

New wave in clean water

A new system can deal with waste water cleanly by using just water and oxygen

IT SOUNDS LIKE the stuff of science fiction—destroying organic waste using just water and oxygen. But that's precisely the technology being promoted by Cork firm Super Critical Fluids International (SCFI). According to the company, the highly innovative technology has the potential to offer an environmentally benign option for waste disposal.

The process, known as super critical water oxidation offers efficient organic waste destruction (99.99 per cent) as well as environmental characteristics with almost none of the emissions associated with incineration. It is seen as especially suitable for the treatment of waste water and sludges from domestic sewage and the paper, pharmaceutical and biopharmaceutical industries.

Waste treatment and recycling firm Eras Eco has commissioned the first commercial scale system from SCFI for its new €10 million treatment facility in Youghal. Eras Eco specialises in the treatment of waste water treatment plant sludges and materials recycling and it plans to use the SCFI system for the destruction of aqueous organic waste.

SCFI is also involved in an InterTradeIreland Innova programme project with Northern Ireland partners Cleanfields and Williams Industrial Services to demonstrate the viability of the technology for use on a commercial scale by water utilities.

The technology is based on special properties water acquires when it enters what is known as a supercritical condition or fourth phase. This occurs when its temperature and pressure are above 374 degrees and 221 bar respectively. The phase is additional to the more familiar solid, liquid and gaseous phases.

Under these conditions, the physical properties of water change: it becomes less dense than in its liquid state, it has the same viscosity as in its gaseous state and, most importantly, the solubility of gases and organic compounds are increased to almost 100 per cent, while inorganic compounds become largely insoluble.

"Every molecule has a supercritical point but supercritical water is particularly useful," says SCFI chief operating officer David Kerr. "At the supercritical point a substance takes on new properties. These can often be quite useless, but in the case of water they are particularly useful."

These special properties have been known theoretically for a long time and in the 1970s and 1980s work began on exploiting them for practical applications. An oxygen supply was introduced and the process became known as supercritical water oxidation (SCWO).



The disposal of sludge has become a headache for local authorities; the new process could help. Photograph: Getty Images

When a stream containing organic material is added to a reactor containing supercritical water, and oxygen is introduced, a very rapid and complete oxidation reaction takes place—having the same effect as incineration but with few, if any, of the undesirable by-products. Unlike incineration, the only gaseous emissions from the process are carbon dioxide (CO₂) and nitrogen (N₂).

The technology has already been tested on sewage sludge by Swedish company Chematur Engineering AB. The test results to date confirm 99.99 per cent destruction of the organic material and the generation of a small amount of inorganic inert residue or ash. SCFI has performed its own extensive tests which bear out the Swedish results.

"The process is well proven now," says Kerr. "It will work in any area where there is organic waste containing carbon and produces no hazardous waste. It is also extremely environmentally friendly as the process actually produces more energy than it uses. The oxidation process gives off heat and the water temperature increases to between 380 and 550 degrees at 221 bar by the end of the process. We are able to put this water through a heat exchanger to create steam to drive a turbine to generate electricity. The CO₂ can be sold back to the gas supplier who'll give credit for it as they can use it for dry ice manufacturing or other industrial applications. The nitrogen can be safely released into the atmosphere."

Of particular interest in Ireland is the use of the technology for the treatment of sewage sludge. The disposal of sludge has become a

major headache for local authorities in recent years and the SCWO process has the potential to offer complete destruction of the organic portion of the sludge, converting it into carbon dioxide, nitrogen and sterile water. Furthermore, according to Kerr, the residual inorganic fraction from the process can be subjected to a process to recover phosphorous and other materials for resale.

According to Patrick Phibbs, operations manager with leading water company Aecom Ireland, the technology may have potential. "Should the process prove to be commercially viable, it may have a role to play in the water industry as an alternative to drying and composting of sewage sludge and possibly alum sludges," he says.

"As with all new potential better technologies, the industry will be watching the current efforts to have this process prove its worth to the Irish water industry. The process itself is well known but the issue is, how do you make it work across wide-scale applications? That means it must be proven to be robust, efficient and easy to operate at a price that fits below the whole-of-life costs of existing solutions available in the market, of which there are many."

