Continuous Removal of Hydrogen Peroxide with Encapsulated Catalases

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Abstract

Hydrogen peroxide (H_2O_2) is a powerful oxidant that is used as a bleaching agent or microbicide in paper, food, textile, and semiconductor industries.[1)] Since hydrogen peroxide itself is a toxic substance, hydrogen peroxide residues should be removed before disposal. Catalases are abundant enzymes in nature that decompose hydrogen peroxide to water and molecular oxygen. Some commercially available catalases have been used for elimination of residual hydrogen peroxide in various industries. However, the enzyme cost has hampered its applications, even though catalase is one of the most effective enzymes. The cost can be reduced by immobilization and reuse of the enzyme. In addition, enzyme immobilization prevents catalase from flowing out and interacting with the next process. In this work, a catalase was encapsulated in chitosan beads[2,3)] and silica sol-gel.[4)] The catalytic activity of the immobilized catalase was compared with that of free enzyme. For continuous H_2O_2 removal, a hydrogen peroxide solution was pumped into a water-jacketed reactor packed with the encapsulated catalase. Effect of the flow rate, pH, and temperature of the H_2O_2 solution on the H_2O_2 removal efficiency of the immobilized catalase was investigated. We expect that encapsulated catalases can enhance their applicability for continuous degradation of hydrogen peroxide.

References

1. Oh, S.-H., H.-J. Yu, M.-S. Kim, S. So, and H.-J. Suh (2002), Biodegradation of hydrogen peroxide in semiconductor industrial wastewater with catalase from *Micrococcus* sp., *J. Food Sci. Nutr.* **7**, 33-36.
2. Çetinus, Ş. A. and H. N. Öztop (2003), Immobilization of catalase into chemically crosslinked chitosan beads, *Enzyme Microb. Technol.* **32**, 889-894.
3. Eberhardt, A. M., V. Pedroni, M. Volpe, and M. L. Ferreira (2004), Immobilization of catalase from *Aspergillus niger* on inorganic and biopolymeric supports for H_2O_2 decomposition, *Appl. Catal. B: Environ.* **47**, 153-163.
4. Vera-Avila, L. E., E. Morales-Zamudio, and M. P. Garcia-Camacho (2004), Activity and reusability of sol-gel encapsulated α-amylase and catalase. performance in flow-through systems, *J. Sol-Gel Sci. Technol.* **30**, 197-204.