Removal of oil from simulated oilfield wastewater using modified coal fly ashes

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ABSTRACT

Three methods, HCl treatment, FeCl₃ treatment, and HCl–FeCl₃ treatment, were used to modify coal fly ash as an absorbent for oil removal from oilfield wastewater. Results from scanning electron microscopy and BET analysis indicated that the specific surface area (SSA) increased from 3.16 m²/g for the untreated fly ash to 10.13, 28.67, and 48.89 m²/g for fly ashes modified by FeCl₃ treatment, HCl–FeCl₃ treatment, and HCl treatment, respectively. X-ray fluorescence (XRF) analysis showed that Fe content in FeCl₃-treated fly ash (TFA-FeCl₃) and HCl–FeCl₃-treated fly ash (TFA-HCl–FeCl₃) was obviously higher than that in HCl-treated fly ash (TFA-HCl) and untreated fly ash (FA). Results from XRD and XRF analysis revealed decreased CaO content in TFA-HCl, TFA-FeCl₃, and TFA-HCl–FeCl₃. The oil removal capacity of all studied fly ashes was investigated and maximum oil removal ratio of studied fly ashes was in the following manner, TFA-HCl/FeCl₃ > TFA-FeCl₃ > TFA-HCl > FA (94.7, 86.3, 80.1, and 62.0%). The study showed that the oil removal capacity of fly ash had a close relation to SSA and Fe content, and the excellent oil removal capacity of TFA-HCl–FeCl₃ may stem from the synergetic effect between adsorption and flocculation. Dose, pH, contact time, and temperature affected oil removal capacity of fly ashes. In the treatment, the oil removal ratio can reach up to 96.8%, and the oil content reduced sharply from 262 to 8.4 mg/L. The method set forth in the work had potential application in deep removal of oil from oilfield wastewater.

Keywords: Coal fly ash; Modification; Simulated oilfield wastewater; Oil removal

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