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BIOREMEDIATION ASSESSMENT ON LINEAR ALKYLBENZENE-POLLUTED AQUIFER

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Abstract

Linear alkylbenzenes (LABs) are used to manufacture alkylbenzene sulphonates (LASs), one of the most widely used anionic surfactants in domestic and industrial applications. An industrial site near Barcelona (Spain) whose groundwater was polluted following the rupture of an old storage tank was examined.

The aim of the presentation is to offer an overview of the research related and the implementation of an in-situ bioremediation system. Phase I includes in vitro degradation tests under different redox conditions and in vitro chemical oxidation coupled to biodegradation. In phase II in-situ microbial community analysis using BioSep technology and in-situ bioremediation actuations were carried out.

Oxygen and nitrate concentrations in groundwater suggested that denitrification processes may take place. Therefore, feasibility assays of bioremediation were carried out under aerobic, denitrifying and aerobic-denitrifying sequential conditions, at lab scale, with successful biodegradation of LABs. More than 40% and 90% of degradation were found under denitrifying and aerobic conditions, respectively.

Additionally, in order to increase the degradation rates of LNAPL (hydrophobic and viscous), in vitro chemical oxidation assays were performed, coupled to bio stimulation. Sodium persulfate, potassium permanganate and a modified Fenton reaction were tested. In addition the capability of subsequent natural attenuation after chemical oxidation and the changes on the product bioavailability were also assessed. The results showed that chemical oxidation did not increase the degradation compared to enhanced natural attenuation (biostimulation). Anyway, the quantification of functional genes related to alkane and aromatic biodegradation pathways, such as alkB, tol, tod, bssA and phe was assessed to determine autochthonous microbial populations resilient to chemical oxidation for further biodegradation of LABs.

To apply a bioremediation, it is necessary to demonstrate the in-situ occurrence of natural attenuation processes. Conventionally, monitored indicators of biodegradation include the distribution of contaminants, the occurrence of metabolic products, geochemical parameters and functional gene analysis. BioSep technology, a down-well aquifer microbial sampling system, was used to gain insight on microbial populations related to alkylbenzene biodegradation under in-situ groundwater environmental conditions, monitoring the groundwater microbial community dynamics during field bioremediation experiments. Main microbial populations and functional genes above described and denitrification-related-genes such nosZ gene were assessed by means of DGGE and quantitative PCR (qPCR). Lab tests and in-situ microbial communities exhibited changes significantly throughout biodegradation processes.

Bearing in mind lab test and in-situ results, an in-situ actuation has been defined. A physical barrier has been placed to hold the LNAPL, whereas subsequent bioremediation will be applied downstream.