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Biofilmy w instalacjach wodnych i strategie antybiofilmowe z zastosowaniem polimerów krzemoorganicznych

Biofilms in water systems and antibiofilm strategies with the use of organosilicon polymers

PhD dissertation abstract

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ABSTRACT

Microorganisms in the drinking water can occur mainly in the form of planktonic cells and biological layers growing on surfaces in contact with water. Conventional microbiological tests of water detects only a small fraction of the population, which is about 2% of the total number of microorganisms in the water. Biofilms forming in installations are practically not detected, but their presence not only causes a decrease in water quality standards and irreversible structural changes in the installation material, but above all, it carries a health risk for individual and collective recipients. It is therefore essential that the criteria and microbiological tests should be based on a real risk assessment. Water safety management should also include strategies to prevent biofilm formation.

The aim of the research was to assess the microbiological condition of water at various technological stages, to isolate and identify bacteria that are the dominant water contaminants, and to assess the adhesive capacity of isolates. In the research on minimizing the phenomenon of adhesion and formation of biofilms, N-acetylcysteine (NAC) and reference bacterial strains and isolates with a high ability to form biofilms in the aquatic environment were used: *Agrobacterium tumefaciens*, *Aeromonas hydrophila, Citrobacter freundii, Enterobacter soli*, *Janthinobacterium lividum* and *Stenotrophomonas maltophilia*. It was confirmed that NAC itself may be a source of C and N for some bacterial isolates, especially in water with a low content of organic compounds.

Due to the ability to assimilate NAC by some bacteria, organosilicon polymers were functionalized with this compound by photo-initiated thiol-ene addition to appropriate polymer precursors containing vinyl substituents. As a result of attaching NAC to the polymer matrix through the sulfhydryl group, its antimicrobial activity was blocked.

NAC polymers were more hydrophilic than the control glass surface. The surface free energy of the polymers ranged from 240 mJ/m^2 to 380 mJ/m^2, with the value of this

parameter equal 180 mJ/m^2 for the control material - glass. It was noted that as a result of blocking the active thiol group, the obtained polymers were characterized by a weaker antibacterial action. Inhibition of the growth of the tested strains in the presence of polymers varied and depended not only on the kind of bacteria, but also on the solubility of these compounds in water. However, compared to native NAC, the polymers were more effective in removing mature biofilms. Treatment of bacterial biofilms with polymer suspensions at a concentration of 1% w/v resulted in a significant reduction in the number of viable bacterial cells in the biofilm matrix.

The method of obtaining organosilicon polymers from NAC and their use have been patented (Patent RP 235567).

KEY WORDS: water systems, bacteria, biofilms, organosilicon polymers