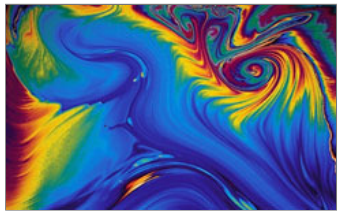
NEWS

Discovery could limit nanotechnology's environmental impact

23 November 2009, by Tom Marshall

A new technique may help remove nanoparticles from sewage.



Coating silica nanoparticles in a detergent-like chemical known as a surfactant makes them clump together so they can easily be removed during primary wastewater treatment, scientists have found.

These tiny particles are increasingly popular ingredients in consumer products from food to cosmetics; it's estimated manufacturers use a million tonnes of silica nanoparticles alone each year.

A large proportion of these are washed down the drain and into the sewers. At present, we don't know what happens to these particles during sewage treatment and whether they make their way into rivers and enter the food chain.

A lot of research is currently being directed at understanding the effects of these nanoparticles once released into the environment; earlier research has suggested various kinds of nanoparticles can have wide-ranging effects, including harming fish by lodging in their gills.

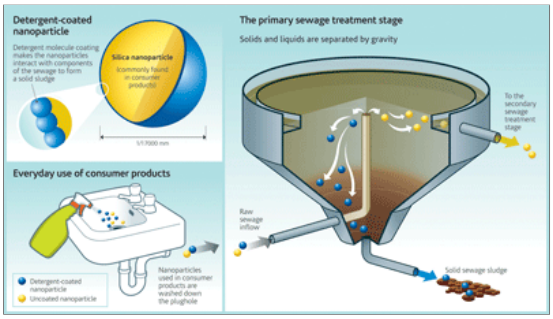
Scientists from the Centre for Ecology & Hydrology (CEH), ISIS Neutron Source, King's College London and Oxford University simulated the environment in a primary sewage treatment facility, in which waste is initially held for a few hours in large tanks to allow solid matter to settle out.

They found that coating the nanoparticles in surfactant before introducing them into the sewage meant that the nanoparticles interacted with components of the sewage to form a solid sludge. This sludge can be separated from the wastewater and disposed of. By contrast, uncoated nanoparticles stayed dispersed in the wastewater and were likely to continue through the effluent stream.

'The research shows that the surface chemistry of nanoparticles influences their likely removal during primary sewage treatment,' says Dr Helen Jarvie of CEH, who took part in the study, published in Environmental Science and Technology. 'By adding a coating which modifies their surface chemistry, it may be possible to re-route their journey through sewage treatment plants, preventing them from eventually entering the aquatic environment.'

Jarvie adds that more research is needed on whether similar techniques could be used to remove other kinds of nanoparticles. Another topic in need of more investigation is whether it might be possible to coat the nanoparticles with surfactant during the primary sewage treatment stage.

Even measuring the quantity of nanoparticles in sewage is challenging, as commonly-used tests don't distinguish between chemicals like silica in their normal and nanoparticle forms.



The journey of silica nanoparticles (commonly found in consumer products) through the sewage treatment system. (Click to enlarge).

The researchers made the discovery using the Science and Technology Facilities Council ISIS Neutron Source, a facility near Oxford that uses a beam of intense neutron radiation to look at matter on a tiny scale without disrupting its behaviour. The neutrons are fired at the sample under study; scientists can then examine how they scatter off the atoms of the sample to gain insight into its internal structure.

Alternatives such as looking at the nanoparticles using an electron microscope would require the nanoparticles to be dried out first, which would have prevented the scientists from studying the particles' behaviour when suspended in sewage.

'Using neutron scattering technology lets us directly quantify changes in nanoparticle levels, measuring the proportion lost through flocculation and sedimentation,' Jarvie explains.

The work was funded under the Environmental Nanoscience Initiative (ENI), a programme to investigate the potential environmental effects of nanotechnology. The ENI is a partnership between the Department for the Environment, Farming and Rural Affairs (Defra) Environment Agency, the US Environmental Protection Agency, the Engineering and Physical Sciences Research Council and the Natural Environment Research Council.

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