

SCIENTIFIC AND TECHNICAL REPORT

Program 2: Increase the Competitiveness of the Romanian Economy through Research, Development and Innovation

Subprogramme 2.1. Competitiveness through the Research, Development and Innovation

Project type: Experimental - demonstration project – PED

Project Title: New “green” technology for advanced water treatment based on functionalized polysulfones/ionic liquids membranes

Contract no: 310PED/2020

Project code: PN-III-P2-2.1-PED-2019-3013

Project acronym: GreenTechMembr

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Partner: Politehnica University Timisoara

Project leader: dr. Anca Filimon

Stage 1 (2020) - Optimization of the properties in solution in order to obtain polysulfonic membranes (PSFQ) functionalized with ionic liquids (IL) and designing of the membrane treatment unit (MTU) by integrating the experimental demonstrator (SLM, PIM).

Reporting period: August - December 2020

Stage summary

The general objective of the GreenTechMembr project is to develop a new technology for water treatment, of TRL4 level, by integrating an experimental demonstrator for its use in a technological microfiltration process (TRL3), starting from a conceptual model of TRL2 level. In this sense, in accordance with the established implementation plan, **in 2020** the research concerning the optimization of the properties in solution has begun, in order to obtain polysulfonic membranes functionalized with ionic liquids (PSFQ/IL) that will be integrated and used as separating media in a membrane water treatment unit (MTU). To achieve this goal, the **Stage 1** was based on the following activities:

Activity 1.1 - Conformational characterization of the (PSFQ/ILs) solutions obtained by rheological study

Activity 1.2 - Establishing the optimal electrospinning conditions by optimizing the obtained rheological parameters

Activity 1.3 - Development of polysulfonic membranes functionalized with ionic liquids using various techniques: deposition/immersion - SLM; incorporation/mixing - PIM

Activity 1.4 - Configuration of the membrane treatment unit (MTU) by integration of the experimental demonstrator (SLM, PIM)

Activity 1.5 - Dissemination of the results

Within the **activities 1.1. and 1.2 of basic research type**, the systems consisting of chemically modified polysulfone with quaternary ammonium groups (PSFQ) and various ionic liquids were developed and studied from the perspective of the optimization of the conformational, thermodynamic and morphological characteristics under the influence of various factors (temperature, composition, concentration, etc.). In most cases, the polymer processing starts from the solution phase, so that based on the fundamental research studies on the properties in solution, the rheological behavior of these systems was evaluated under the influence of concentration, composition, temperature in correlation with the structural features of the polymer and the properties of the ionic liquids used (hydrophobicity, polarity, length of the alkyl chain, etc.). In order to successfully obtain the fibrous materials that modelate the membranes properties, the rheological study has allowed the control and optimization of the solution parameters associated with the properties of the polymer and ionic liquids in correlation with the operating parameters of the electrospinning apparatus and environmental parameters (temperature, humidity, etc.). The study notes the influence of the flexibility/hydrophilicity of the involved polymer/ionic liquids and of the interactions that occur in the system, so that the examination and control of the rheological parameters are really important and has allowed to establish the optimal conditions in the field.

Activities 1.3 and 1.4 of experimental development type, realized together with the consortium partner, has allowed the modelation of new membrane materials with increased efficiency in the microfiltration processes by the optimal combination of the PSFQ (with controlled structure, chemical and mechanical stability, etc.) functionalized with various ionic liquids (trihexyl chloride tetradecyl phosphonium (Cyphos IL-101) and methyl trialkyl ammonium chloride (Aliquat 336)). Thus, by method of casting solution, the polysulfonic membranes with controlled thickness were obtained. By mixing/including the polysulfonic solutions (PSFQ) with selected ionic liquids (Cyphos IL-101 and Aliquat 336) in different ratios, PIM membranes were obtained, and SLM membranes were made by depositing/immersing of the already obtained PSFQ membranes in ionic liquids. The methodology was tested in the laboratory and the developed experimental demonstrator was analyzed, allowing an efficient evaluation and providing conclusions on their characteristics and performance. The membrane treatment unit (MTU) was designed/built for a variable flow of raw water, and the configuration of the unit by integrating the experimental demonstrator (SLM, PIM membranes) in the proposed technological installation was made to operate in optimal conditions for their application in microfiltration processes. The development of an experimental demonstrator in the laboratory has constituted one of the premises necessary for experimentation of some technological processes in a membrane treatment unit (MTU) developed on a laboratory scale within the project.

At **activity 1.5 of support type** all members of the consortium have participated. One scientific paper was sent for publication in an ISI journal and 2 papers were presented at the international conferences. To promote the project and disseminate its results, a presentation was held at a representative symposium in the subject of the project, **the web page of GreenTechMembr project** <https://icmpp.ro/greentechmembr/> was created and updated.

ISI scientific papers:

1. Processing of quaternized polysulfones solutions as tool in design of electrospun nanofibers: Microstructural characteristics and antimicrobial activity
A. Filimon, N.Olaru, F. Doroftei, A. Coroaba, S. Dunca, Journal of Molecular Liquids (in evaluation)

Communications:

1. Improving the performance of the polysulfone membranes induced by the presence of ionic liquids: Rheological investigations
A. M. Dobos, M. D. Onofrei, L. Lupa, A. Filimon
26th International Symposium on Analytical and Environmental Problems, Szeged, Hungary, November 23-24, 2020.
2. Modeling the functionalized polysulfone fibers by the electrospinning process and control of solutions parameters
A. Filimon, N. Olaru, F. Doroftei
26th International Symposium on Analytical and Environmental Problems, Szeged, Hungary, November 23-24, 2020.
3. **Project presentation:**
A new "green" technology for advanced water treatment based on functionalized polysulfone membranes/ionic liquids: PN-III-P2-2.1-PED-2019-3013
L.A. Lupa - Faculty of Industrial Chemistry and Environmental Engineering – UPT
National Symposium "Quality of products and services, quality of education, quality of environment", 12th Edition, November 9 – 13, 2020.

Within the project, the implementation team fulfilled its tasks, all the activities proposed for this stage were carried out.

Project leader,
dr. Anca Filimon