Feasibility of NH_2-MIL-125 as an adsorbent for the removal of organic pollutant in water

ABSTRACT

Titanium-based benzenedicarboxylate metal-organic framework (MIL-125) is a nanoporous material that exhibits high surface area and unique pore architecture. The stability of MIL-125 in water, however, is the major drawback that limits the application of this material in aqueous condition. This study reports the water stability of amino-functionalized MIL-125 (as NH_2-MIL-125), as well as its adsorption capability towards cationic methylene blue (MB) in comparison to that of MIL-125. Both MIL-125 and NH_2-MIL-125 compound were prepared by reflux method followed by activation through conventional solvent-exchange technique. Framework of the as-synthesized of MIL-125 and NH_2-MIL-125 was confirmed by powder X-Ray diffraction whilst the amino-functional group was confirmed through FTIR spectroscopy. The C-N stretching vibration peak found at 1256 cm^{-1} was the characteristic feature for the NH_2-MIL-125 compound. Morphology of the as-synthesized MIL-125 and NH_2-MIL-125 realized by the scanning electron microscopy as circular-plate shape with the crystal size ranges between 0.5 to 1 μm. The obtained results showed that NH_2-MIL-125 had better water stability that exceeded 24 hours in comparison to MIL-125 which disintegrated in water in less than 1 hour. Furthermore, preliminary adsorption result revealed that NH_2-MIL-125 was able to adsorb 90% of MB in water (with 360.60 $mg.g^{-1}$ of the calculated adsorption capacity towards MB) whilst only 68% of MB was adsorbed by MIL-125 (with 272.58 $mg.g^{-1}$ of the calculated adsorption capacity towards MB) within 4 hours of reaction time. This study implies that NH_2- MIL-125 material can be a potential adsorbent for the removal of cationic organic pollutants in water.