Facts and challenges on hydrocarbons bioremediation

Cavaleiro AJ[1], Paulo AMS[1], Salvador AF[1], Alves JI[1], Castro R[1], Langenhoff AAM[2,1], Stams AJM[3,1], Pereira MA[1], Alves MM[1]

[1] *CEB - Centre of Biological Engineering, Universidade do Minho, 4710-057 Braga, Portugal*
Group: BRIDGE | Line: Environmental Biotechnology and Bioengineering

[2] *Sub-department of Environmental Technology, Wageningen University, Bornse Weilanden 9, 6708WG Wageningen, The Netherlands*

[3] *Laboratory of Microbiology, Wageningen University, Stippeneng 4, 6708WE Wageningen, The Netherlands*

The intense activity of the oil industry generates substantial amounts of contaminated wastes and wastewaters. Moreover, accidental oil spills occur frequently, causing severe damages in the marine environment and in the soil. Subsurface soil contamination is generally caused by oil leakages from underground storage tanks and transport pipelines that can further lead to groundwater contamination. To date, common techniques for remediation of petroleum-contaminated environments include physical removal, washing by cosolvents or surfactants, thermal desorption, electrokinetic movement of contaminants and oxidation/reduction via chemical agents. Biological technologies can be an alternative to the more aggressive physicochemical methods, as bioremediation exploits the metabolic diversity of microorganisms and their ability to degrade organic contaminants.

Aerobic bioremediation is frequently preferred over anaerobic processes, due to faster rates of hydrocarbons activation and biodegradation [1]. However, in subsurface environments oxygen is generally scarce and anoxic conditions prevail. Anaerobic microorganisms can biodegrade hydrocarbons coupled to the reduction of nitrate, iron(III), sulfate or under methanogenic conditions [2]. *In situ* bioremediation of hydrocarbons at anoxic conditions has not been extensively studied, despite the broad occurrence of these contaminants in the subsurface. Reduced knowledge on the catabolic mechanisms and microbial communities involved in anaerobic hydrocarbons biodegradation has limited this approach, and needs further research.

Our work has been focused on the bioremediation of petroleum-contaminated environments in the absence of molecular oxygen. Culture-dependent and independent approaches have been applied for improving knowledge on the key microorganisms involved in anaerobic biodegradation of hydrocarbons. The effects of different redox conditions in hydrocarbons biodegradation, and in the structure and composition of the microbial communities involved in these metabolic pathways, were investigated. Isolation of a novel *Desulfomonile* bacterium is ongoing, and its potential for bioremediation of halogenated compounds is being studied. By adding different co-substrates, methane production from olefins was accelerated. The work developed was awarded by NASA in the 12th International Workshop on Environment and Alternative Energy (Cape Canaveral, USA, 2014).

References

[1] Rabus, R, Boll, M, Heider, J, Meckenstock, RU, Buckel, W, Einsle, O, Ermler, U, Golding, BT, Gunsalus, RP, Kroneck, PM, Krüger, M, Lueders, T, Martins, BM, Musat, F, Richnow, HH, Schink, B, Seifert, J, Szaleniec, M, Treude, T, Ullmann, GM, Vogt, C, von Bergen, M, Wilkes, H, Anaerobic microbial degradation of hydrocarbons: from enzymatic reactions to the environment, *Journal of Molecular Microbiology and Biotechnology* 26(1-3), 5-28, 2016.

[2] Mbandinga, SM, Wang, LY, Zhou, L, Liu, JF, Gu, JD, Mu, BZ, Microbial communities involved in anaerobic degradation of alkanes, *International Biodeterioration and Biodegradation*, 65(1), 1-13, 2011.