



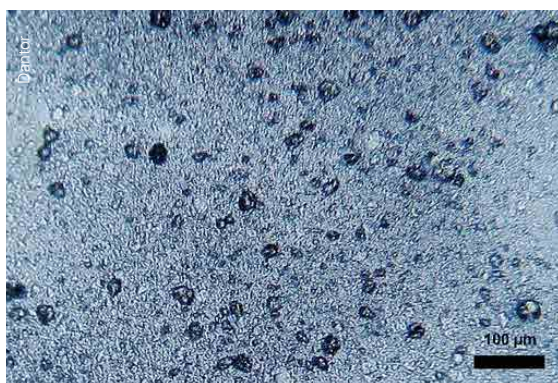
Microplastics and the oceans

Key words

polymers
microbeads
pollution
marine environment

Have you used a soap or cleanser recently which contained small bits of solid? These are known as microbeads and are usually made from plastic. When you rinse them down the drain they are too small to be filtered out by water treatment works and so end up in rivers, lakes and ultimately the ocean.

A typical household product such as a facewash or toothpaste can contain millions of microbeads. Up to 86 tons of microbeads are washed into the water supply from the UK alone each year. According to the United Nations, the build-up of these and other small plastic particles known as microplastics is a growing threat to the health of humans and other organisms.



Polythene based microparticles in toothpaste

Plastic rubbish on the beach

Microplastics are particles of plastic with a diameter of less than 5mm. Microbeads from household products are relatively straightforward to stop using and although cosmetic companies are unwilling to admit when they began to put microbeads into their products, most have now agreed to remove them from their formulations as it becomes apparent the scale of the damage they could cause. They are far from the only source of microplastics in the oceans, however.

Thrown away plastic

According to the United Nations, between 2004 and 2014 the amount of plastic produced worldwide rose by 38 per cent – this plastic has to end up somewhere and for some of it this is in the oceans. By one estimate, in 2010 between 4.8 million and 12.7 million tons of plastic was washed into the seas including plastic bags, plastic drink bottles, take away containers and fishing gear. The larger pieces of plastic waste get broken down by the action of the seas and in time become tiny pieces of microplastics. Another major source is from washing machines. As clothes made of synthetic fibres like fleece and polyester are washed they release tiny fibres which also end up in waste water. Like the microbeads these are too small to be filtered out by water treatment works and so end up in the world's waters.



Monticello
Many cosmetic products contain microbeads which can get into the oceans.

Trillions of tiny pieces of plastic are accumulating in the world's oceans, lakes and estuaries, harming marine life and entering the food chain. The microbeads in scrubs, shower gels and toothpastes are an avoidable part of this plastic pollution problem. A single shower can result in 100 000 plastic particles entering the ocean. One study estimated that there are 5 trillion pieces of plastic in the ocean, over 90% of them microplastics. They are spread throughout the world, with plastics reported in a remote Mongolian lake and in the deep sea sediments. They are not spread evenly, with larger concentrations in parts of the Pacific Ocean and with the seas round Japan having up to 27 times the world average.



MAR-ECO
A krill – these organisms sometimes ingest microplastics. When they themselves are eaten the microplastics may move up the food chain.

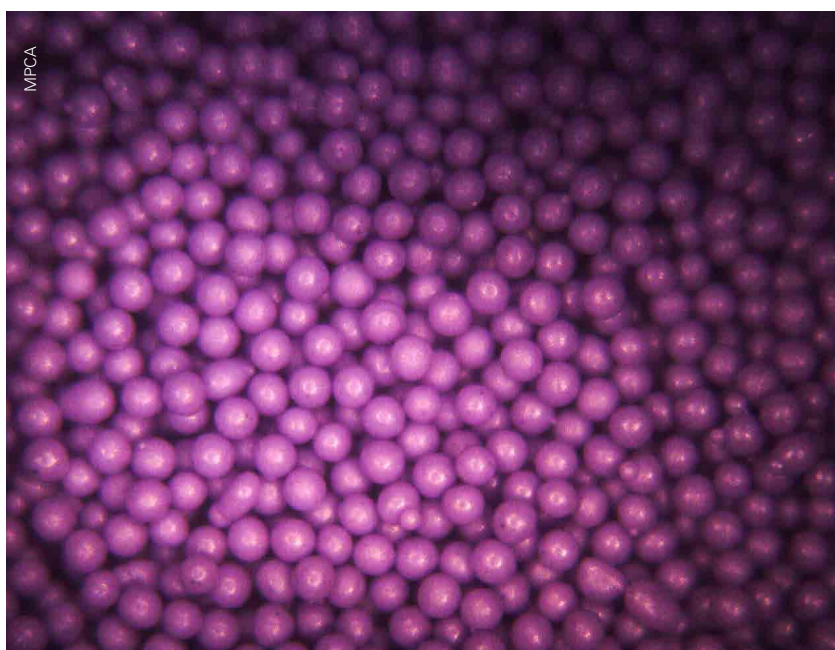
The thought of the oceans filling up with pieces of plastic is obviously unappealing, but why does the United Nations consider it such a threat? The pieces of plastic can be eaten by plankton such as krill, whales, fish and other marine life as they look like their normal food sources. A recent study analysed fish for sale in markets in California and Indonesia and found that a quarter of them contained plastics. When these are eaten by people the plastic can be ingested by them too.

