385b Comparison of Adsorbents for Deep-Desulfurization of Diesel

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Removal of sulfur from the transportation fuels has gained importance ever since governments worldwide regulate further drastically lowering of sulfur levels in coming years. It is now required that the sulfur levels in diesel and gasoline be brought down to a maximum of 15 and 30 ppmw (parts per million on weight basis) from the existing levels of the order of 430 and 130 ppmw respectively. Sulfur compounds have been removed by hydrodesulfurization (HDS) process operated at elevated temperature (>300oC) and pressure (20-100 atm H2) using Co-Mo/Al2O3 or Ni-Mo/Al2O3 catalyst. Since the HDS process is less effective for refractory sulfur compounds such as benzothiophene (BT), dibenzothiophene (DBT) and 4,6-dimethyldibenzothiophene (4,6-DMDBT) and needs much energy and high capital costs for deep desulfurization, the search for alternatives to HDS process is attracting numerous studies on desulfurization.

In this work, we investigated the adsorption capacity of sulfur compounds on several adsorbents of metal impregnated zeolite-Y and activated carbon. A breakthrough capacity were observed for Ni-Y (~ 40 mg S/g ads.) and Cu-Y (~ 30 mg S/g ads.) zeolites at room temperature for removing sulfur to less than 10 ppm from a model diesel of 150 ppmw sulfur compounds comprising BT, DBT and 4,6-DMDBT. The aromatics content and moisture in diesel were found to have detrimental effect on the desulfurization capacity of the adsorbents. Sorption capacity of sulfur on activated carbon was insensitive to aromatic concentration in diesel, but the adsorption capacity of sulfur was low, 2 mg S/g ads., for the commercial diesel. Sorption capacities will be reported for the modified activated carbon and zeolite which contains metallic nano-particles.