

Application of TiO₂-embedded expanded polystyrene balls to inhibit the algal growth in rivers and lakes

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1. Introduction - A new immobilization technique of nanoscale TiO₂ powders to expanded polystyrene (EPS) balls with temperature-controlled melting method was validated for mass production, and the photocatalytic activity of TiO₂ powder-embedded EPS (TiEPS) balls using *M. Aeruginosa* under ultraviolet irradiation and under the natural solar light irradiation was evaluated.

2. Experimental – The detail mass production processes of TiO₂-embedded EPS (TiEPS) balls were presented in previous study. The experiment was performed using acrylic reactor in indoor and outdoor conditions, and total 49 TiEPS balls were inserted in each reactor. The experiment was conducted using four reactors with various conditions of control and TiEPS balls. *In-situ* water quality monitoring and sampling were conducted continuously. Dissolved oxygen (mg/L, %), pH, temperature, and electrical conductivity were monitored (YSI Co., USA) while chlorophyll-*a* (Chl-*a*) and phycocyanin were measured using portal sensor (Modernwater Co., UK).

3. Results and Discussion – Based on the comparison of cell number of *M. Aeruginosa* control and TiEPS balls with different shading ratios, the cell numbers and growth rates decreased for TiEPS balls. The photocatalytic degradation of *M. Aeruginosa* using TiEPS balls can be explained by the reaction of oxygen species (OH•, O₂•-, and H₂O₂) released from the irradiated TiO₂ particles on the surface of TiEPS balls. Thus, highly reactive hydroxyl radicals can attack the lipid cell membrane through the peroxidation reaction and inhibit the self-protection mechanisms, eventually resulting in cell inactivation. Therefore, TiEPS balls were feasible to prevent and inhibit the excessive growth of algae in eutrophic water body.

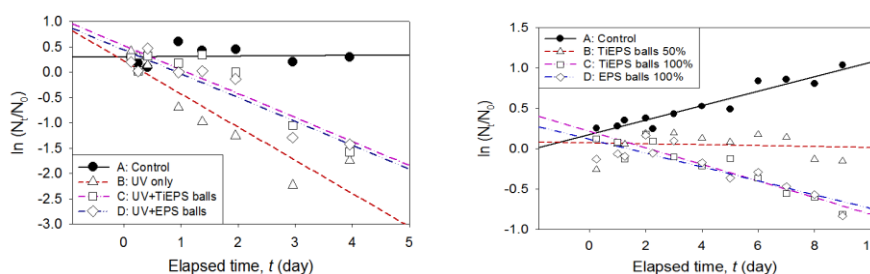


Image 1. Growth and degradation rates fitting of *M. Aeruginosa* by application of TiEPS balls.

4. Conclusions – The highly reactive hydroxyl radicals (OH•) from TiEPS balls degraded the lipid cell membrane through the peroxidation reaction with the light shielding, eventually resulting in cell inactivation. Although dominant inhibitory effects on the growth of *M. Aeruginosa* were ambiguous, TiEPS balls were feasible to prevent and inhibit the excessive growth of algae in eutrophic water body.

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