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SUMMARY OF FINDINGS:
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Developing Coated Filtration Membranes for Water Purification

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Membrane filtration is a well-known means of producing clean water. In this project we have developed polymer-coated membranes which can be used to remove the heavy metals chromium and copper from water based samples. The modified membranes were investigated for their potential to selectively transport or exchange nitrate ions. There is considerable concern about the level of nitrate in water with the Nitrates Directive (1991/676/EEC), the National Nitrates Action Programme and the on-going public consultation on Irelands Nitrate Plan, and the EU Water Framework Directive (2000/60/EC).
The requirement for the levels of chromium (VI) and copper (II) to be monitored in Irish water was clearly outlined in the Water Framework Directive. Chromium (VI) is a highly toxic metal ion that is well known for its contribution to a variety of health problems. It is a hazardous pollutant produced by a number of industries, which can contaminates groundwater, and there is a need to ensure its removal from industrial waste to within the regulatory limits. Copper, when consumed in relatively large amounts, can cause symptoms of acute food poisoning, with additional health concerns over long term exposure. It is toxic to aquatic species and is associated with significant bioaccumulation. Copper is commonly used in electrical and plumbing applications, and is a waste product of a range of industries. A disadvantage of membrane technologies is that they can suffer from fouling due to dissolved matter in the water such as proteins and humic acid. We have attached coatings to membranes in order to reduce the extent of protein fouling.

Key Words: Water quality, Water filtration membranes, Heavy metals, Chromium, Copper, Nitrate, Conducting polymer, Irish environmental technology.

Background - Water security and quality is a key issue for Ireland to safeguard the health of its people and ecosystems, and to foster economic development. Protecting the quality of water resources and the sustainable use of resources, including water, are key environmental goals in the EPA 2020 Vision strategy document, and are also in line with the Flagship initiative of the Europe 2020 strategy for a resource efficient Europe. The fifth State of Environment EPA report, Ireland's Environment 2012 – An Assessment, reports that Ireland's water quality is better than the average when compared with other EU member states, and there is evidence of general improvement in Ireland's water quality. However Ireland must confront significant challenges in meeting targets set for 2015, 2021 and 2027 as required by

the Water Framework Directive. It is a strategic priority of the EPA Strategic Plan 2013-2015 to maintain a vibrant and relevant environmental research programme to influence policy, identify pressures and develop solutions to key environmental challenges such as water quality and a sustainable environment. The EU Joint Programming Initiative "Water challenges for a changing world" is a strategic initiative to pool National research resources of member states in this important area. In addition, the support of research into nanotechnologies will enable Ireland to benefit from the enormous growth forecasted for the economic impact of these technologies, as highlighted by the Forfás 2010 report "Ireland's Nanotechnology Commercialisation Framework 2010 - 2014".

Key points

- This project involved a laboratory scale study into improving the properties of commercial water filtration membranes for removal of metal ions such as copper and chromium from water, forming ion selective smart membranes and the reduction of protein fouling.
- The research in this project has indicated potential for the development of new environmentally advantageous technologies for water treatment using coated membranes. '
- The combination of a conducting coated membrane and electrochemical reduction is an attractive alternative, recyclable technology for the removal of chromium(VI) or copper(II) ions from water.
- A number of the coated membranes showed improved anti-fouling properties compared to unmodified commercial membranes.
- This research falls under the priority area Processing Technologies and Novel Materials as highlighted by the Forfás Report of the Research Prioritisation Steering Group.

Findings/Recommendations

- Future research would set out to increase the stability and recyclability of coated membranes, to investigate how other species present in real water samples may interfere with the membranes, to reduce the cost of forming the membranes, and to carry out cost analysis on this technology.
- Support for research which underpins innovative technologies that deal with current water challenges is important as there are significant economic opportunities for Ireland in a growing world market in this sector.

For Further Information

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http://www.epa.ie/pubs/reports/research/tech/strive116developingcoatedfiltrationmembranesforwaterpurification.html

Peer-reviewed Publications Associated with this Report:

Doyle, R.; Breslin, C.; Power, O.; Rooney, D. (2012) Electrochemical Characterisation of Polypyrrole Doped with p-Sulfonatocalix[4]arene, Electroanalysis, 24, 293-302.

McCarthy, C.; McGuinness, N.; Carolan, P.; Fox, C.; Alcock-Earley, B.; Breslin, C.; Rooney, D. (2013) Electrochemical Deposition of Hollow N- substituted Polypyrrole Microtubes from an Acoustically formed Emulsion, Macromolecules, 46, 1008-1016.