Remediation of tributyltin-contaminated sediments and water

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Introduction: Tributyltin (TBT) is a pollutant, mainly found in sediments and sludges as a result of its wide use as a marine anti-fouling agent in paints used on the hulls of boats. It is highly toxic to some marine organisms and causes the phenomenon of imposex to shellfish (Figure 1). Banned from use on small boats since 2003, TBT has proven to be persistent in nature and the contamination remains. Disposal of TBT-contaminated dredgings on landfill sites is not only an environmentally unsustainable solution but it is also increasingly expensive. The aim of this work was to assess and develop cost-effective remediation technologies for TBT contaminated dredgings to be used by Land and Water Services Ltd, a large dredging company in the United Kingdom.

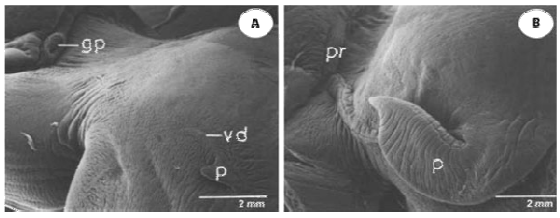

Figure 1 Scanning electron micrograph example of imposex developed on the marine gastropod *Nucella lapillus*[1]

Methods: The analysis of sediments employed a hexane/hydrochloric acid extraction followed by Grignard derivatisation to tetraalkylated tin species that could be determined by gas chromatography with pulsed flame photometric detection[2] (GC-PFPD).
A standard leaching test (BS EN 12457-3:2002) was adapted to assess the leachability of TBT from TBT-contaminated dredgings.
The analysis of water and leachate samples was based on the derivatisation of TBT with $NaBEt_4$ and extraction into hexane[3] followed by determination by GC-PFPD.
Satisfactory performance was achieved for the analyses, with estimated detection limits of 6 µg/kg dry weight TBT (as Sn) for a 0.5 g of sediment sample and 3 ng/L TBT (as Sn) for a 250 mL water sample respectively.

Results and Discussion: Incineration was assessed as a TBT destruction method, but with temperatures of 1000°C having been found to be necessary for TBT to become undetectable, this method is not likely to be currently commercially acceptable due to high costs.
Ultrasonic destruction of TBT in solution was found to only remove ca. 40% of the TBT in water and was not investigated further.
A number of materials have been screened for their abilities to immobilise of TBT in TBT-contaminated sediments. The materials investigated included carbon products, pure clays, organically modified clays, iron, fly ash and a range of cements.
Results from these tests were promising and scale-up Experiments, as well as long-term efficiency assessments, are currently under way.

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References:
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