Performed Of Filter Nano Textile For Purification Of Aerosol Water By Electrospinning Technique

1,1 K H Jawad, 2,2 D B Mohammed and 3,3 M R Alsaffar
1University of Babylon, Department of Poly. Eng. ,Iraq
2University of Technology , Department of Applied Science, Iraq
3Oil ministry / Iraq/

hanajawad21@yahoo.com; balkees1957@yahoo.com; rusulrusul83@yahoo.com

Abstract. Poly styrene (PS) Nano filter prepare by electrospinning technique for cleaning the dust water from dumps and maintain the properties of the resulting water. 18% con. of (PS + dimethyl forma amide DMF ) solution prepared for electrospinning pump on Aluminium surface for (10hr.), 4µm thickness filter resulted. Some test performed on this filter involve: morphology by using scanning electron microscopy (SEM) , thickness by digital micrometre, contact angle by contact angle shape drop analyser .In addition that, some tests performed on the water sample after dumps 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 have hydrophobic behavior and it has (108°) θ (contact angle), the prepared filter has nano structured with beads through its morphology.

1. Introduction

Fast population expansion generate the huge problem of limited pure water supply in the world and the dust water treatment is the only purification process that can beat on this problem. Nanotechnology is one of solutions and it has extensive domain for dust water treatment. [1]

Filtration is a process of separation of particles and impurities from water by coercion the water through a porous media. There are some types of porous media involve: natural, as sand, gravel and clay, or nanotextile wall made of various materials [2].The development of Nano science and technology has presented new chances for using smaller and more steady structures for porous films.

[3]

A number of methods have been employed to fabricate super hydrophobic surfaces, such as electrochemical sedimentation [4], electrophoresis precipitation [5], chemical inscription [6], layer after layer self-assembly [7], chemical vapour deposition (CVD) [8], electrospinning technique [9]. Electrospinning technique is a novel method for preparation various types of nanofibers textile as ‘having a diameter of less than one micron for different application such as medical textile, personal care, filtration, barrier, composite, insulation and energy storage [10]
2. Experimental

2.1 Materials
Polystyrene (PS) pellets, with molecular weight (MW = 35,000), density (1.06 g/cm³), from Sigma Aldrich. PS is an organic, Hydrophobic Polymers N, N - Di methyl forma amide (DMF) (CH₃)₂NCH(OCH₃)₂, boiling point (65°C), as a solvent was used.

2.2 Electrospinning set up: Electro spinning 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 metallic needle, and the negative power supply connected to earthy metallic collector.

2.3 Fabrication of Porous Hydrophobic Textile:
15ml of (PS/DMF) pumped by electrospinning system for (10hr), and collected on aluminum foil (20cm*15cm²), then it cut according to required test as in table (1).

2.4 Dust water System Preparation:
(1g) soil mixed with (49g) distil water with constantly moving for (5min).

2.5 Soil / water (Dust water) System Separation:
Soil/ water system separation by using prepared nanofilter was performed, by using the following system, fig (2):
2 mbar pressure used for pumping the dust water from tank of dust water to clean water tank passing through the nanofilter.

Figure 1 electrospinning set up

Figure 2 water purification system

3. Result and Discussion

3.1 Morphology of Nanofilter by SEM:
Fig (3) show the SEM image of prepared nano filter: We show from fig (3 a) there are an beads in morphology were showed, these because instability through electrospinning operation. These beads are very important at this time, because it lead to increase of roughness of nanofiber surface which leads to increase of hydrophobic and decrease the wettability of nonfilter. These beads collected the dust and impurities from water, then it permit water to pass through it by its porous. Fig (3 b) show the SEM image of filter after removal the dust from water which agglomerates on the surface of water by hydrophobicity of this filter.
3.2 Contact angle analysis:

Fig (4) show the contact angle of (PS) nanofilter, we noticed the contact angle of nonofilter is \(108^\circ\), and this leads to high hydrophobic properties, and this nanofilter is able to separate the water from the dust and soil high efficiency. [11]

3.3 Wettability:

Figs (5 - 6) show the change of contact angle with time for constant periodic time (55 min) with constant increasing ratio (5 min) Fig (7) referees to there are an small change of contact angle with increasing of remaining time on the textile surface, this is because the roughness due to the beads which prevents water from spreading and penetrate through the of fabric texture hydrophobic prepare textile surface. [12] Also from fig (6) notice the contact angle decrease to \(66^\circ\) after the water drop passing through the filter by porous effecting.
3.4 water characteristic before and after dust separation:

