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Influence of the procedure of casting solution preparation on the antimicrobial properties of polyethersulfone membranes modified with titanate nanotubes

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ABSTRACT

The influence of the titanate nanotubes (TNTs) on the antimicrobial properties of mixed-matrix polyethersulfone membranes obtained by the wet phase inversion is discussed in relation to the procedure of preparation of casting solution. Various attempts to TNTs dispersion in the polymer-solvent (*N,N*-dimethylformamide) were investigated, based on the application of ultrasonic bath (indirect sonication) or ultrasonic probe (direct sonication). The antimicrobial properties of the membranes were evaluated using *Escherichia coli*. The physicochemical properties of the membranes were assessed based on scanning electron microscopy, atomic force microscopy, and isoelectric point measurements. It was found that the direct sonication led to the formation of smaller TNTs agglomerates compared to the indirect method. As a result, the membranes obtained with the application of the former technique exhibited smoother surface and higher water permeability compared to the membranes fabricated with the latter approach. A linear correlation between mean surface roughness (R_a) and inhibition of bacterial growth was proved. The best antimicrobial performance exhibited the membrane characterized by the highest R_a, prepared with the application of the indirect sonication. The inhibition of *E. coli* growth after 24 h of incubation in the presence of this membrane was about five times higher than that observed for the unmodified membrane.

Keywords: Polyethersulfone membrane; Titanate nanotubes; Roughness; Antimicrobial activity; *Escherichia coli*

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