Adsorptive Removal of Ba, Na, Ni and V From Fuel Oils Using Low-cost Fe3O4@Cellulose Nanocrystals: Adsorption Kinetics, Isotherm, Thermodynamic and Recyclability Studies

Authors : Njabulo S. Mdlulia, Masixole Sihlahlaa, Vusimuzi Pakadea, Philiswa N Nomngongob, Nomvano Mketoa

Abstract : The removal of Ba, Na, Ni and V metals in crude oil, gasoline, diesel and kerosine was achieved by using Fe3O4@cellulose. The Fe3O4@cellulose was synthesized by using the co-precipitation method and was then characterized using the scanning electron microscope (SEM), energy dispersive X-ray spectroscopy (EDX), Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Brunauer-Emmentt-Teller (BET), zeta potential and Transmission electron microscopy (TEM). To obtain the optimum adsorption conditions, multivariate optimization tools such as a two-level full factorial and a central composite were used. The optimum conditions for the adsorptve removal of Ba, Na, Ni and V in the fuel oils were found to be 4.5, 1.5 M of HNO3, 40 minutes, 0.15 g and 0.15 g for pH, eluent concentration, extraction time, adsorbent mass and sample mass (model oil concentration). The adsorption method developed was very sensitive as it reported MLOD ranging from 0.022-1.51 µg/g while MLOQ ranged from 0.072-5.03 µg/g for metals under study. The optimum conditions were then applied to real fuel samples, which were crude oil, gasoline, kerosene and diesel.

Keywords : adsorption kinetics, F=fuel oils, isotherms, metals, thermodynamics
Conference Title : ICACMS 2025 : International Conference on Applied Chemistry and Materials Science
Conference Location : Cape Town, South Africa
Conference Dates : April 10-11, 2025