Arvia Nyex

water treatment first as Scottish Water trials Nyex for organics removal

Decentralised water treatment can be desirable in rural and island locations with low population density, where there is no mains supply. Often the cost of installing the necessary infrastructure prohibits the option of piping water from a centralised plant. Scottish Water's customer base includes many rural communities where decentralised systems are the most effective way of delivering clean water supplies. Starting in January 2018, the public utility is undertaking the world's first long-term trial of Nyex treatment on drinking water at an established pilot plant in West Lothian. The trial is running on a separate 10m^3/day sidestream and will assess the effectiveness of the system in removing organic material from raw water.

Containerised Nyex treatment system on-site at Scottish Water

The scaled-up treatment system is the first long-term drinking water application for Nyex following DWI approval

Background

The level of organics in water entering treatment works in some rural areas means utilities and municipalities require treatment systems that can bring dissolved organic carbon (DOC) within regulatory limits. Colour removal is also a requirement of utilities seeking to eliminate customer complaints about the aesthetic quality of drinking water and produce colourless supplies.

Nyex is a tertiary treatment system which combines adsorption with oxidation in a process that has many potential applications in water and wastewater processing. In drinking water applications, the main advantage of Arvia's Nyex over granular activated carbon (GAC) filters is the elimination of waste, cutting the cost of having to dispose of spent adsorbent to landfill.

Nyex media is approved for the treatment of drinking water and has been certified for BS EN 12902:2004/12915-1:2009 since 2017.

Project drivers

Organics and colour are often hard-to-treat with traditional treatment and advanced techniques can be energy intensive. Nyex tertiary treatment system can efficiently remove both DOC and colour. Scottish Water's overall treatment target is to ensure DOC is consistently at <0.4mg/l and colour is removed altogether.

Scottish Water is seeking to make it's rural treatment systems more robust as well as cost and energy efficient. Identifying innovative technologies to reduce operational expenditure, maintenance requirements and waste disposal to landfill will help to deliver these objectives.

The project

Scottish Water's trial of the Nyex treatment system is focused on establishing whether Nyex could have an application on removal of natural organic material and colour from raw water sources, due to the impact this can have on drinking water treatment. Laboratory trials have shown that Nyex can remove 68% of organic material from water, with the pilot project set to test the treatment at a larger scale to see if these results can be replicated and sustained.

At this site, the system is being applied in a train alongside other treatment technologies to assess the effectiveness of Nyex in different positions within the treatment process. Changing weather conditions can impact on flow into the plant and the load of

organics may vary considerably throughout the year. The pilot will assess the effectiveness on a range of flow and current parameters and locate the technology at different positions in the treatment train, including before and after pre-treatment. It will also be moved to accommodate seasonal variations and fluctuations in organics load.

The technology is being applied in combination with an ion exchange system and the total solution is targeting both hydrophobic and hydrophilic organic components. Peaty water naturally contains humic compounds along with fulvic acid which causes colour. Nyex preferentially removes the hydrophobic components, which stick to the system's adsorptive media.

The containerised Nyex treatment system combines the advantages of adsorption and electrochemical regeneration within a single unit to treat organics in water. Key to this innovative process is an alternative approach to adsorption. Conventionally, high capacity adsorbents with high porosities and surface areas, such as activated carbons, are used. These technologies are very effective, but require complex and costly regeneration or disposal.

Nyex uses a patent protected adsorbent media which is a non-porous and highly conducting, enabling it to act as both the adsorbent and a 3D electrode. Its non-porous nature means kinetic activity during adsorption and regeneration is extremely fast and can be repeated many times in situ.

The benefit of in situ regeneration greatly outweighs the relatively lower adsorptive capacity of the media; meaning the Nyex process requires a significantly lower mass of adsorbent than activated carbon. This reduces footprint and total capital expenditure.

The high conductivity of the adsorbent means that it operates at low cell voltage to create a chemical-free, waste-free, cost and energy efficient process. Organics are adsorbed onto the media surface and a low DC electric current, proportional to the organic concentration, is passed through.

Contaminated water is top fed in the Nyex treatment system and percolates through the bed of adsorbent with in situ simultaneous adsorption and electrochemical oxidation. Adsorbed organics are oxidised and the surface of the media is regenerated for further adsorption without interruption or replacement. The clean treated water flows from the bottom of the system for use.

