2007 Research Seeding Grant *$15,700*

REMEDIATION OF DIOXIN-CONTAMINATED SOILS BY HIGH POWER ULTRASOUND

overview of the project

The clean up of contaminated sites is a challenging task, particularly those containing dioxins which are very toxic and cling persistently to soil particles. The University of Western Sydney successfully demonstrated the feasibility of using high-powered ultrasound to clean dioxin-contaminated soils and river sediments. Dioxins are unwanted by-products of uncontrolled burning and certain industrial processes.

High power ultrasound is a green, energy efficient technology that minimises the use of chemicals during treatment. It requires no external heat and does not generate dangerous by-products or uncontrolled emission of pollutants into the environment. Current solutions for the remediation of dioxin contaminated sites generally involve excavation and landfilling or incineration technologies which can result in the formation of other dioxins in the long term from the recombination of products.

how the project was carried out

Researchers used a dioxin surrogate similar in structure to dioxin, as working with real dioxin compounds is expensive due to the high cost of chemical analysis and stringent occupational health and safety requirements. The seeding grant allowed researchers to test the methodology on a less expensive but comparable surrogate before embarking on more detailed research.

Three soil types were studied: a sand sourced from a Sydney supplier, a silty sediment from Bonnet Bay and a clayey sediment from Lindfield. These soils were considered to represent a cross-section of the soil types found within the Sydney region. Each of the soil samples were carefully spiked with the dioxin surrogate 4-CPDE, and then chemically analysed to see how much of the surrogate had been eradicated with the ultrasound treatment.

outcomes now and in the future

The results of the research demonstrate that there is a very high likelihood that comparable results will be achieved for dioxin-contaminated soils as for the dioxin surrogate. This project provided researchers with valuable insights into the process of dioxin destruction by the high power ultrasound and also showed its limitations. It was found that high power ultrasound eradicates up to 94% of the dioxin surrogate in the first five minutes of treatment but that the rate of eradication then levels off with further treatment (similar to observations of radioactive decay).

The study has estimated that the energy consumed in remediating contaminated soil using high power ultrasound is significantly lower than currently available technologies. This, coupled with the fact that no harmful by-product from the process could be detected indicates that the technique has the potential to be developed into a clean and green remediation technology.

benefits, challenges & lessons learned

With the experience of the dioxin surrogate behind them, the researchers at the University of Western Sydney are now in a position to plan further research using actual dioxin compounds. Presentation of this work at national and international conferences has generated interest in the project and has resulted in a number of international collaborators being identified for future work.

There were no significant challenges or problems encountered during the study. While it was originally proposed to use sediment from the Parramatta River it was later decided to substitute sediment from Bonnet Bay so as to avoid any potential for background contamination.

While the technique worked in all three of the soil types studied, the results suggest that fine silty sediments may be more challenging to treat by high power ultrasound. This may be one of the challenges that needs to be overcome in further trials of this technique.

OEH 2011/700 Published September 2011