Cost–effective microwave rapid synthesis of zeolite NaA for removal of methylene blue

Abstract:

In this study, microwave rapid synthesized NaA (NaAmw) was used to adsorb a methylene blue (MB) from an aqueous solution. The adsorption was optimized under four independent variables including: pH, adsorbent dosage, initial concentration, and ageing time based on central composite design (CCD) with response surface methodology (RSM). A period of 15 min was determined to be the optimum microwave ageing time for the synthesis of NaAmw, which is about sixteen times shorter than using conventional heating technique. An amount of 1.0 g L 1 NaAmw demonstrated the optimum dosage for adsorption of 120 mg L 1 MB, with predicted adsorption uptake of 53.5 mg g 1, at pH 7 within 1 h of contact time at room temperature. This result approximated the laboratory result, which was 50.7 mg g 1. The experimental data obtained with NaAmw best fits the Langmuir isotherm model and exhibited a maximum adsorption capacity (qmax) of 64.8 mg g 1, and the data followed the first-order kinetic equation. The intraparticle diffusion studies revealed that the adsorption rates were not controlled solely by the diffusion step. Thermodynamic studies showed that the adsorption is endothermic, non-spontaneous in nature, and favor at high temperature. These results confirm that the adsorption process of MB onto NaAmw was controlled by both physisorption and chemisorption. The reusability study shows that the NaAmw was still stable after five cycling runs. These results indicate that NaAmw efficiently adsorbed MB, and could be utilized as a cost-effective alternative adsorbent for removing cationic dyes in the treatment of wastewater.