Table 1. Dimension of Samples According to Tests

| Sample No. | Dimension cm² | Test                                |
|------------|---------------|-------------------------------------|
| 1          | 1             | SEM (Scan Electron Microscopy)       |
| 2          | 4 (2*2)       | Contact angle                       |
| 3          | 5 cm diameter | Cleaning of dust water              |

Table 2 characteristic of water after & before separation from dust

| Characteristic     | Before separation from dust | After separation from dust |
|--------------------|-----------------------------|---------------------------|
| Weight g           | 50.001                      | 50.09                     |
| Density g/cm³      | 1                           | 1.09                      |
| Viscosity Cp       | 0.98                        | 1                         |
| Surface tension mN/m| 6.8                         | 6.9                       |
| PH                 | 7                           | 7.2                       |

Table (2) show the characteristic of water before and after the separation from dust: From table (2) observed there are an agreement between the results of characteristic of water (before & after ) its separation from dust, this refers to high efficiency of prepare textile for obtain on normal pure water with very little steps, and this prepared textile have superior properties for its separation from dust. This is because two factors, involve hydrophobic surface property and winding depth filter property. [13]
4. Conclusion:
1- The electrospinning technique is very active method for preparation the hydrophobic textile for separation dust/water system.
2- this textile has two filtration properties, surface filtration by its hydrophobic characteristic, and depth filtration by winding and beads of nanofibers characteristic.

5. Acknowledgements
The authors extend their appreciation to the Technology university /Applied science department /materials branch , Nano technology research center and Babylon University / Material engineering college for perform this search

6. References:
[1] Anil K., Akansha G.&Bhagwan N., "A review: Nano Membrane and Application" Inter. Jour. of Innovative Res. in Sci., Eng. and Tech.". V.3, Iss.1, (2014)
[2] Vikas Sh. and Akhilesh Sh., " Nanotechnology : An Emerging Future Trend in Wastewater Treatment with its Innovative Products and Processes ", Inter. Jour. of Enhanced Research in Sci. Tech. and Eng. VOL. 2 ISSUE 1, DEC-(2013)
[3] Y. Han “Molecular sieving using nanofilters: past, present and future”. Lab. Chip 8, 23–33 (2008).
[4] L. Feng, Z. Zhang, Z. Mai, Y. Ma, B. Liu, L. Jiang, D. Zhu, A. Super-Hydrophobic, Super-oleophilic coating mesh film for the separation of oil and water, Angewandte Chemie International Edition 43, (2014)
[5] Xufeng W. and Gaoquan Shi, " Production and Characterization of Stable Superhydrophobic Surfaces Based on Copper Hydroxide Nanoneedles Mimicking the Legs of Water Striders",J. Phys.Chem. B, v.110 No.23. (2006)
[6] Zuxin S., Qing Li, Zhongwei Wang, Longqin Li, Funan Chen, and Juncen Zhou," Novel Method for Controllable Fabrication of a Super hydrophobic CuO Surface on AZ91D Magnesium Alloy", ACS Appl. Mater. Interfaces, 4 (8), pp 4348–4356(2012)
[7] Zhijian Ch. and Wei Li, " Introduction to the special issue of the International Symposium on Crystal Engineering & Drug Delivery Systems", Frontiers of Chem. Eng. in China, V. 4, Iss. 1, (2010)
[8] Shunsuke N., Hitomi S., Xintong Z., Zhaoyue Liu, Kazuya N., Taketoshi M., Yoshihiro K. and Akira F., "Assembly of Self-Assembled Monolayer-Coated Al2O3 on TiO2 Thin Films for the Fabrication of Renewable Super hydrophobic–Superhydrophilic Structures", Langmuir, 25 (13), (2009)
[9] Al dabbagh B. M. & Alshimary H. J. " SiO2/ Polyamide Nanocomposite textile for super hydrophobic coating by Electrospinning technique ", international journal of research in science,Vol.(2), No.(4) 2016
[10] Al dabbagh B. M. & Alshimary H. J. "Polyamide Nanofibers Coating by Electrospinning Technique for Anti Corrosion Behavior", Engineering and Technology Journal, Vol. 35, Part A, No. 10, 2017
[11] Haiyan S., Zhen Xu Ch., " Multifunctional, Ultra-Flyweight, Synergistically Assembled Carbon Aerogels", Advanced materials, V.25, Iss.18 . (2013)
[12] Chao-Hua X., Peng-Ting J. , P. Z., Ya-Ru L. , Shun-T. J., " Fabrication of superhydrophobic and superoleophilic textiles for oil–water separation ", Applied Surface Science. (2013). DOI: 10.1016/j.apsusc. 2013.07.120
[13] K. Sutherland, Filters and filtration handbook, 5th , Elsevier, USA, (2008).