

5th World Convention on

RECYCLING AND WASTE MANAGEMENT

September 11- 12, 2017 Singapore

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Efficient separation of dilute oil contaminations from wastewater by functionalized magnetic nanoparticles

There are several industries producing large quantities of dilute oily-wastewater for which the oil separation is challenging. Current technologies to separate the oil contaminants are compositional dependent, energy and material demanding and expensive. They require large buffering tanks because of low selectivity and frequent process maintenance in the case of membrane-based separation technologies. These challenges are intensified for large wastewater throughput and for conditions where the oil is in the form of stable emulsions with a high viscosity and of comparable density to the water phase (e.g., heavy oil-water mixture). Moreover, the presence of surfactants and solid contaminations add complexity to the challenge. We had proposed a methodology to use magnetic nanoparticles (MNPs), dispersing them in the aqueous phase to encapsulate the oil droplets and to separate them using a magnet. The tailored wettability of nanoparticles provides dispersibility of nanoparticles in the aqueous phase and will allow them to accumulate on the interface of oil droplets with water (or inside the oil droplets). The magnetic force between modified MNPs and a magnet accelerates the oil separation which decreases the energy requirements for such separation process. Experiments were conducted by preparing 1% oil in aqueous phase solution of 0.3% SDS. The mean size distribution of emulsions after preparation is measured by DLS at about 155 nm, which grows to 214 nm after one week. The emulsions tend to grow initially but stabilized after about 15 hours. The emulsions were created by first homogenizing the oil, water and surfactant mixture in high shear mixer followed by ultrasonication. The size distribution of emulsion with this method was unimodal. Then we used Fe^3O_4 magnetic nanoparticles (MNP) in hexane and also Fe^3O_4 with different coatings for the separation process.

Biography

Ameer A Al-Haddad has been teaching Chemical Engineering courses for past 30 years in Kuwait University, Kuwait. He is actively involved in various research fields mainly environmental engineering, land and water pollution, chemical warfare and polymer kinetics. He has published more than 40 papers in various research journals.

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