Abstract

Due to the latest environmental regulations, a deep desulfurization to achieve an ultra clean transportation fuels with less than 15 ppmw of sulfur became an increasingly important subject worldwide. Therefore, developing alternative desulfurization process is highly desirable.

Based on the fact that ultrasonic waves can destabilize the boundary layer between solid catalyst and reagent and hence increasing the reaction rate, a sono oxidation (20 KHZ, 750 W, operating at 40%) of the commercial hydrotreated diesel fuel, containing 513 ppmw sulfur, was investigated. The study propose the application of functionalized multiwalled carbon nanotubes as a catalyst and hydrogen peroxide / carboxylic acid system as oxidant in a batch system at mild operating conditions. In this step the non polar dibenzothiophene (DBT) in diesel oli is converted to its corresponding polar sulfones. A liquid/liquid extraction using acetonitrile as a solvent has been ultilized for the removal of the sulfones from oxidized diesel.

The presence of oxygen containing group (OH,COOH on the surface of the oxidized nanotubes treated with a concentrated mixture of HNO_3 and H_2SO_4) was characterized and confirmed by the means of scanning electron microscopy (SEM), X-ray diffraction (XRD), and fourier transform infrared spectroscopy(FT-IR).

The influence of the oxidant/fuel ratio (0.2-1) vol./vol., concentration of oxidant (H_2O_2) (50%-15%), time (2-20) min, catalyst dose (0-5) gm/l and

solvent/oxidized oil ratio (1:1, 2:1, 3:1) vol./vol. on the efficiency of desulfurization were investigated.

An empirical formula that represents the relationship between the sulfur removal efficiency and the operating parameters studied was proposed and found to be:

$\%SR=3.33+215.9 *G-403.7 *G*D+3.13*t*N+395.4*N*D-163.5*N^2$

R= 0.96111

The experimental results exhibit that the highest removal efficiency of sulfur could amount approximately to 98 %, and sulfur level can be reduced to 11 ppm at t=10 min; Temp.=70°C; 40% Amp.; $\%H_2O_2$=50; CNTs dos.= 0.5gm/l; HCOOH / H_2O_2 (v/v)=0.5; O/S (v/v)=0.5 and solvent ratio=3:1. This indicates that functionalized mutltiwalled CNTs as catalyst has useful applications in petroleum industry because of their operational simplicity, high efficiency, and high capacity.