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Yorkshire Contaminated Land Group Technical Meeting

Developments in Site Investigation and Remediation

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held on 25/02/14

Yorkshire Contaminated Land Forum held its annual R & D focussed technical meeting at Sheffield University on 25th February 2015 with the theme 'Developments in Site Investigation and Remediation'.

The first presentation was given by Dr. Steven Mudge from Exponent Ltd on *Environmental Forensics - Identifying the Source and Apportioning Blame*. Two case studies were presented demonstrating how stable isotopes within Lead (and many other elements) can be used in environmental forensics. The first case study presented results from an investigation into the source of elevated Lead in the River Conwy which was failing the relevant quality standards under the Water Framework Directive. This Conwy flows through an area of historic mining with several old mine workings including adits located in the catchment. Of particular interest was the 'Parc Mine' as a large area of mine tailings were stabilised in the 1970s by covering with geotextile and topsoil. The question was whether these old mine workings are responsible for poor water quality.

Lead has four stable isotopes that come from natural radioactive decay series. ICP MS was used to measure the concentrations of these four isotopes. The ratios of each isotope were then used to determine the fingerprint of the sample. Samples from along the catchment were compared with samples from Parc Mine and found to have different signatures. Therefore, it was concluded that the 1970s stabilisation was effective and that the source of lead was somewhere else. However, tracking down other potential sources was not one of the project objectives.

The second case study presented the findings of a forensic investigation of an illegally landfilled site in Malaysia.

Leaching Behaviour Of A Basic Oxygen Furnace Steel Slag: Implications For Leachate Chemistry And Vanadium Mobility was the title of the second presentation by Andy Hobson of Leeds University. It is estimated that in 2013 between 150-230 million tonnes of steel slags were produced worldwide much of which is landfilled. Lime is used in steel production because it helps remove impurities but produces large quantities of slag rich in calcium oxide. This readily weathers and can cause a number of environmental issues including high pH (>12), carbonate precipitation and mobilisation of metals in leachate (e.g. vanadium, chromium, arsenic, cadmium, lead) into the environment. Most research has focussed on anaerobic conditions but this research focuses on aerobic conditions.

As part of this research samples were ground up and subject to batch leaching. The research identified that leaching of Vanadium in aerobic conditions was much higher than anaerobic conditions. Leaching of slags across a range of pH conditions was also assessed. This showed that most metals release at low pH and drop off almost completely at neutral conditions. Trace metal release is limited under anaerobic conditions except at low pH.

Juan Mujica from the University of Sheffield then gave a presentation on his current research examining *Microbial Community Dynamics Across Chemical Interfaces And Their Role In Bioremediation Of Plumes*. Juan's research is investigating the establishment of microbial communities in contamination plumes. Microbial communities are both planktonic and attached. The study is evaluating the time required to establish an attached community whether the attached community is stable with time. Initial findings have found that attached communities formed relatively quickly (within a matter of weeks) and expanded rapidly with time. Further research is underway to establish how a community responds to changes in the plume.

After a coffee break and networking, sponsored by Lithos Consulting, Prof Neil Bruce from University of York provided an insight into the way plants have been engineered to remediate explosives pollution. There are extensive contamination problems in US associated with firing ranges. It is estimated that over 10 million hectares are contaminated. There is never complete explosion and when munition detonates it produces a plume of soot laced with TNT and RDX that is deposited on the ground. Pollution of ground has become so bad at some ranges in US that they have been closed down by Regional Environmental Protection Agency.

Research of soil samples identified bacteria that can use the nitrogen in explosives as a food source. These bacteria break down TNT into molecules that the plant can use in its cell structures. Soil samples have been collected from a wide variety of sites. From this they carried out selective enrichment of the bacteria and were then able to identify the enzyme that was degrading the explosives. These enzymes have been engineered into native grasses found on training ranges in US. Research demonstrates that the transgenic plants are highly effective at breaking down explosives whereas the wild type plants have no effect. The next stage is field trials in the US.

The final presentation was given by Dr Phil Studds, Ramboll of a case study off the coast of Denmark entitled *Groyne 42 - In situ alkaline hydrolysis (ISAH) of pesticides – a large scale demonstration project*. The site was a landfill for a nearby pesticide plant where they legally deposited pesticide wastes between 1957-1962. They estimate that 270 tonnes of contamination is present in an area of 20,000m2 and there is a plume that extends 1km into the sea. In 2006 the area was encapsulated and contained within a sheet pile wall which had a 20 year lifespan. There are a number of beaches close to the site but the area is closed to the public because of chemical toxicity.

The containment system is now approaching the end of its design life the Danish Government started pilot studies in 2011 to investigate alkaline hydrolysis of the pesticides. Soil bound contamination isn't available to hydrolyze so they need to move this off the soil to make it available to degrade. This is achieved using sodium hydroxide. The water is pumped out for ex situ treatment at the local chemical works which is still in operation. Results show that the process was effective for some of the pesticides but not all of them. Therefore, it looks like this process won't go ahead and instead the soil will be excavated and shipped to an incinerator in Germany. More information about this case study can be found at www.northpestclean.dk

The presentations from the event are available on the YCLF website www.yclf.org.uk

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