soil biology

Innovative Technologies for Remediation of Environmental Contamination

E.O. Scott-Emuakpor[1], M.A. Alawadi[1], S.A. Alrumman[1], H. Alzahrany[1], E.K. Budde[1], L. Cassidy[1,2], W. Cowie[1], E.E. Diplock[1,3], O.I. Iroakasi[1], N. Mackay[1], S.M.A. Dehlawi[1], D.P. Mardlin[1,3], D. Standing[1] , D.E. Macphee [4] & G.I.Paton[1,2,3]

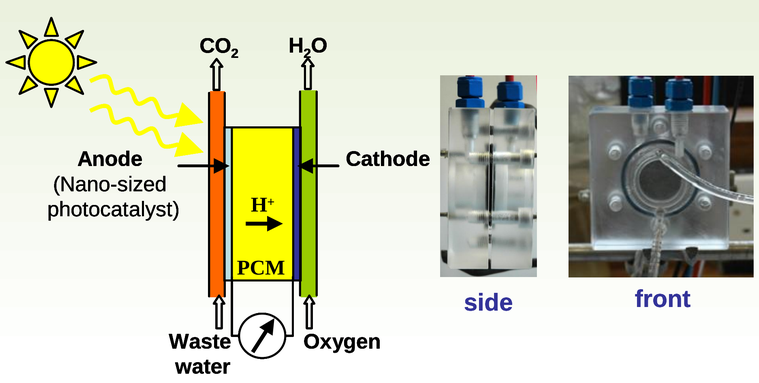
[1]Biological Interactions in Soils, Cruickshank Building, Institute of Biological and Environmental Sciences, University of Aberdeen, Aberdeen AB24 3UU
[2]DRAM, The Device for Remediation and Attenuation of Multiple Pollutants, Institute of Biological and Environmental Sciences, Aberdeen AB24 3UU
[3] Remedios Limited, Balgownie Technology Centre, Balgownie Drive, Aberdeen,AB22 8GW
[4]School of Natural and Computing Sciences, University of Aberdeen, Meston Walk, Aberdeen, AB24 3UE

Introduction

A global increase in the extent of contaminated land and water means that practical solutions are required to resolve this. The solution must be adequate to protect the selected receptor (human, water or ecological) yet must be economically viable. Lessons that we learn in the developed world must also be translated to the developing world where cost may be a more significant driver. The research group has experience in working throughout the world in areas impacted by hydrocarbons, chlorinated solvents, metals and metalloids and pesticides. Fundamental to the success of any given project is the need to underpin the solution with fundamental science. The group illustrate the application of technology in three different studies.

Photoelectrocatalytic Fuel Cell (PECFC) (D.Macphee, Chemistry)

This sustainable technology makes use of visible light for the degradation of organic pollutants in waste water.

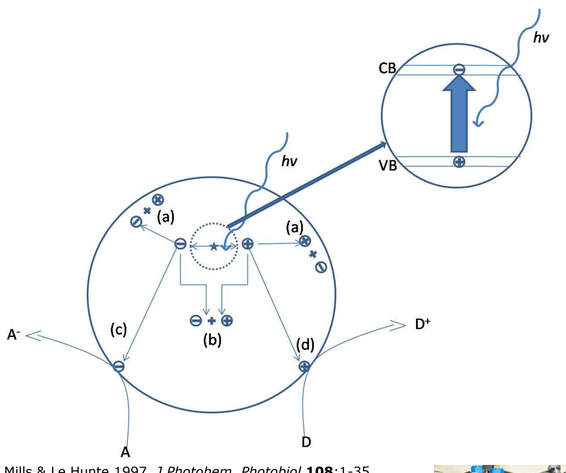


side

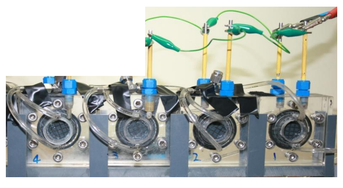
front

Absorption of light creates electron (e^-) hole (h^+) pairs which generate free hydroxyl radical (OH*), which undergo secondary reactions. Photogenerated e^- are removed via an external circuit to prevent charge recombination (achieved by applying an electric field /anodic bias)

