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Enzymatic removal of micropollutants in water with new bio-based immobilization supports

The presence of pharmaceutical pollutants and endocrine disruptors in urban and industrial effluents is becoming an actual problem for environment and public-health. Their removal is very difficult because the compounds are generally refractory to classical wastewater treatments and are present at very low concentration (< µg/L). The enzymatic treatment of such effluents can be an interesting alternative to classical wastewater treatments, in particular when enzymes are immobilized in beads in order to be reused and increase their stability [1]. In this thesis, new immobilization gelatin-based supports will be designed for laccase immobilization. Gelatin beads of a diameter ranged between 1 to 2 mm have been prepared by dropping a gelatin solution in an aqueous solution of polyethylene glycol (PEG) [2]. This polymer has the advantage of being non toxic, relatively cheap, and having a large exclusion volume which will result in forming two-phase systems with other polymers. The elaboration process of the supports has been optimized and the properties of the supports have been studied. Laccase are immobilized on the surface of the gelatin beads by covalent bonding with a cross linking agent, glutaraldehyde. The stability of the immobilized enzyme has been investigated towards pH, temperature and storage. The immobilized enzymes have proven efficient to degrade different pollutants, such as tetracycline (antibiotic) and catechol (phenolic compound). A fluidized bed reactor has been conceived and the first tests have shown good feasibility of reaction inside the reactor, the fluidization allowing an easier contact between the immobilized enzymes and the substrates.

[1] Mateo C., Palomo J.M. et al, Improvement of enzyme activity, stability, and selectivity via immobilization techniques, (2007). Enzyme Microbial Technology, 40, 1451-1463.

[2] Y-Q Kong, D. Li, L-J. Wang, B. Adhikari, Preparation of gelatin microparticles using water-in-water (w/w) emulsification technique. Journal of food engineering, 103, 9-13, (2011).