Abstract

The sulfur removal methods from petroleum products have become an important research topic. Sulfur poisons the catalysts found in vehicles engines and it is also a major air pollutant (Nehlsen, 2005). Recent sulfur specifications require refineries to produce ultra-clean products (Ma *et al*., 2002). This work aims at exploring a batch adsorptive desulfurization technique using a polymer-supported imidation agent (PI) as an adsorbent. The test was carried out at atmospheric pressure and on two commercial diesel fuels with sulfur contents of 5200 (Case 1) and 670 (Case 2) mg/kg which resembles the feed and outlet streams from the hydrodesulfurization (HDS) reactor respectively. The adsorbent was synthesized according to the procedure described by Shiraishi *et al*. (2003), BET, FTIR, SEM equipped with EDS and TGA were used for charaterization of the adsorbent.

The PI was successfully synthesized and its surface area was 0.5333 m^2/g which was incredibly lower than that of the PI synthesized by Fadhel (2010). Hence carbon nanotubes (CNTs) were added to the solution with the aim of improving the sulfur removal efficiency of PI. The obtained results indicated that PI with CNTs yield better results than PI without CNTs. In overall, the lowest sulfur content of 3462 mg/kg (33% removal efficiency) and 26 mg/kg (96% removal efficiency) for Case 1 and Case 2 respectively were obtained. Furthermore, the adsorbents were most effective at lower mixing rates (150 – 400 rpm), longer contact time (30 – 40 hours), practically high adsorbent amount (1 g) and moderate lower temperatures (25 – 50 ºC).

The Freundlich adsorption isotherm model was the best fit to the experimental data in both Case 1 and Case 2. The kinetic model that best fitted well the experimental data is the pseudo-second-order model for both Case 1 and Case 2. The kinetic rate constant for Case 2 (4.079×10^{-3} g/mg.min) was greater than that for Case 1 (6.75×10^{-5} g/mg.min) thus indicating that fuel with low sulfur content has a higher sorption uptake than fuel with high sulfur content.

Based on the results obtained in this study, it is suggested that the adsorption of sulfur at high sulfur content fuel is not capable to be used as a complimentary method to the HDS process. On the other hand, at low sulfur content fuel, there is an opportunity for combining this method with the traditional HDS method to achieve ultra-clean fuel.