Biopolymers as biofilters and biobarriers

Abstract

The use of biopolymers is a sophisticated method of soil and wastewater treatment as a substitute for using chemicals, which is a public health concern. A number of mechanisms, such as polymer bridging, polymer adsorption, charge neutralization (including electrostatic patch effects), coagulation/flocculation, and adsorption have been suggested to describe the destabilization of colloids and suspensions by biopolymers. A number of factors, such as sorption capacity of biopolymers, concentration of biopolymers, DO, NO3-, pH, additives, extracellular polymeric substances, and microbial immobilization time, have been optimized to enhance the efficiency of biopolymers in biofiltration/biobarrier systems. Beside this, biopolymers in combination with other polymers, biopolymers, and microorganisms have been successfully employed as biofilters/biobarriers. In order to enhance application and decrease prolonged startup procedures of a biofilter, such systems are often seeded with microbes of interest to expedite quick biofilm development. Upflow packed bed bioreactors using microbial cellulose have greater than 90% denitrification capacity. Fixed-bed bioreactors using magnetic chitosan and polycaprolactone have excellent efficiency to remediate Cu, P, As(V), As(III), and NO3-. Mulch film biobarriers, permeable reactive biobarriers using peat moss, and organic mulch and biotrickling filter systems have been successfully implemented for the remediation of naphthalene, organic compounds, and isopropyl alcohol and benzene-toluene-ethylene-xylene, respectively. Therefore, biopolymers have been verified to be appropriate for remedial properties by regulating the microbial entrapment and adsorption in the biofiltration system. The emergence of these novel biofilters and biobarriers for large-scale effluent treatment and implementation should be accompanied by some key objectives. © 2016 Elsevier Ltd.