

Water Treat

Optimising particulate adsorbants for electrochemical water treatments



arvia
ORGANICS
DESTRUCTION

This collaborative project between Arvia Technology Limited and the Centre for Global Eco-Innovation is developing an understanding of the properties of adsorbent materials beyond the current practices used in the treatment of mixed, organic and radioactive wastes. Arvia's innovative technology for the destruction of waste materials has put them at the forefront of offering solutions to some of the most pressing environmental challenges faced today.

Based at the Science and Innovation Campus in Daresbury, the company provides a low carbon, low waste, chemical free process to a range of industries including nuclear and water treatment both nationally and overseas.

“At the inception of this project, the potential benefits provided by the technology were

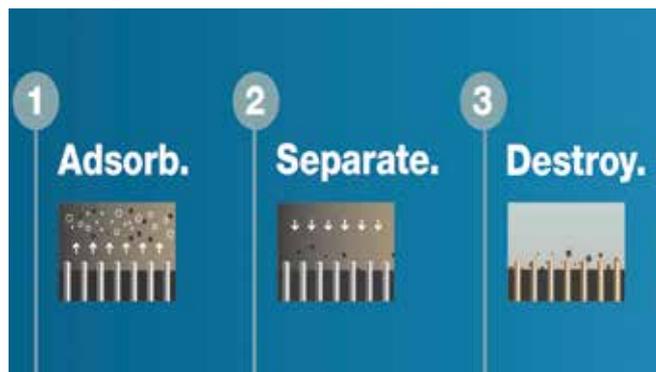
already clear.” says Jacob Whittle, a graduate researcher working on the project. “The low volume of consumable materials, and low power usage in comparison to standard off-site treatment options, makes the technology a highly attractive alternative solution to the high economic and environmental cost of current waste management systems.”

“Recent life cycle analysis of the Arvia process, in comparison to other current-activated carbon based technologies, demonstrated up to a possible 90% reduction in CO₂ equivalent emissions. Reductions of other pollutants include a 30% reduction in sulphate equivalent materials, and up to 98% reduction of phosphates.”

“However, the contribution to CO₂ equivalents associated with the manufacturing process and subsequent transportation of the adsorbent materials, is significant.”

“This factor only emphasises further the commercial and environmental importance of extending the useful lifetime of the adsorbent material, which has been a key ambition of this project.”

So how does it work? The technology employs a proprietary material called Nyex for the adsorption of pollutants; followed by separation under gravity sedimentation, and finally, destruction of the adsorbed material using electrochemical oxidation to convert it to H₂O and CO₂.



The unique nature of the Nyex adsorbent material presented a range of challenges to be overcome by the project. The properties of the material in relation to the process were not fully understood and deterioration of its structure was presumed to be the cause of a residual discolouration in treated water. A robust experimental program was developed to evaluate whether this deterioration was caused physically or by electrochemical means. Trials were carried out extending the product's useful working lifetime to assess impact on the efficiency of the adsorption and regeneration processes.

“A highly attractive alternative solution to the high economic and environmental cost of current waste management systems”

Utilising a range of imaging techniques and analytical methods the particle size, surface structure and topography of the raw material were investigated. Next, a bank of five prototype organic destruction units provided by Arvia were used to determine the changes in particle nature over time, under a range of operating conditions. Work has shown that the effect of physical attrition is limited, with degradation attributed to electrochemical processes. The study also identified the effects of chlorinated electrolytes on the system and, whilst some benefit may be

Ongoing work within the project will expand further the current understanding of the underpinning electrochemical processes occurring within the system. Better understanding of the mechanism of breakdown of both adsorbent material and adsorbed wastes and assessment of the effect of adsorbate particle size on process efficiency will improve process control and facilitate optimisation of the technology by Arvia, supporting current and future business opportunities and technology development.

gained in terms of regeneration rates, a minor reduction in longevity occurs due to formation of free chlorine.

The benefits of the project to the company have already been realised by providing guidance on the operating life of adsorbate materials and thus supporting expansion into international markets and new opportunities. Data generated is currently being used as part of Arvia's ongoing project with the American Department of Energy to remediate low level radioactive organic wastes from the nuclear industry. These waste oils are notoriously difficult to dispose of using conventional methods of incineration and encapsulation because of environmental risks.



Jacob Whittle | Graduate researcher