BIOLOGICAL ACTIVITY OF SILICONE-BASED MEMBRANES WITH FUNCTIONALIZED SILSESQUIOXANES. CHARACTERIZATION AND PERSPECTIVES FOR ENVIRONMENTAL APPLICATIONS

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Abstract
A series of three silsesquioxanes (containing either the original organic function (SH) (silsesquioxane 2, SH_SS), a derivatized one (NH_3Cl) (silsesquioxane 1, A_SS) or completely chloro derivative (silsesquioxane 3, Cl_SS)) were obtained by acid hydrolysis of the three organo-trialkoxysilane (3-aminopropyltriethoxysilane, 3-mercaptopropyltrimethoxysilane and 3-cyanopropyltriethoxysilane). The biological compatibility was tested for the three composite films. The values of water vapors sorption capacities increase in the following order: P_Cl_SS < P_SH_SS<P_A_SS. Depending on the silsesquioxane type, an increasing of the dielectric constant value up to 4.5 as compared with the value for the silicone matrix was obtained. The bactericidal performance in environmental applications of the newly blends with specific microarchitecture, controlled porosity and higher hydrophobicity, is measured by its ability to maintain the balance between the biological selectivity and membranes functionalization as disinfection materials

Introduction
Three different molecular or polymeric well-determined complex structures containing silsesquioxanes moieties with different functionalities were incorporated into a polymeric matrix based on a polydimethylsiloxane of low molecular weight. After the incorporation of the silsesquioxane, the films were investigated by dynamic vapour sorption (DVS) analysis, stress–strain measurements and dielectric spectroscopy. The presence of the siloxane moiety in the material ensures good mechanical properties.

Experimental
Antibacterial and fungicidal activities of silsesquioxanes functionalized with ammonium chloride (1), mercaptopropyl (2), and chloropropyl groups (3) were evaluated by performing "in vitro" tests against pure culture of three fungi species (Aspergillus niger, Penicillium frequentans, Alternaria alternata) and against both Gram-negative (Pseudomonas aeruginosa) and Gram-positive (Bacillus polymyxa) bacteria.

Results and discussion
Three new membrane materials with three silsesquioxanes: - original organic function (SH) (silsesquioxane 2, SH_SS), - derivatized one (NH_3Cl) (silsesquioxane 1, A_SS); - completely substituted chloro derivative (silsesquioxane 3, Cl_SS). Polymeric matrix consists in low molecular weight polydimethylsiloxane. After the incorporation of the silsesquioxanes, the bactericidal performance in environmental applications of new blends with specific microarchitecture, controlled porosity, and higher hydrophobicity were measured by its ability to maintain the balance between the biological selectivity and membranes functionalization as

disinfection materials. The inhibition of the Gram-negative bacteria for the P_SH_SS was more pronounced than the inhibition for P_Cl_SS, P_A_SS and P membranes.

Conclusion

Processing of the functionalized silsesquioxanes led to new materials with high-performance characteristics designed to be used in a membrane system for wastewater treatment. Characteristics of materials generated by the structural properties of the polymeric chains and the history of the films influence the surface morphology indicating that the prepared membranes could be applied as membranes in wastewater treatment. Filtration properties of the composite silicone membranes have demonstrated the suitability of these to act as selective barriers, permitting the free transport of water vapor through the pores. Evaluation of the applicative potential of these membranes, tested in terms of antimicrobial activity, confirms their excellent performance as potential candidates in the field of wastewater treatment.

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