Environmental Engineering and Management Journal — *March 2012, Vol.11, No. 3, Supplement, S152*
http://omicron.ch.tuiasi.ro/EEMJ/

"Gheorghe Asachi" Technical University of Iasi, Romania

Rhodococcus BIOSURFACTANTS: PHYSICOCHEMICAL PROPERTIES AND ENVIRONMENTAL APPLICATIONS

M.S. Kuyukina[1,2], I.B. Ivshina[1,2], M.I. Richkova[1]

[1]Institute of Ecology & Genetics of Microorganisms, Perm, Russia; [2]Microbiology & Immunology Department, Perm State University, Perm, Russia; e-mail: kuyukina@iegm.ru

Abstract

Alkanotrophic *Rhodococcus* strains isolated from oil-contaminated environments are able to produce biosurfactants in response to the presence of liquid hydrocarbons in the growth medium. These biosurfactants are predominantly cell-bound glycolipids containing trehalose as the carbohydrate. Physiological roles of these glycolipids are diverse and involve participation in the uptake of water-insoluble substrates, promotion of the cell adhesion to hydrophobic surfaces and increasing the bacterial resistance to toxic chemicals. In terms of surfactant characteristics (e.g. surface and interfacial tension, CMC, emulsifying activity), *Rhodococcus* biosurfactants compete favourably with other microbial and synthetic surfactants. Their environmental applications include soil washing and *in situ* bioremediation of soils contaminated with crude oil and heavy metals. Particularly, a biosurfactant from *R. ruber* was found to partition up to 93% of crude oil from oil-polluted soil, and it was applied in pilot-scale oil-shale cuttings separation. Moreover, oil-removal activity of the *Rhodococcus* biosurfactant was 1.9-2.3 times greater than that of a synthetic surfactant Tween 60. Laboratory soil column experiments revealed that *R. ruber* biosurfactant promoted heavy metal desorption and removal from soil; it removed 80-92% of nickel, cadmium and molybdenum from soil simultaneously contaminated with metals and crude oil. The biosurfactant produced by rhodococcii grown on dodecane appeared as an efficient soil washing agent under cold conditions (≤15°C), but at higher temperatures (20≥°C) the biosurfactant from hexadecane-grown bacteria was most effective. Mathematical models based on a filtration theory were developed for crude oil- and heavy metal-contaminated soil washing processes using biosurfactant, which could be used to determine optimal washing parameters and predict efficiency. An oleophilic biofertilizer based on *Rhodococcus* biosurfactant and consisted of active hydrocarbon-degrading bacterial cultures and NPK mineral salts was tested in the field soil bioremediation trial performed in a cold climate region (West Urals, Russia). Consecutive bioremediation techniques, namely, slurry bioreactor treatment and biopile systems were applied resulting in 80% decrease of oil contamination after 10 weeks. Remediated soil contained 0.2% (w/w) of residual hydrocarbons and retained no phytotoxicity.

Acknowledgements

Research was funded by the Russian Academy of Sciences (MCB Program) and RF Ministry of Education and Science (contracts 16.518.11.7069, 16.513.12.3015).