Abstract

Poly(ether sulfone) (PES)/polyvinylpyrrolidone (PVP) membranes are widely used in various industrial fields such as drinking water production and in the dairy industry. However, the use of oxidants to sanitize the processing equipment is known to impair the integrity and lifespan of polymer membranes. In this work we showed how thorough electrokinetic measurements can provide essential information regarding the mechanism of degradation of PES/PVP membranes by sodium hypochlorite. Tangential streaming current measurements were performed with ultrafiltration and nanofiltration PES/PVP membranes for various aging times. The electrokinetic characterization of membranes was complemented by FTIR-ATR spectroscopy. Results confirmed that sodium hypochlorite induces the degradation of both PES and PVP. This latter is easily oxidized by sodium hypochlorite, which leads to an increase in the negative charge density of the membrane due to the formation of carboxylic acid groups. The PVP was also found to be partly released from the membrane with aging time. Thanks to the advanced electrokinetic characterization implemented in this work it was possible for the first time to demonstrate that two different mechanisms are involved in the degradation of PES. Phenol groups were first formed as a result of the oxidation of PES aromatic rings by substitution of hydrogen by hydroxyl radicals. For more severe aging conditions, this membrane degradation mechanism was followed by the formation of sulfonic acid functions, thus indicating a second degradation process through scission of PES chains