USE OF VEGETATION FOR THE ENVIRONMENTAL MANAGEMENT OF COOLING SYSTEMS FORMULATIONS AND VOLATILE SOLVENTS

[1]Sigifredo Castro, [2]Lawrence C. Davis, [3]Peter Kulakow, and [1]Larry E. Erickson.
[1]Department of Chemical Engineering, Kansas State University, Manhattan, KS 66506; Phone: (785)532-5584; Fax: (785)532-7372.
[2]Department of Biochemistry, Kansas State University, Manhattan, KS 66506; Phone: (785)532-6121; Fax: (785)532-7278.
[3]Department of Agronomy, Kansas State University, Manhattan, KS 66506 Phone: (785)532-7239; Fax: (785)532-6094.

ABSTRACT

Phytoremediation, or use of plants as active decontamination agents, can be applied in different forms as an economically feasible alternative for environmental management of a great number of organic chemicals such as industrial solvents, agrochemicals, and specialty chemicals. Our research group has studied the effects of vegetation on soils contaminated with cooling systems formulations and with volatile solvents. The formulations, which are used to prevent freezing in cooling systems and in aircraft deicing, are composed of glycols as active agents, corrosion inhibitors such as 5-methyl benzotriazole (MBT), and some other additives. We have found that vegetation is beneficial through two mechanisms. The first one is the "rhizosphere effect", in which the roots of the plants promote development of a bacterial population capable of degrading glycol. The second mechanism is the direct phytotransformation of the MBT by enzymatic processes within the plants, taking advantage of the structural similarity of the MBT with some of the constituents of lignin. In the case of organic solvents such as methyl-tert-butyl ether (MTBE) and trichloroethylene (TCE), phytoremediation can be used exploiting a different mechanism. The evapotranspiration activity of the plants facilitates the transport of solutions contaminated with organic solvents toward the roots, where bacterial degradative processes are more likely to occur and/or transport the contaminant through the plant into the atmosphere where it can be degraded by photolysis. Through experimental studies our group has been able to determine tolerance levels, most favorable environmental conditions, apparent kinetic models, limitations, and potential for use of phytoremediation as a feasible alternative at field scale.

Key words: phytotransformation, rhizosphere effect, phytovolatilization, glycol, triazole, MTBE, TCE