Faculty and Post Doc,
Energy, Environment&
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# Designing of polyethylene-based material modified by plasma discharge for water/oil separation

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## 1 Introduction

**Produced water** is one of the largest wastewater generated in Qatar. Soluble and insoluble oil contaminants are presented in this water. Adsorption technique is a common procedure used in the industry for a wastewater treatment. It is simple, cost effective and it can be easily regenerated. Currently there are many available adsorbents such as natural materials, biomass and byproducts. **Polyolefin** represent **pure hydrocarbon polymers** with **high sorption efficiency** for low-molecular weight hydrocarbons present in the water [1]. Nowadays, the most available commercial oil sorbents from the water surface are made of **polyethylene (PE)** and polypropylene excelled by a fast adsorption and high sorption capacity [2]. Despite this, there is lack of comprehensive and complex study focused on the use of these **polymeric materials** as a **filtration media** in **tertiary** filtration with respect to key parameters determining their adsorption ability. In response to this issue, this research work focused on the separation of oily components from **emulsified water/diesel oil (DO)** mixtures with oil contents of up to 200 ppm by plasma-treated low-density polyethylene (LDPE) powder in batch configurations. **Plasma treatment** was performed to improve the wettability of the LDPE sorbent by the emulsion, and, thus, to enhance its adsorption capacity.

## 2 Methodology

### 2.1. Preparation of sorbents

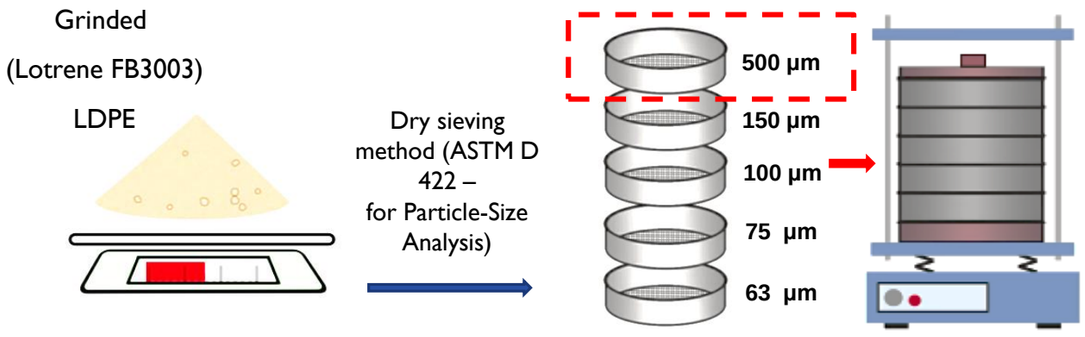


Figure 1: Schematic diagram of size analysis experimental procedure.

### 2.2. Preparation of emulsions

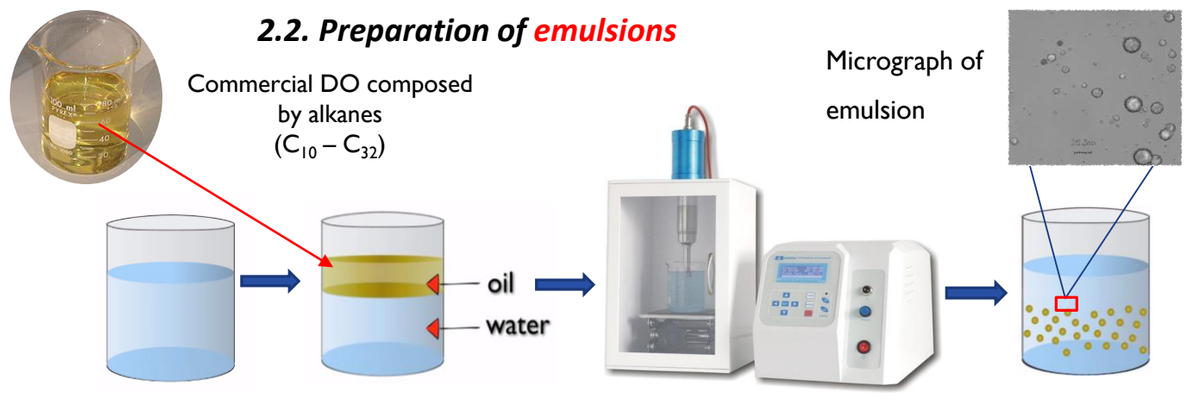


Figure 2: Schematic diagram of preparation of emulsions.

