SEPARATION OF OIL/WATER SYSTEM BY POLYMERIC THE SUPER HYDROPHOBIC MATERIAL FOR CIVIL APPLICATION

BALKEES. M. AL. DABBAGH¹, HANAA. J. AL. SHIMARY² & RANA. M. SALIH³

¹Applied. Science, Materials branch, University. of Technology, Iraq

² Department of Poly, University. of Babylon / Materials Engineering. Coll, Iraq

³ Department of Applied. Science, University. of Technology, Iraq

ABSTRACT

Poly Methyl Meta Acrylic (PMMA) Nano filter prepared by electrospinning technique for separating the oils from water (fully clean) and maintain the properties of the resulting water. 5% conc. of (PMMA + dichloromethane) solution prepared for electrospinning pump on Aluminum surface for (15 hr.), 3 μ m thickness filter resulted. Some test performed on this filter involves: morphology by using scanning electron microscopy (SEM), thickness by digital micrometer, contact angle by contact angle shape drop analyzer

In addition that, some tests performed on the water sample before&after oil separating from water by preparing nano filter, these tests involve viscosity, surface tension, density, PH number, and weight of the sample. Results show the prepared filter to have superhydrophobic behavior and it has (147 o) θ (contact angle), the preparing filter has nano structured with beads through its morphology. Also, results show the water sample keep its properties after separating from oil.

KEYWORDS: "Nano filter, Cleaning Water, Electrospinning & Hydrophobic"

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INTRODUCTION

Given the large quantities of industrial effluents wastewater from chemical, petrochemical, and mineral industries, as well as frequent oil leakage incidents, separation of oil and water is an important environmental problem. [1]

There are some methods used for solving this problem involve, oil skimmer vessels, combustion, and absorbent materials. These methods are a conventional approach, and have some disadvantages such as oil skimmer vessels has low affectivity, while, combustion leads to an environmental pollution, also traditional absorbent materials have poor selectivity and recyclability.[2]

Newly, superhydrophobic and super hydrophilic improved for separation the oil from water with high efficiency, this is because these surfaces tend to wet by only oil and expel the water.[3]

Overall Moisturization ability of materials for adoption selective for order oil from oil/water mixtures to show all of superhydrophobic and super -hydrophilic property at the same time [4].

A number of methods have been employed to fabricate superhydrophobic surfaces, such as electrochemical sedimentation [5], electrophoresis precipitation [6], chemical inscription [7], layer after layer self-assembly [8], chemical vapor deposition (CVD) [9], electrospinning technique [10]. The summarized topics of electrospun nanofibers as separation tool include three parts: nanofibrous sorbents, nanofibrous membrane and nanofibrous aerogels as in figure (1)

Figure 1: Electro Spun Nano -Fibrous Materials for Oil/Water Separation

Nano-fibers absorbent for cleaning oil is extraction mechanism performed by using an absorbent material. [11]Fiber nanomembrane for separation oil/water system, because of the high separation efficiency and is a simple operation method, this approach widely used. [12] Nano-fibrous aerogels for emulsifying oil/water separation, three dimensions (3D) bulk own multilateral porosity, high properties of the internal surface area, also low density. [13]

EXPERIMENTAL

Materials

Polymethyl meta acrylic (PMMA) PMMA GPC, powder, 200336, with molecular weight (MW = 150,000), density (1.2 gm/cm³), from Sigma Aldrich. PMMA is Bioelectronics, Flexible Organic Transistors, Hydrophobic Polymers.

Dichloromethane (DCM) (CH₂Cl₂), with a viscosity (0.43 cP), density (1.3 g/cm³), and boiling point (39.6 oC), as a solvent was used.

Electrospinning Set Up

Electrospinning set up shown in figure (2)

Figure 2: Electrospinning Set up

Electrospinning solution placed in a syringe connected to a syringe pump to regulate the fluid flow, while the

positive high voltage power supply connected to the metallic needle, and the negative power supply connected to earthy metallic collector.

Fabrication of SuperHydrophobic/ Super Hydrophilic Textile

15 ml of (PMMA/ DCM) pumped by electrospinning system for (15 hr) and collected on aluminum foil (20 cm * 15 cm²), then it cut according to a required test as in table (1).

Table 1: Dimension of Samples According to Tests

Sample No.	Dimension cm ²	Test
1	1	SEM (scan electron microscopy)
2	1	Contact angle
3	225 (15*15)	Separation oil from water

Oil/ water System Preparation

(1g) Motor oil with SAE viscosity about (21-26 cSt) at (100 o C) mixed with (40 g) distill water with constantly moving for (5 min).

Oil/ water System Separation

Oil/ water system separation by using prepare nano filter was performed, by emersion the nano filter in oil/water system for (10 min), then the nano filter sequesters the oil from water by absorbing phenomena, and estrangement the water by its superhydrophobic property.

RESULTS AND DISCUSSIONS

Morphology of Nano filter by SEM

Figure (3) show the SEM image of prepared nano filter

Figure 3: SEM Images of PMMA Nano filter

We show from these images there are beads in morphology were showed, these because of instability through electrospinning operation. These beads are very important at this time because it leads to increase of roughness of nano-filter surface which leads to increase of hydrophobic and decrease the wettability of nano filter. Also, this result supported the contact angle results strongly.

Contact Angle Analysis

Figure (4) show the contact angle of (PMMA) nano filter

Figure 4: Contact Angle of PMMA

From figure (4) noticed the contact angle of nonfilter is (147 o C), and this leads to high hydrophobic properties, and this nano filter is able to separate the oil from water with high efficiency. [14]

Wettability

Figures (5& 6) shows the change of contact angle with time for constant periodic time (3-18 min) with the constant increasing ratio (3 min)

Figure 5: Show the Contact Angle by Contact Angle Analyzer at Different Remaining Times

Figure 6: Relationship Between Contact Angle of Super Hydrophobic Textile and Remaining Time

Figure (6) referees to there are a small change of contact angle with increasing of remaining time on the textile surface, this is because of the roughness due to the beads which prevents water from spreading and penetrate through the of fabric texture hydrophobic prepare textile surface[15].

Characteristic of Water Before and After Separation of Oil

Table (2) show the characteristic of water before and after the separation from oil:

Table 2: Characteristic of Water After & Before Separation from Oil

Characteristic	Before preparation of oil	After separation of oil
Weight g	40.099	40.06
Density g/cm ³	1.002	1.001
Viscosity cP	0.98	0.99
Surface tension mN/m	6.8	6.7
Ph	7	6.9

From table (2) noticed there is a match between the results of a characteristic of water (before & after) its separation from oil, this refers to the high efficiency of prepare textile for obtaining on the normal pure water with very little steps, and this prepared textile has superior properties for its separation oil from oil.

CONCLUSIONS

We conclude that the electrospinning technique is a very active method for preparing the superhydrophobic textile for separation oil/water system and this textile is suitable for many smart applications for cleaning and it is a friendly environmental material.

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