Slovak Society of Chemical Engineering
Institute of Chemical and Environmental Engineering
Slovak University of Technology in Bratislava

PROCEEDINGS

51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025

Hotel DRUŽBA
Jasná, Demänovská Dolina, Slovakia
May 27 - 30, 2025

Editors: Assoc. Prof. Mário Mihaľ

ISBN: 978-80-8208-158-2, EAN: 9788082081582

Published by the Faculty of Chemical and Food Technology Slovak Technical University in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2024

Stor, M., Krasiński, A., Kryszczyńska, K.: Evaluation of biofouling rate of polypropylene water filters doped with composites of silver nanoparticles on halloysite, Editors: Mihaľ, M., In *51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025*, Jasná, Demänovská Dolina, Slovakia, 2025.

Evaluation of biofouling rate of polypropylene water filters doped with composites of silver nanoparticles on halloysite

Michał Stor[1], Andrzej Krasiński[1], Karolina Kryszczyńska[1]

[1] Warsaw University of Technology, Faculty of Chemical and Process Engineering, Waryńskiego 1, 00-645, Warsaw, Poland
e-mail: michal.stor.dokt@pw.edu.pl

Keywords: halloysite, silver nanoparticles synthesis, bacteriostatic additives, water filtration, melt-blow filter media

The filtration is a common process of water purification for industrial and domestic applications. Typical contaminations in water are particles (mineral, microplastics etc.), a variety of dissolved compounds (e.g. organics, ions, including heavy metals), and microorganisms. The ubiquitous bacteria, fungi and other species include their presence in the water, which creates potential hazards for human health and also affects downstream equipment, which includes equipment clogging, microbial corrosion, and coating of adsorbent or catalytic particles by forming a biofilm on their surface, etc. Non-woven filters manufactured using the melt-blown technique are widely used at various scales of filtration units. Over a long time of operation, the microorganisms captured inside the porous filter can intensively proliferate, which leads to reducing the operation time of the filter (determined by the maximum allowable pressure drop). This detrimental effect can be significantly reduced by incorporating of antibacterial compound into filtration materials.
The research aimed to evaluate the antibacterial effects of milled halloysite particles impregnated with nanoparticles (AgNP). The in-house prepared composites were dry-blended with polypropylene granules (1-2% by mass). The thermal resistance up to 300°C for additive was demonstrated, which confirmed its suitability for the melt-blown technique of filter manufacturing. The filtration experiments were carried out for 5-inch long filter cartridges using a controlled contamination of bacteria (Escherichia coli – Castellani & Chalmers ATCC 8739 strain) in a multipass operation mode. The concentration of living bacteria cells during filter testing corresponded to the concentration commonly observed in surface waters (i.e. was in the range 10^3-10^4 CFU/mL). The time needed to reach the pressure drop of 0.8 bar (the maximum achievable for the lobe pump used in the system) due to the biofouling of filter media was estimated. The time-dependent dP profiles were compared to unmodified polypropylene filters as a reference. The biofouling resistance for structures manufactured with halloysite-based composites has been proved: the reduction of the biofouling rate and the extension of time needed to reach the maximum allowable dP value were observed. Moreover, the elimination of the living bacteria from the water was confirmed for modified filter media using petri dish water cultivation and Microsnap test kit from Hygiena®.

The research was supported by the Polish National Centre for Research and Development, grant no. TECHMATSTRATEG-III/0005/2019-00