## 3 Results and Discussion

### 3.1. Characterizations of sorbents & emulsions

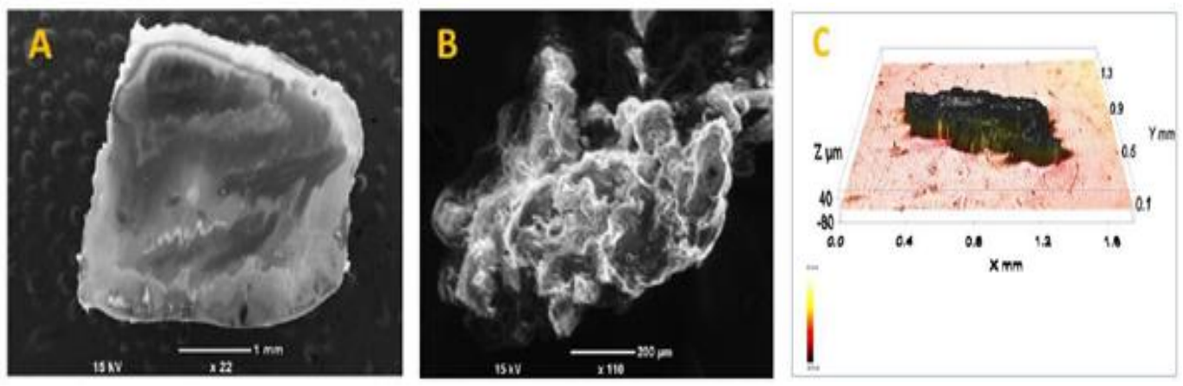


Figure 3: SEM micrograph of common LDPE pellet as produced (A), SEM micrograph (B) and profilometry image (C) of LDPE powder prepared by grinding,

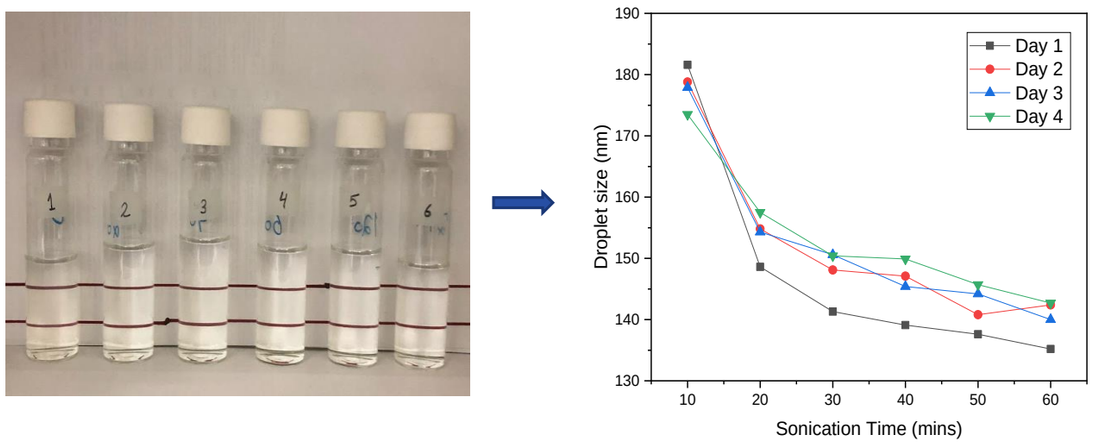


Figure 4 : The dependence of the droplet size in the time of sonication and the duration of the emulsions' storage (untill four days).