Consuming plastics is potentially harmful for a number of reasons. One is that the tiny pieces could cause physical harm in the organism. Another is that many contain additives such as colours, UV stabilisers or plasticisers which are harmful or toxic. If enough is eaten these might cause poisoning, infertility or genetic disruption. In addition, microplastics can act like little chemical sponges

so other toxic chemicals in the environment may attach themselves to plastics, meaning that even more harm can be caused by eating them. Once they have been eaten the chemicals may come off the microplastic to cause harm to the organism.

Future research

There have also been very few studies into how much plastics humans and other organisms are actually consuming or how much harm is caused by their doing so. Fresh water treatment plants are thought to have filters small enough to filter out microplastics, but one study of 24 brands of German beer found microplastics in every bottle, which the researchers thought probably came from the water used to make the beer. A Chinese study in 2015 found that 15 brands of lake, rock and sea salt were contaminated with microplastics.



MPCA
Microbeads can be very regular in size and shape (above) but they end up as part of a mixture in the environment (below).



Volunteers clear plastic waste from a beach in Malaysia

It is possible to predict how various plastics will behave in fresh and salty water from the density of the polymer. Polythene, polypropylene and expanded polystyrene will all float; polyvinyl chloride and nylon will sink. In the environment, however, it is not so simple. For one thing the various plastics may contain additives which change their density. Biofilms, from algae and other organisms, can form on them and make them heavier. This difficulty in predicting how plastics will behave means that we have very little idea how much plastic is in various parts of the ocean. It is relatively easy to see how much is on the surface, but it is not known how much more there is deeper down and how much is in various marine organisms.

Action

Although there are many unanswered questions about microplastics and far more research is needed, many scientists believe that there is sufficient evidence that they do harm to require action. The best way to reduce the amount of microplastics and other plastics in the seas is to prevent further plastics from entering the water supply. Banning microbeads is a start, but it will not of itself solve the problem. Coastal clean ups happen around the world and these are a great way to make a difference – in the UK the *Two minute beach clean* campaign encourages people to take two minutes to clean rubbish off beaches. Plastic rubbish taken from the beach is plastic which does not become microplastics in the seas. There is project called *The ocean clean-up* which is a larger version of a beach clean-up where nets are used to try to remove plastics from the oceans.

Better than removing plastics once they are in oceans is preventing them from getting there in the first place. This requires an increase in the amount of recycling which actually takes place. At present many items which are labelled as recyclable are not recycled in practice. As much as 40% of the plastics which are produced each year are only for using once – for example in packaging. This could be designed differently to reduce the amount and to ensure that it is worthwhile recycling after it has been used. Reducing the amount of plastics that we use is also possible. England's carrier bag usage has dropped a huge 86% since the 5p charge for a bag was introduced, a reduction of 6 billion plastic bags per year. The other UK nations have seen similar falls in plastic bag use. This shows that it is possible to encourage people to use less plastic.

Most environmental scientists are not suggesting that we should stop using plastics altogether. They are very useful materials in a variety of applications. But the build-up of plastics in the oceans shows that we need to think very carefully about what we use plastic for, avoiding it where we can, and consider how we deal with plastic products when we have finished with them.

Vicky Wong is Chemistry editor of *Catalyst*.

Look here!

More about the two minute beach clean:
<http://beachclean.net>