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Assessment of Constraints to Bioremediation in Contaminated Sites

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The application of natural attenuation to the restoration of brownfield sites has the potential to provide a cost-effective long-term solution to the problems associated with contaminated land. The quantification of microbial bio-degradative activity and toxicity are two parameters fundamental to assessing the potential efficacy of a bioremediation program. Reticulated Vitreous Carbon (RVC) units, developed to obtain representative samples of biomass from groundwater, have been used at several contaminated sites to quantify pollutant bio-degradative activity using ^{14}C-mineralisation assays, and groundwater toxicity has been assessed using a *lux*-marked microbial biosensor. At one paint-manufacturing site toxicity assessment of the groundwater pre-and post-sparging averaged 36% (% of maximum luminescence S.E. ±9) and 83% (% of maximum luminescence S.E.±4) respectively, for 9 monitoring well samples. This indicated that the toxicity was caused by the presence of Volatile Organic Compounds (VOCs). Pre-sparge toxicity correlated strongly with Total VOC (r_2=0.73), while microbial counts decreased with increasing VOC. ^{14}C-Toluene bio-degradative activity varied considerably (0.001 to 1.503 µg toluene h^{-1} RVC $unit^{-1}$) between different well samples with activity increasing with Total VOC, indicating an adapted VOC degrading microbial consortia in high VOC environments. At a wood preservative-manufacturing site, significantly lower toxicity constraints were found, with pre- (92% S.E. ± 4) and post-sparging (98% S.E. ±6) averages of 12 monitoring well samples. The removal of VOC by sparging decreased toxicity constraints further. ^{14}C -Toluene bio-degradative activity varied from 0.30 to 0.85 µg toluene h^{-1} RVC $unit^{-1}$. In this paper *ex-situ* bio-degradative activity will be presented in the context of constraining factors determined through toxicity assessment.