increased when the temperature was increased from 293 to 318 K and the time of complete decomposition reduced from 90 to 45 min, respectively. The decomposition process of hydrazine on Mn/MgAl-LDH depended on the formed ions of manganese(II) and (III) as well as Mn_3O_4 on the surface. The existence of Mn^{3+} as a strong oxidant could decompose hydrazine to nitrogen and hydrogen. The catalytic decomposition of hydrazine was best followed by the first-order rate law and the calculated E_a value was found to be 24.841 kJ mol^{-1}. The simple methodology regarding the material preparation and the method used as well as its effectiveness may provide a promising future for the decomposition and removal of hydrazine.

Keywords: Layered double hydroxide (LDH); Manganese; Hydrazine; Decomposition; Removal

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