Allan Mason, Senior Project Manager for Business Excellence at Scottish Water, said:

> *"Research and innovation is key to Scottish Water being able to improve its water and wastewater services and ensure we are operating as efficiently as possible, even in the most remote of our communities. The bench trials of the Arvia system produced some excellent results on a difficult-to-treat raw water and I am very excited to see if we can replicate and sustain performance on a larger scale.*
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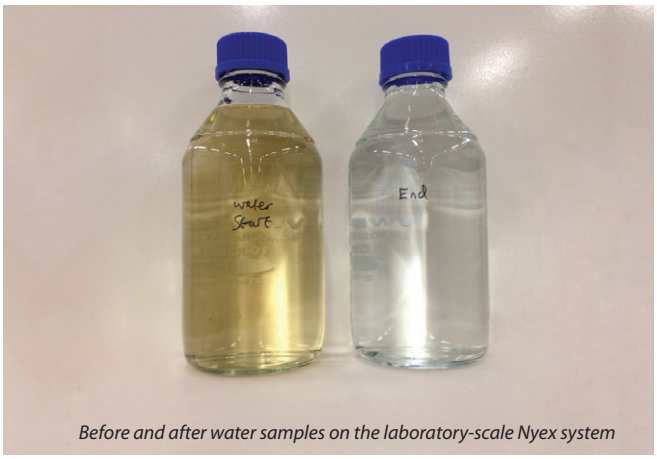
> *"If it performs well during this pilot, it could potentially offer us another method for treating drinking water in an efficient and cost-effective manner which continues to meet the high standards of service we aim to provide to our customers."*



Before and after water samples on the laboratory-scale Nyex system

Conclusion

The growing demand for clean water globally means the market for decentralised water and wastewater treatment systems is growing.

Nyex marks a step-change in this market because it can restore water to potable quality, extending the water resources available. As a plug-and-play containerised system, Nyex can be deployed to any area and is easily integrated into a train with other treatment systems. It has the potential for solar-powered applications and disaster relief purposes.

Arvia Senior Project Manager Dr Akmez Nabeerasool said:

> *"We are delighted to be taking this pilot project with Scottish Water to a scaled-up level. There are many potential uses for Nyex globally and this is a fantastic opportunity to show its effectiveness in removing organics from raw water."*

This article was prepared by Natasha Wiseman at Wise on Water on behalf of Arvia Technology Ltd.
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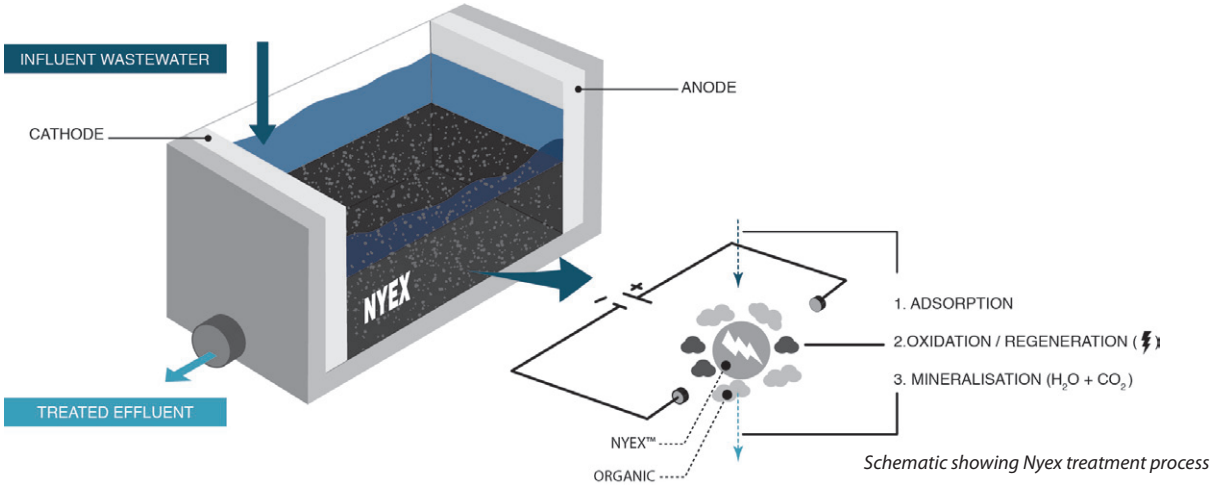

Schematic showing Nyex treatment process