SCIENTIFIC REPORT - SUMMARY

Stage-1: October – December 2015

Project title: "**Polymer-based materials as sorbents for the enhanced removal of oil spills and dyes from the contaminated waters**"

Project code: **PN-II-RU-TE-2014-4-1266;** Acronym: **POLYSORB**; Contract: no. **95 / 01.10.2015**

Nowadays the modern society is still dependent on oil resources. Therefore, the accidental oil spill pollutions are inevitable, being caused by the activities related to processing, storage and transportation of oils and petroleum products [1-3]. In this regard, the development of new sorbents with rapid action to combat oil spill pollutions is of particular interest for environmental science and engineering [4-7]. The present project proposes to address this topic by carrying out the research activities included in the *Objective-I* of the project.

OBJECTIVE – I : Preparation and characterization of polymer-based sorbent materials and their application for the enhanced removal of oil spills from contaminated waters

Activity I.1 ***Preparation of electrospun fibrous nonwovens and their application for sorption of oils***

In this study high-porous sorbents consisting of polysulfone nanofibers were prepared by means of the electrospinning method. The polymeric solutions used for electrospinning were prepared by dissolving polysulfone pellets in a mixture of organic solvents (*dimethylformamide* and *trichloroethylene*). The electrospun nonwoven materials were prepared under various electrospining conditions, i.e. varying the levels of different factors like polymeric solution flow rate, voltage and distance between needle and collector. The nonwoven polysulfone materials were characterized by scanning electron microscopy (SEM). The SEM images were analyzed in order to plot the histograms for fiber diameters and pores sizes distributions. On the basis of histograms the mean values and dispersions of these parameters were evaluated. Figure 1 shows the histograms of the pore sizes distributions for a nonwoven sample made of electrospun polysulfone fibers. Thus, the polysulfone fibrous nonwoven materials were obtained with fiber diameter ranged from 0.3 and 3.0 µm, and pore dimensions varying into the interval from 1 to 15 µm. The prepared nonwovens had the thickness of 0.11 mm – 0.21 mm and porosities higher than 90%.

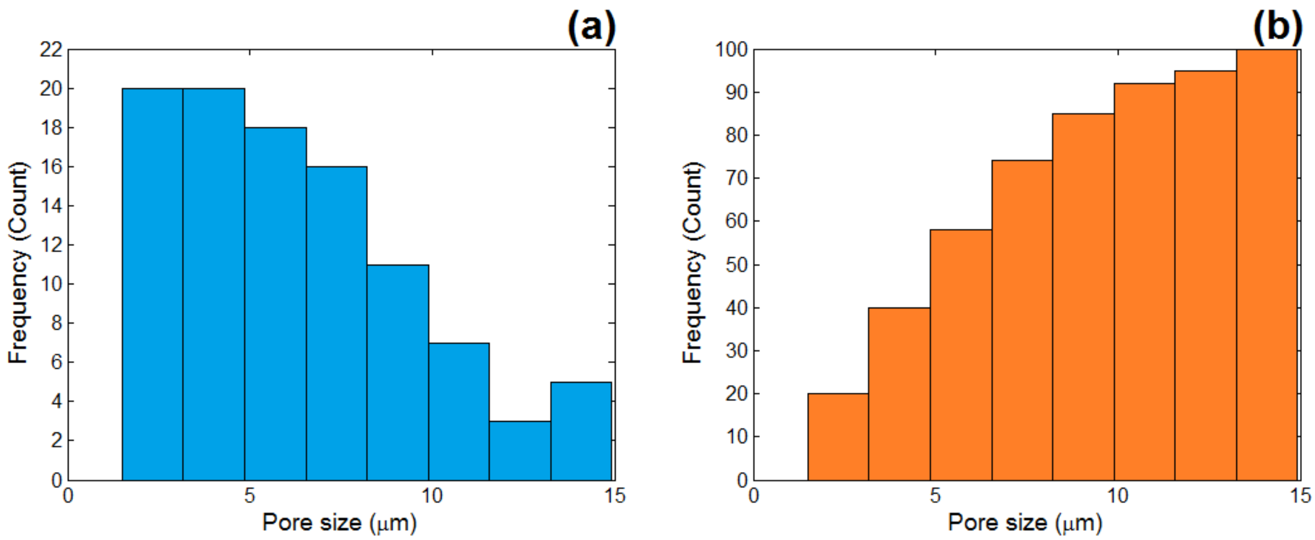

Fig.1. *Histograms of the distribution of pore sizes for the polysulfone electrospun nonwoven: (a) Histogram of pore size distribution; (b) Cumulative histogram.*

The wetting properties of the polysulfone nonwoven materials were determined by measuring the water contact angles. The observed water contact angles higher than 120^{o} pointed out the hydrophobic properties of polysulfone nonwovens.

Activity I.2 ***Hydrophobization of polymeric nonwovens by polysiloxanes***

Polymethylhydrosiloxane copolymers with Si-H reactive groups have been synthesized and characterized according to the method reported in the Ref. [8]. The obtained copolymers (polymethylhydrosiloxane) have been applied for hydrophobization of commercial nonwoven materials made of polyester fibers. The diameters of polyester fibers were measured by microscopy and were laying into the interval 10 – 80 µm. The polyester nonwoven is a macroporous material, where the distances between fibers represent the macropores.

The hydrophobization of nonwovens were carried out by the immersion-evaporation technique from the organic solutions containing polysiloxanes followed by the cross-linking reaction. The polyester nonwovens (initial sample and hydrophobized samples) were characterized in terms of weight-to-surface factor (β, g/m^2), thickness (d, mm), apparent density (γ, g/cm^3), total volume of material (V_L, cm^3/g), total volume of pores (V_P, cm^3/g) and porosity (ε, %). According to the experimental results, the deposition of polymethylhydrosiloxane copolymer onto polyester fibers led to decreasing of the porosity.

Likewise, the polyester nonwoven materials (initial sample and hydrophobized samples) were characterized by Fourier transform infrared spectroscopy (FTIR). The FTIR spectra showed that the hydrophobization process conducted to the physical-chemical deposition of polymethylhydrosiloxane onto the polyester fibers. The water contact angle measurements were carried out for the initial polyester nonwoven and hydrophobized nonwoven samples. According to the experimental results, the water drops wet the untreated polyester fibers and are immediately absorbed into pores of the nonwoven. In this case, the water contact angle could not be measured due to the hydrophilic properties of polyester nonwoven. By contrast, the water drops were not absorbed by treated nonwoven with polymethylhydrosiloxane, and the measured water contact angle values higher than 110^{o} revealed the hydrophobic properties of these materials.

Conclusions

The prepared polymeric fibrous materials (micro- and nano-structured) showed hydrophobic properties and porous structures suitable for the applications related to sorption of oily pollutants (oils, petroleum products) from top surfaces of the contaminated waters.

References

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