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Anti-fouling high flux ultrafiltration monophasic hybrid membranes for water treatment

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Titanium dioxide (TiO2) is currently one of the most common photosensitive materials used in photocatalysis due to its exceptional properties such as low cost, lower toxicity and high chemical content stability, being very useful in water treatment when combined with other components such as cellulose acetate (CA) [1].
Several integrally skinned asymmetric monophasic hybrid CA-based membranes were synthesized by coupling phase inversion and sol-gel techniques. Two series of membranes were synthesized: cellulose acetate/silica (SiO2)/Titania (95/3/2), CA/SiO2/TiO2 (90/6/4), CA/SiO2/TiO2 (85/9/6) and CA/SiO2 (95/5) in the first series; and CA/TiO2 (97/3) and CA (100) in the second series.
Hydraulic permeability (Lp) was studied, and the antibacterial properties of the membranes against Staphylococcus aureus, Escherichia coli, Enterococcus faecalis, Pseudomonas aeruginosa and Bacillus subtilis were evaluated with and without UV treatment, through 3 tests, changing only the way in which the active layer of the membranes was in contact with the bacteria.
The hydraulic permeability values were 12, 33, 7, 33, 27, 12 kg/m2.bar, for the membranes CA, CA/SiO2, CA/SiO2/TiO2 (95/3/2), CA/TiO2, CA/SiO2/TiO2 (90/6/4), CA/SiO2/TiO2 (85/9/6), respectively. In series 1, the addition of TiO2 to the membrane structure did not increase the Lp of the CA/SiO2/TiO2 membranes in relation to the reference membrane CA/SiO2, whereas for the CA/SiO2/TiO2 (95/3/2) membrane, Lp decreased with the addition of TiO2. In series 2, TiO2 increased the Lp of the CA/TiO2 membrane compared to the pure CA reference membrane.
In terms of antibacterial properties results revealed that all types of bacteria grow when placed in contact with the bottom porous layer of the membranes. When Bacillus subtilis was spread on top of the top active layer of the UV-treated CA/SiO2/TiO2 (95/3/2) membrane the bacteria created a “mucus”, known to be produced as a form of resistance to activation. Further tests performed on the CA/SiO2/TiO2 (90/6/4) and CA/SiO2/TiO2 (85/9/6) membranes showed that increase in the TiO2 content did not result in death of the bacteria.

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