Overall Cell reaction:
Hydrocarbon + OH^* $\longrightarrow$ $H_2O + CO_2$ + energy



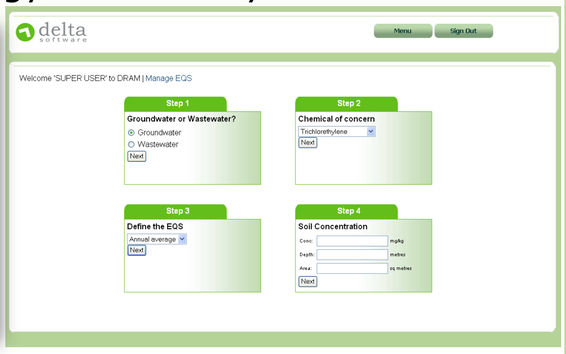
Mills & Le Hunte 1997. *J Photohem Photobiol* **108**:1-35



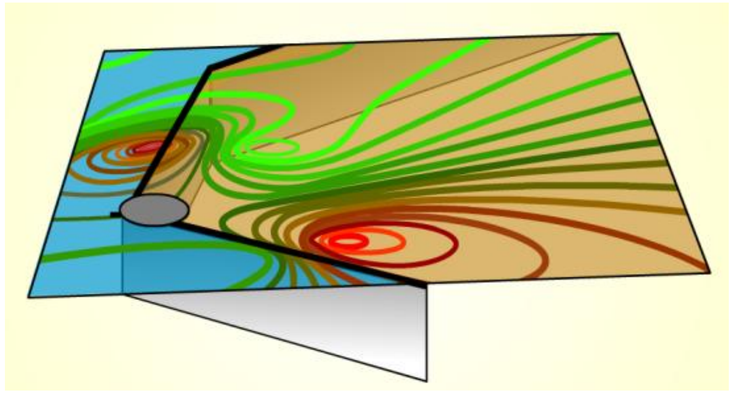
The design of this state of the art PECFC means that scaling-up to side-by-side stacks can be achieved, potentially in-line with existing waste water treatment systems.

Device for Remediation and Attenuation of Multiple Pollutants (DRAM)

This technology uses a by-product of the whisky industry to remediate pollutants in water. It is effective for hydrocarbons and solvents (both through binding and degradation) and also for metals and metalloids. Initially designed for groundwater treatment it is well suited to the wastewater and utility market where field trials have just been completed. Bespoke devices enable focussed application of this technology in a case by case basis.



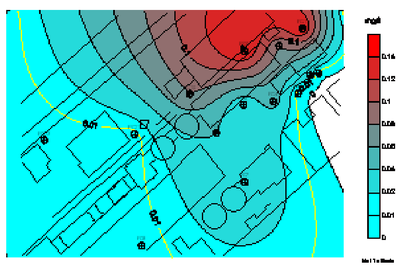
For both groundwater and wastewater, DRAM works because of detailed and well characterised preliminary data.
These data are processed through a bespoke software tool which marries the contaminant problem with the environmental quality standard and the form and volume of DRAM required to match this. All data were derived from extensive lab trials and supplemented by field trails. The commercial launch of this project will enable further innovation and target for new scenarios and chemicals of concern.



Remediation-DST

This is a decision support tool. Data collected from experiments and field trials has been assimilated and interpreted to aid future remedial strategies. At the moment the technology mainly supports hydrocarbon impacted soils and waters but current work is extending this to cover hydrophobic compounds, solvents and metals (both in soils and water).

The output is end-user compatible and is the type of system ideal for stakeholders. This software brings together a wide range of data to enable a "ranked suitability index" of remedial options. It operates at level depending on available data. At the first level there are generic approximations but by level 3 a bespoke operating strategy is delivered.



Genuine case studies support the quality of the output data (oil spill and former railway yard). The group is uniquely placed in being able to upscale technologies from lab to field and appraise success.

Conclusions

The group have been able to use empirical laboratory derived data to apply innovative and sustainable technologies at the field scale. Working as a team, the Remediation-DST has a capacity to consider new technologies in a comparative manner against a wide range of genuine scenarios and to address the underpinning science in a site specific format. Uniquely these technologies in combination can deal with a range of clean-up targets; matched to defined receptors.

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DRAM - The sustainable environmental solution

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