With Ireland's first commercial SCWO plant due to come online in Youghal shortly, and the process being mid-way through the InterTradeIreland Innova project to demonstrate its viability for local authority use, it may not be too long until Ireland has a viable alternative to incineration for the destruction of organic waste streams. ■



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INTERTRADEIRELAND

INTERTRADEIRELAND'S INNOVA programme is the only all island research and development (R&D) initiative that actively encourages and facilitates cross-border collaboration through funding and other supports. It is aimed at stimulating, promoting and supporting co-operation between firms in all corners of the island.

Projects supported have included an IT solution for wastewater treatment compliance monitoring and management, the development of an innovative heart monitoring device, and the development of a hygiene management system to help healthcare institutions reduce the spread of infection.

"The Innova programme is unique in that it aims to encourage the development of the open model of innovation," explains Margaret Hearty, director of programmes and business services with InterTradeIreland. "In the past, the process of commercial innovation was considered to take place only within the business. However the new understanding of innovation in the knowledge-based economy is that it also emerges when companies interact and cooperate with the external environment.

"This open model involves companies accessing external knowledge and drawing on alternative pathways to bring ideas to market and provides greater access to innovation capabilities, cost effectiveness and increases speed to market."

Through Innova, a company forms a strategic innovation partnership with others offering complementary expertise in the opposite jurisdiction, Hearty adds. "Companies benefit by developing new or improved innovative products, processes or services, through an increased rate of commercialisation, sharing otherwise inaccessible knowledge, technology and expertise, as well as access to complementary expertise, networks and channels to market from their innovation business partner," she says.

Among the latest projects to benefit from the Innova programme is a collaboration between Northern Ireland companies Cleanfields and Williams Industrial Services, and SCFI from Cork.

"What we see at the supercritical phase are some weird properties," Kinney notes. "You get some of the classical properties of water being inverted. For example, oil becomes soluble and salt becomes insoluble. And if you take some thing organic, made with carbon, this will also dissolve."

The aim of the project is to develop new processes and technology using super critical water oxidation, which will provide local authorities and water utili-



A cross-border body is helping progressive Irish companies to develop their ideas, commercialise them and take them to market

ties with a more efficient means of treating its sewage sludge, including conversion into a renewable energy resource.

The project uses SCFI's AquaCritox technology, which is based on super critical water oxidation. The process allows matter to be destroyed underwater, explains John Kinney of Cleanfields.

The Innova funding has allowed the group to scale up the technology to demonstrate its capabilities in large-scale water treatment settings. "At the start of the project last June, we decided on 14 different work studies and we are about half way through that now," says SCFI chief operating officer David Kerr.

"The process is well proven commercially and what we are doing now is proving it for sewage sludges and drinking water treatment sludges. It will work in any area where there is organic waste."

Kinney adds. "The Innova project is allowing us to demonstrate the technology and show that we say happens does happen", says Kinney. "At present we have a test plant operating in Cork and that is helping us prove that the process will work at a larger scale. Innova is assisting

us to bring the process through commercial trials and enable sales and it is allowing us to do this locally us to do this locally. This is allowing us to compete with international brands. If all goes well the technology could be fully commercial for the treatment of sludges by 2012."

Such products can help to turn around the fortunes of the Irish economy, says Hearty. "This is the type of innovation we need for economic recovery: innovation that involves a significant change in either a company's technology or business model is required.

"There is naturally more risk attached to this type of innovation, but it also results in the creation and commercialisation of new business opportunities that provide a competitive advantage to the companies developing them. This is potentially game changing for the companies involved."

The benefits to the companies that have participated in Innova so far were highlighted by recent InterTradeIreland research which showed that more than €45.5 million worth of business development value has been generated from just 10 of the 24 Innova projects that have

taken place to date; the other 14 of projects are still ongoing. It is also excellent value for money with funding of just €6.5 million being advanced to companies so far.

Innova fundings geared towards product, service or process developments that demonstrate identifiable benefits to the firms involved; represent a fundamental part of their strategic business plans; strengthen existing North/South R&D collaborations or form new collaborations; and are innovative and technology based with plans that have the prospect of significant commercial success.

Companies can apply for Innova funding, up to a maximum of €175,000, through the registration of an "expression of interest". The proposals are then reviewed and short-listed partnerships are invited to complete an application and submit their business plan.

Applications are assessed by independent commercial and technical advisers who assist InterTradeIreland in the decision making process. ■

For information on the Innova programme, see intertradeireland.com/innova

SUPPORT FOR CO-OPERATION