Case Studies Demonstrating Activities Focused on Developments for the Water Industry

1. Development of rapid (real-time) detection system for chemical and biological contaminants in water

Situation:

The water industry requires timely analysis of water samples for both environmental waters and potential potable water, either through laboratory bench-top or field-deployable sensors. Laboratory testing has slow turnaround time and portable sensors are currently not relied on.

Approach (through Nanotechnology Victoria):

Evaluated the need of the industry, through interviews and discussions with water management authorities and Victorian-based companies in the water management and usage value chain, including accredited analytical laboratories. As a result of this analysis, we then decided to develop products that would supply the identified un-met demand for field instrumentation, to detect the presence of chemical and biological contaminants in water.

Identified, co-ordinated and managed two projects (technologies) with partners from; industry (sensors, water and purification) and academia (Swinburne and Monash Universities), through to completed proof-of-concept studies. Identified potential development partners, designed testing regimes and further assessed the market.

Result:

Successfully developed two complementary, field-deployable devices as prototypes. Demonstrated the required sensitivity and selectivity using standard water samples in addition to with industry-specific samples. This preliminary work was successful, and one of these devices (for phosphate and nitrate detection) has been licensed to a South Australian start-up company with expectations of going to market within 12 months.

The market positioning of the second device (SERS-based) is currently being assessed and trials considered with emergency services and for homeland security during 2010.

The final commercial outcome of the proposed program is a prototype of a hand-held, field instrument for the rapid detection of chemical and biological contaminants in source and drinking water, as well as industrial and agricultural water resources.

2. Commercial development of on-site, cost-effective systems for the detection and monitoring of ammonia in water.

Situation:

Ammoniacal build up in the environment results from sewage effluent, land fill sites, and effluent generated by the paper, textile, leather, chemical, pharmaceutical, metallurgic and agricultural industries. The UK Environment Agency identified an important need for localised testing, which could be adopted by all major water providers and industries. A portable field instrument measuring low levels of total ammoniacal nitrogen would have the potential to provide significant savings in time and effort, compared with current practices of centralised laboratory testing.

Approach (through Applied Enzyme Technology Ltd, UK):

We worked alongside the UK Environment Agency to:

- Assemble and manage a collaborative project, with members including the Environment Agency, The University of West England and two industrial partners to develop a commercially viable portable ammonia testing unit.
- Accessed DTI (Department of Trade and Industry) funding for product development
- Identified the most appropriate instrument and test format – this being a disposable, low cost and rapid electrochemical enzyme sensor with hand-held, custom designed instrument.
- Designed and produced simple and reproducible method of water sampling
- Developed and implemented manufacturing processes for large scale production of disposable sensors.
- Organised and managed field trials with Environment Agency in the South of England and Wales, for instrument validation.

Result:

The commercialisation program resulted in a validated, portable ammonia test kit and instrument, which is now marketed by Applied Enzyme Technology (UK).

3. Management of multi-disciplinary collaboration, for the development of a laboratory-based flow injection system, for pesticide detection in water.

Situation:

The presence of organophosphate compounds such as Paraoxon and Chlorpyrifos in water is a serious concern, due to their potential to cause severe adverse neurological and toxic effects in humans when present at low levels. These chemicals are primarily used as insecticides in agricultural industries and collect in streams and other natural water sources as a result as run-off from farmland. The detection of this class of compounds at levels in the parts per billion range was identified to be of significant importance by a European consortium of research and industry groups and as such was the focus of a European Framework 5 Funding Application.

Approach (through UMIST, UK):

As co-ordinators of the Framework 5 SAFEGARD product development program, we worked with a seven member consortium, including research groups in the UK, France and Crete and engineering and device companies in the UK and Ireland to develop a laboratory-based, bench-top, flow injection system for the simultaneous detection of six of the most prevalent organophosphate compounds. The technology utilised nano-structured, highly sensitive polymeric surfaces that were designed to specifically detect low levels (sub ppb) of the compounds of interest. Program reviews were conducted on a monthly basis, with face to face meetings organised every 6 months throughout the course of the program to ensure a focused, coordinated approach.

Result:

The program resulted in a validated laboratory flow instrument that was demonstrated for use in the detection of ultra-low levels of organophosphate insecticides.

4. Process for removal of contaminants from water (specifically arsenic).

Situation:

In the USA, about 2 million people need their water treated for removal of arsenic. There are about 4,100 community drinking water systems in the USA, where arsenic levels exceed the new EPA standard of 10ppb. About 3,000 (5.5%) of the nation's 54,000 community water systems and another 1,300 non-community water systems will need to take measures to lower arsenic levels in their drinking water.

India and Bangladesh are other markets requiring similar measures with respect to the treatment of its arsenic contamination levels in municipal drinking, and similarly there are several country towns in Australia where the arsenic levels exceed the latest standard.

Approach (through Nanotechnology Victoria):

We evaluated a CSIRO nano-enhanced technology for the removal of arsenic, as well as other contaminants, from local water supplies. This involved negotiating a license to the IP and arranging the testing and process development of the CSIRO material on water samples with partner companies. The efficiencies of the material were then related to world-wide needs and markets and scale of production to determine commercial potential. The use of the material was also explored for specific towns through discussions with water management authorities.

Result:

The technology has achieved proof of concept for the removal of arsenic from water. Commercial analysis was conducted and the construction of a small municipal test plant has also been explored in collaboration with local water authorities and engineering companies.