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Biofouling is a major problem in water membrane processes, especially in seawater reverse osmosis plants. Inactivation of *Vibrio fischeri* (a well-known marine bacterium forming biofilm) through photocatalysis via visible light was investigated in this work using active FeO₃-TiO₂ nanoparticles. Five FeO₃-TiO₂ photocatalysts with different weight percentage of FeO₃ (0–5wt%) were synthesized using an ultrasonic-assisted co-precipitation method. The photocatalysts were characterized by powder X-ray diffraction (XRD), BET surface area, transmission electron microscopy (TEM) plus selected area electron diffraction (SAED) patterns, scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX) and diffuse-reflectance spectroscopy (DRS). Based on the design of experiments, the synthesized photocatalysts were tested for inactivation of *V. fischeri* under visible light irradiation at different temperatures (25–35°C) and different photocatalyst dosage (0.1–2g/L). The photocatalytic microbial inactivation experiments were performed in artificial seawater appropriate for growth of the marine bacterium. The results revealed that the highest inactivation efficiency of *V. fischeri* was achieved when 1g/L of 2.5wt% FeO₃-TiO₂ were used, at 35°C. Photocatalytic inactivation of microorganisms using visible light-driven FeO₃-TiO₂ photocatalysts, could introduce an innovative green method in pretreatment units of reverse osmosis plants to control the membrane biofouling.

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