Modification of ZSM-5 Nanozeolite by Transition Metals such as Co and Fe and Their Applications in Adsorption of Acridine Orange Dye

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It was found that ZSM-5 zeolite with small or nanosized crystallite could achieve excellent catalytic performance in certain reactions [1]. However, most publications concerning the synthesis of ZSM-5 with small crystallite always use the Tetrapropyl ammonium hydroxide or bromide as templates. The substitution of Co and Fe atoms into the nanozeolite framework structure could be applied to the large pore nanozeolite by means of modified treatments as well as direct hydrothermal synthesis. The Co and Fe containing zeolites have selective catalytic properties in the various oxidation reactions [2]. Many industries use dyes and pigments in their products [3]. Wastewaters containing dye are usually treated by physical or chemical processes [4]. Dyes can be classified according to their structure as an ionic and cationic [5]. Acridine orange is a nucleic acid selective fluorescent cationic dye useful for cell cycle determination. In the low pH conditions, the dye will emit orange light when excited by blue light.

In this study, we investigated a novel method for the synthesis of ZSM-5 nanozeolite. The ZSM-5 nanozeolite was modified by transition metals such as Co and Fe and was characterized using X-ray diffraction (XRD), scanning electronic microscopy (SEM) and Fourier transform infrared (FT-IR) techniques. Adsorption of Acridine orange onto the Co-ZSM-5 and Fe-ZSM-5 nanozeolites has been investigated in an aqueous medium. Different parameters such as contact times (i.e., 20, 40, 60, 80 and 100 min), temperatures (i.e., 303, 313 and 323 K) and pH (i.e., 4, 6, 8, 10, and 12) were investigated using a PG instrument Ltd–Model T90+ UV spectrophotometer at a maximum wavelength ($\lambda_{\text{max}}$) of 477 nm.

In conclusion, we developed an effective method for the synthesis of ZSM-5 nanozeolite that modified by cobalt and iron. Removal of dye from wastewaters was performed by modified ZSM-5 nanozeolite using Uv-vis technique. Results indicated that the synthesized Fe-ZSM-5 and Co-ZSM-5 nanozeolite can be utilized as a good adsorbent for Acridine orange dye. Application of modified ZSM-5 nanozeolite as an adsorbent was found to increase efficiency of Acridine orange adsorption as compared to the unmodified ZSM-5 nanozeolite.

REFERENCES