### 3.2. Adsorption studies :

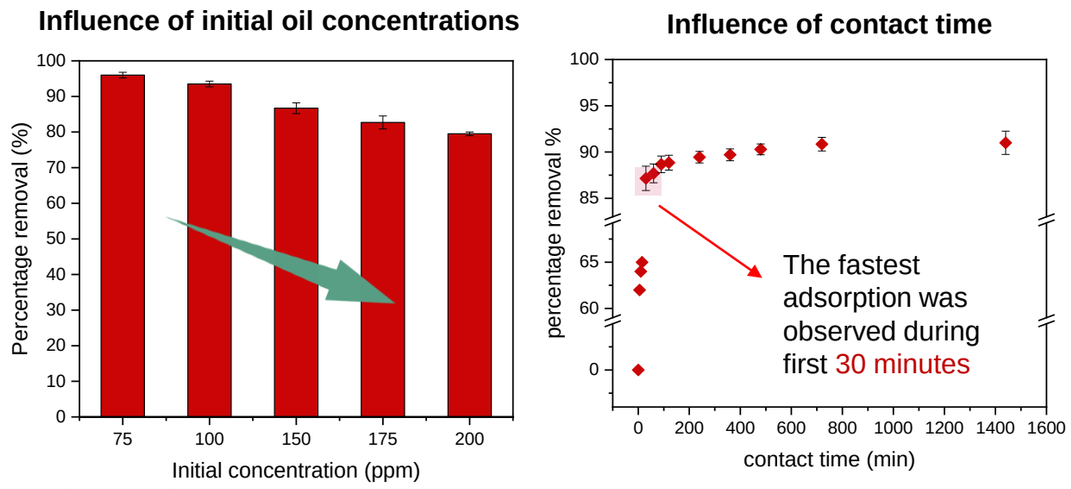


Figure 5: Sorption experiment as a function of : initial oil concentrations (left), contact time (right).

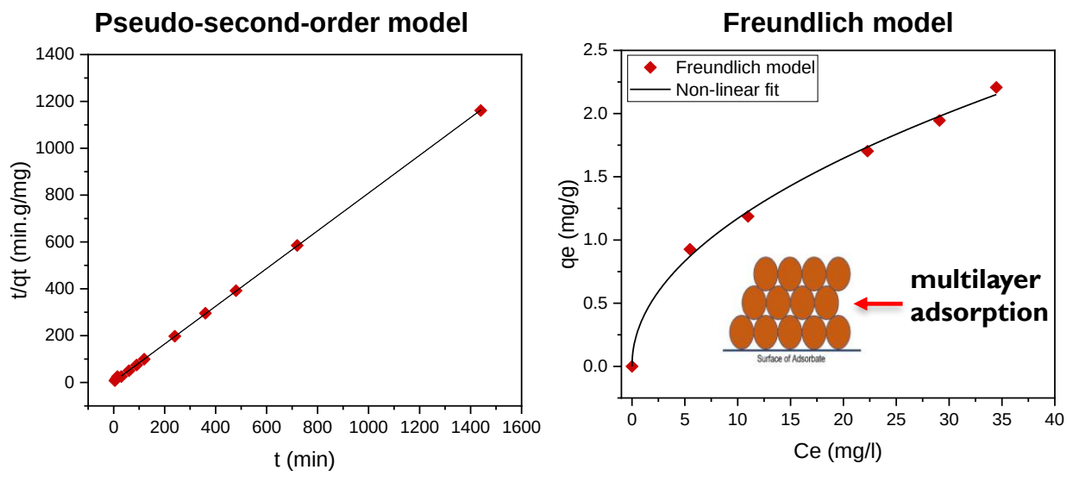


Figure 6: Equilibrium studies : Freundlich adsorption models (left) and pseudo second-order kinetic model (right).

## 4 Conclusion

- **Plasma treatment** resulted in enhanced sorption capability of treated PE powder against the untreated one with an oil removal efficiency exceeding ***93.5%.***
- The experimental data were well fitted by the **Freundlich isotherms.**
- The adsorbed amount of oil increases with the increase of contact time. The fastest adsorption was observed during first ***30 minutes*** of the treatment. The adsorption kinetics of emulsified oils onto sorbent follows ***PSO kinetic model.***

## 5 References

[1] C. Nam, H. Li, G. Zhang, L.R. Lutz, B. Nazari, R.H. Colby, T.C.M. Chung, *Practical Oil Spill Recovery by a Combination of Polyolefin Absorbent and Mechanical Skimmer, ACS Sustain. Chem. Eng. 6 (2018) 12036–12045*.

[2] J. Saleem, M. Adil Riaz, M. Gordon, *Oil sorbents from plastic wastes and polymers: A review, J. Hazard. Mater. 341 (2018) 424–437*.

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