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Superhydrophobic Magnetic Polymer for Oil Spill Cleanup

Darwish MSA*

Egyptian Petroleum Research Institute, Cairo, Egypt

***Corresponding author:** Mohamed Said Darwish, Egyptian Petroleum Research Institute, 1 Ahmed El-Zomor Street, El Zohour Region, Nasr city 11727, Cairo, Egypt, Tel: +(2) 01156268403; E-mail: msa.darwish@gmail.com

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Introduction

Contaminations of the environment by oil pollutions have a high risk of environmental impact and the design to develop high efficient material to absorb the sudden accidents of oil leakage is the most challenging tasks. The treatment should reduce the quantities of contaminants to a level which allows safe discharge according to national and international regulations. Extraction suffers from the limitations as selectivity and environmental impact by forming third phase formation. Superhydrophobic magnetic polymer offer potential advantages in separation treatment, where it provides multipurpose targets; control the hazardous materials' protects the environment against pollution; conserve the mineral resources and recover pure valuable elements and chemical compounds needed in the market. This separation technique may be more interesting than conventional recovery methods. It may be easily recovered by the simple application of an external magnetic field given by a magnet or an electromagnet.

Extraction of Oil from Water

Magnetic polymers have been fabricated with efficient synthesis approaches to shape-controlled, highly stable and biocompatible [1-2]. Depending on the methods of preparation, materials can be obtained with different physical and chemical properties. The magnetic polymer-based graphene foam (MPG) for oil–water separation was fabricated by the synergistic effects of the deposition of Fe_3O_4 nanoparticles on graphene sheets and the self-assembly of graphene on polyurethane (PU) sponge. The resulting MPG exhibited superhydrophobicity and superoleophilicity with the water contact angle of 158 ± 1° and the oil contact angle of 0° [3]. The application of high gradient magnetic separation (HGMS) using polyvinylpyrrolidone (PVP) -coated magnetic nanoparticles (NPs) was investigated. It found that, after 7 h operation (treating 17 L of oil-water mixture), oil removal was near 84% [4]. The superhydrophobic functioned magnetic polystyrene foam (SFMPF) could separate numerous oils and organic solvents from their mixtures with water, and the maximum absorption capacity could reach up to 56.8 times of its own weight. The absorbed oils and organic solvents could be recycled by a simple mechanical extrusion. Moreover, SFMPF remained a high absorption capacity and water contact angle under magnetic field, even after 60 times regeneration [5]. A novel graphene aerogel/ Fe_3O_4/ polystyrene composite was fabricated. The crude oil intake capacity for the composite was 40 times its own mass after 10 water–oil separation cycles, which is among the highest ever reported for oil absorbents [6].

Conclusion

Oil spillage accidents showed a rising trend, which was not only harmful to the ecological environment but also to people's health. Herein, we reported a novel kind of superhydrophobic magnetic polymer with high absorption capacity for oil spill cleanup. Superhydrophobic magnetic polymer is a promising tool in the treatment, due to lower cost, ease of separation and higher adsorption capacity. This would allow a more economic recovery and result in lower environmental impact not only by oil separation, but also cleanup, which also high addition of such materials in environmental impact.

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