ABSTRACT

Owing to the progressing industrialization processes and growing demand of energy from petroleum and its products, the frequency of oil spill incidents have increased and become a global problem due to the associated severe ecological problems and difficulty in its removal from water surface. Hence, efficient and facile remediation techniques to combat the harmful effects of this disaster are urgently required. The research work in the present thesis is an attempt in this regard. Here various facile and suitable methodologies have been adopted for the development of superhydrophobic/oleophilic sorbent materials from inorganic mineral products, natural products, and nanomaterials for selective removal of spilled-oil from water surface. The sorbents from inorganic mineral products (*viz.* barium sulfate, precipitated calcium carbonate, and magnesium carbonate) have been prepared by surface modification of the raw materials with palmitic acid *via* simple one-step synthetic approach under ambient condition. The prepared sorbents exhibit good selectivity, sufficient buoyancy, high rate of uptake, and good reusability. The oil sorption capacity of the sorbents prepared from barium sulfate, precipitated calcium carbonate, and magnesium carbonate was observed to be >0.3, >1.0, and >3.0 g/g respectively for different types of oil used in the study. Also naturally occurring silkworm cocoons have been surface modified into a superhydrophobic and oleophilic sorbent material with sufficient buoyancy, high selectivity, good reusability, and superior oil sorption capacity for oil spill clean-ups. The oil sorption capacity of the fibrous sorbent was found to be 46.83 and 84.14 g/g for crude and motor oil respectively. Further, it is reusable for more than five times and the oil recovery amount is >93% for both the oils. In another approach, magnetic titania nanotubes, prepared via hydrothermal method, were surface modified with octadecyl amine to impart superhydrophobicity and oleophilicity to the material for potential usage as a sorbent in oil spill clean-ups. The sorbent powder depicts a static water contact angle of 166±1°, while the oil sorption capacity was observed to be >1.5 g/g for oils used in the study. The sorbent also exhibits more than five times reusability. Finally, a superhydrophobic and oleophilic magnetic oil remover pad was fabricated for oil spill clean-ups, which comprises of magnetic polyurethane foam embedded in a superhydrophobic cotton fabric. The sorbent pad possesses sufficient buoyancy as well as high selectivity, facilitates magnetic removal by using external magnets, is reusable for more than ten times and the oil recovery amount is >80%.

Keywords: Oil spill; superhydrophobic; oleophilic; sorbent; contact angle; sorption capacity.