Science for Environment Policy

Microalgae sticks to microplastics and transports them to the seabed

Fragments of microplastics are readily incorporated into groups of microscopic algae, altering the rate at which the plastics move through seawater, a recent study has found. In laboratory tests, polystyrene microbeads, which usually sink to the bottom of seawater at a rate of 4 mm a day, sank at a rate of several hundreds of metres a day when part of microalgae aggregates.

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Contact:
moriceau@univ-brest.fr

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Plastic debris litters the world's oceans. Plastics are resistant to environmental breakdown, and microplastics, which are tiny fragments of plastic less than 5 mm in diameter, are of particular concern because they can be unintentionally eaten by marine life and enter the food chain. The plastic particles may be toxic to wildlife or could accumulate in the gut of marine creatures, leading to their starvation. Microplastics are washed into the sea from household wastewaters, or formed when UV light or wave action breaks down larger pieces of plastics.

Microplastics have been found throughout the ocean, from the surface to sediment on the seafloor. However, the ways microplastics become distributed throughout the sea are poorly understood. This study, funded by the EU MICRO[1] project, focused on the role played by microalgae in transporting microplastics from the sea surface down to the seabed.

Microalgae, also known as microphytes, are tiny marine plants found floating in the surface layer of the ocean. They exude sticky substances and tend to form clumps when they bump into each other. These aggregates can also stick to other particles, including microplastics. They eventually sink to the seafloor, taking the microplastics with them.

The researchers designed a flow-through roller-tank to simulate what happens to microplastics in the ocean. Roller-tanks are rotated on a roller table, which enables the microalgae to collide and form aggregates. The tanks are connected to a flow-through of seawater containing the microbeads, which stick to the aggregates. The researchers used three cultures of microalgae in their experiments: *Rhodomonas salina*, *Chaetoceros neogracile*, and a mixture of the two species.

First they added each of the three mixtures to separate roller tanks, which were rotated to form aggregates. Seawater containing 2 micrometre (μm) diameter polystyrene microbeads was then circulated through each tank. The tanks were stopped and 50 to 100 aggregate samples were taken from each tank to measure their size and sinking rate in a glass column of seawater. Samples were also broken up to calculate their microbead content. They also measured how fast only the microbeads sank.

The sinking rate of *C. neogracile* aggregates decreased from 473 metres a day without microbeads to 165 m/day with microbeads. This suggests that the microbeads slowed the descent of *C. neogracile* aggregates by making them lighter.

In contrast, *R. salina* aggregate sinking rates increased from 76 to 125 m/day, whilst the rate at which the mixed species aggregates sank fell slightly from 144 to 122 m/day. The researchers say the different physical, chemical and biological characteristics of the microalgae species explain these changes.

1. MICRO (MICROPLASTICS Is it a threat for the 2 Seas Area?) is supported by the European Commission under the European Interreg 2 Seas programme. See: http://www.ilvo.vlaanderen.be/micro/EN/Home/tabid/6572/Default.aspx

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European Commission

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Microalgae sticks to microplastics and transports them to the seabed (continued)

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For example, light *R. salina* aggregates have large pores in their structure, which means they can incorporate more microbeads than *C. neogracile* aggregates. Indeed, *R. salina* aggregates contained 18 times more microbeads per ml than *C. neogracile* aggregates. The microbeads are heavier than the *R. salina* aggregates themselves, so their inclusion increases the aggregate sinking rate.

This study suggests that microalgae aggregates could be responsible for transporting microplastics into the deep ocean. They may also be the reason that other studies have found surprisingly few microplastics in surface waters and high concentrations in the seabed.

Worryingly, as marine snow (decaying organic matter, including microalgae aggregates, which falls from the ocean surface to the seafloor) is the main source of food for many marine creatures, they could be exposed to increased levels of microplastics.

The researchers say that measurements of microplastics at all levels of the ocean are needed to better understand their fate in the marine environment. A broader understanding will help policymakers design policies that will better manage the risk of plastic pollution in the environment.