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IN SITU Bioremediation: Possibilities and Limitations

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Abstract - Organic contaminants in the soil is a widespread problem that not only may cause damage to local biota, but also poses an ecological and health threat if the contaminants spread to groundwater aquifers and water ways. Therefore sites known to be contaminated should always be assessed preferable by performing both an ecological risk assessment and a health risk assessment. Monitored natural attenuation (MNA) is in many cases a reasonable approach, but often risk assessment calls for active remediation measures. The most common method in Finland for cleaning a site is excavation and treatment ex situ, but recently a variety of in situ methods, both bioremediation and chemical treatments, have been tested and even employed in field conditions. One bottleneck for a more widespread use of in situ methods is the great variability in the usefulness of each type of treatment. Vital for success is a thorough knowledge of the site and a variety of methods to chose from and, when necessary, to combine. Functionality of a certain method or combination of methods should also, whenever possible, be tested in laboratory conditions before and during field scale application.

For more than 20 years we have tested various approaches for enhancement of bioremediation of sites polluted by organic contaminants. Through collaboration with contractors and site owners, more than 10 actual sites presenting typical problems have been targets for testing and optimization, first by laboratory modeling, and then by applying lab experiences in application scale. Samples from the sites were used in controlled laboratory conditions to build micro- and mesocosm- setups in which biological, physical, and chemical treatments were tested and combined, with the main goal of achieving optimal biostimulation and contaminant degradation. As soon as lab results were available, these were utilized for in situ field purposes. Lab and field tests were run in parallel, so that each new challenge in the field treatment generated modifications in the laboratory testing, and each new full scale treatment method was preceded by laboratory modeling. Successful bioremediation was achieved in most of the target cases. Lab testing also created the knowledge when not to use bioremediation, and this can be regarded as one of the utilities of our results. Fresh oil spills resulting from accidents is a new research topic. While old contaminated sites often can rely on an adapted indigenous microbial community, new spill sites may be less responsive to mere biostimulation, and therefore more active treatment measures may be required. The results from this oil spill simulation performed at a lysimeter field are currently being gathered. We have tested and optimized various combinations of biostimulation, bioaugmentation, extraction, electro-kinetic methods, and the use of previously contaminated soil as a seed for degraders (Kauppi et al. 2011, 2012, Sinkkonen et al. 2012, (Suni et al. 2007) The lab results have then been employed for reaching an optimal result at the field site. Slowly generalizations to be used at “any site” begin to emerge.

References

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