NANOTECHNOLOGY
PUBLIC ENGAGEMENT

Nanotechnology is a new wave of scientific development that is the hottest buzz in laboratories around the world. It manipulates the minuscule – atoms and molecules – to create the extraordinary, such as renewable energy, safe food, smart medicines and clean water for our growing populations.

CLEAN WATER FOR EVERYONE

Most countries around the world, including South Africa, are faced with the increased challenge of access to clean, safe drinking water. Recent statistics indicate that more people are dying annually from unsafe water than from all forms of violence combined, including war. In South Africa, an estimated 5.7 million people lack access to basic water services and some 18 million people are without basic sanitation. These figures are likely to increase due to industrial expansion, rising population and climate change, which is set to drastically affect sub-Saharan Africa. Finding new ways to address the challenge of providing clean water has become a global priority. One of the approaches being explored is the application of nanotechnology.

What is nanotechnology?

Nanotechnology is the manipulation of materials at an atomic and molecular level. At this scale, the normal rules of physics and chemistry do not apply and materials often display unique properties. The new science provides an opportunity to create new methods for treating domestic, industrial and mining wastewater. Water contains different contaminants in different locations; some carry heavy metals (mercury, arsenic), others are affected by biological toxins, including waterborne disease-causing pathogens (cholera, typhoid), and organic and inorganic solutes. Essentially, nanotechnology can offer tailor-made solutions to removing these and other contaminants or perform a combination of functions.

Nanotechnology in South Africa

In South Africa, the National Nanotechnology Strategy (NNS) was launched in 2006, although the science had been embedded in national policy since the publication of the White Paper on Science and Technology a decade earlier. One of the six focus areas highlighted in the NNS is water. This is reflected in the amount of research being conducted at institutions around the country.

To date, through the Department of Science and Technology (DST), the government has invested more than R170-million in nanotechnology research and development. Two innovation centres have been commissioned and have formed collaborative partnerships with industries, universities and bodies such as the Water Research Commission (WRC) to conduct cutting-edge research. It is due to their work that a range of water treatment devices incorporating the technology is available commercially around the country.

Also on the market is a membrane and filter system created by the University of Stellenbosch and the WRC. Called capillary ultrafiltration technology, the system removes metal oxides and reduces colour. It is also suitable for desalination, the pre-treatment of seawater and the treatment of industrial water and wastewater.

The University of the North West and the Council for Scientific and Industrial Research have collaborated to develop a treatment plant for the rural village of Madibogo in North West Province. The majority of the villagers depend on groundwater or borehole water, and the system incorporates filtration membranes to clean it. Several types of membrane have been tested in this pilot study to see which best remove the polluting solutes while retaining the essential nutrients.

A team at the University of Stellenbosch, headed by Professor Eugene Cloete, has developed a 'tea-bag' water filter which can be placed in the neck of a bottle to kill disease-causing microbes as water passes through it. The inside of the tea bag is coated with biocides encapsulated in nanofibres: as the filter traps bacteria, they are killed by the biocide coating. The filter may be a cheap method of purifying water in remote areas. It could also potentially be used worldwide by relief organisations where clean water supplies are threatened by waterborne diseases such as cholera as a result of natural disasters such as earthquakes and floods.

Benefits of nanotechnology

Nanotechnology offers a number of benefits to the water sector. For instance, increased specificity and 'smart' filters enable lower concentrations of contaminants to be removed more effectively. Novel reactions at the nanoscale due to large quantities of surface atoms may also make it possible to remove contaminants that were previously difficult to treat. The number of treatment steps, the quantity of materials, as well as the cost and energy required to purify water could be radically reduced using nanotechnology – making it easier to implement in remote rural communities.

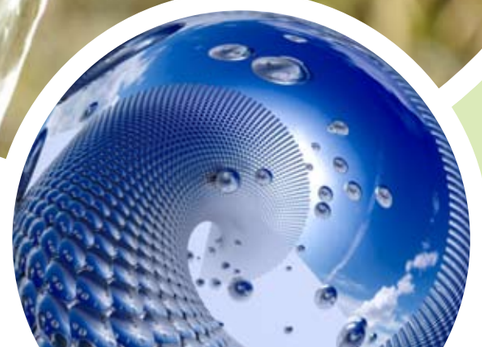
What are the risks?

There are concerns that the same properties that make nanoparticles so useful could also render them harmful to the environment and toxic to humans. What will happen if they enter and build up in drinking water supplies and the food chain, for example? Risk assessment research is crucial: the technology's benefits must be balanced against its consequences. The government, through the DST, is funding a research platform to investigate these concerns. It will also make an inventory of the nano-particles in production or use in South Africa and conduct focused research on the required infrastructure and human capital. A committee of diverse stakeholder representatives is being established to ensure that the technology adheres to ethical principles.

Moving forward

Although substantial initial investment would be required to incorporate or switch to nanotechnology-based water-treatment methods, once they have been adopted, the long-term maintenance costs would be considerably lower and higher-quality water would be provided, particularly to rural communities. It is vital that the water sector becomes familiar with this technology as it is set to change how water is cleaned and can offer significant advantages for a country such as South Africa.

'South Africa is heading for an era of great nanotechnology discoveries,' predicts Mthuthuzeli Zamxaka, programme coordinator of the Nanotechnology Public Engagement Programme (NPEP). 'We have the opportunity to use nanotechnology to supply specific solutions to African problems.' ■



The Nanotechnology Public Engagement Programme (NPEP) is an initiative funded by the Department of Science and Technology (DST) and implemented by the South African Agency for Science and Technology Advancement (SAASTA), a business unit of the National Research Foundation (NRF). Launched in early 2008, the NPEP aims to promote credible, fact-based understanding of nanotechnology through awareness, dialogue and education so that informed decisions may be made on innovations it brings to improve our quality of life.

The objectives of the NPEP are to:
- Create awareness around nanotechnology
- Educate the public about and improve understanding of nanotechnology
- Enable and stimulate meaningful public debate around nanotechnology
- Stimulate interest in nanotechnology and nanoscience as a career in order to ensure long-term capacity-building in the field
- Get industry involved in the development of nanotechnology and take the lead in its innovation.

For more information about the NPEP, visit www.saasta.ac.za *or e-mail* info@saasta.ac.za

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