Particle (ecology)

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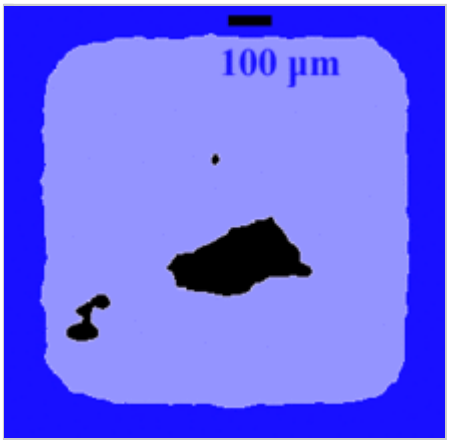
In marine and freshwater ecology, a **particle** is a small object. Particles can remain in suspension in the ocean or freshwater. However, they eventually settle (rate determined by Stokes' law) and accumulate as sediment. Some can enter the atmosphere through wave action where they can act as cloud condensation nuclei (CCN). Many organisms filter particles out of the water with unique filtration mechanisms (filter feeders). Particles are often associated with high loads of toxins which attach to the surface. As these toxins are passed up the food chain they accumulate in fatty tissue and become increasingly concentrated in predators (see bioaccumulation). Very little is known about the dynamics of particles, especially when they are re-suspended by dredging. They can remain floating in the water and drift over long distances. The decomposition of some particles by bacteria consumes a lot of oxygen and can cause the water to become hypoxic.

Particle analysis

Particle levels in water (or air) can be measured with a turbidity meter and analyzed with a particle counter. They can also be scanned with an underwater microscope, such as ecoSCOPE. Collected particles of size 20 - 200 micrometers hovering in the free water in the vicinity of a harbor had the following contaminant levels (table). Many of those contaminants are carcinogenic.

Particles in the vicinity of a harbor

Contaminant	Mass of contaminant relative to total particle dry weight
Arsenic	8.17 mg/kg
Lead	80.1 mg/kg
Cadmium	0.61 mg/kg
Chromium	31.2 mg/kg
Copper	44 mg/kg
Nickel	20.6 mg/kg
mercury	0.86 mg/kg
Zinc	156 mg/kg
EOX	0.79 mg/kg
Anthracene	602 µg/kg
Fluoranthene	5947 µg/kg
Pyrene	5549 µg/kg
Benzo(a)anthracene	5296 µg/kg
Benzo(b)fluoranthene	2499 µg/kg
Benzo(k)fluoranthene	1652 µg/kg



Particles scanned with the ecoSCOPE microscope. The blue frame is a 1 mm contrast grid.

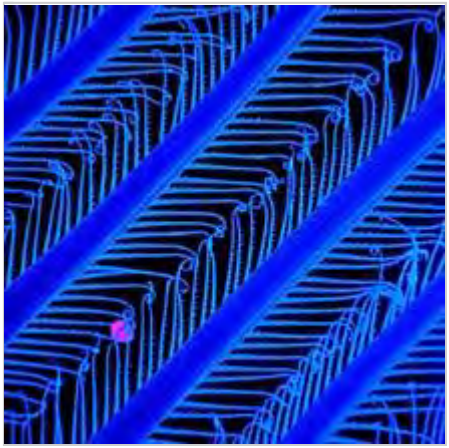
Benzo(a)pyrene	1895 µg/kg
Dibenzo(ah)anthracene	200 µg/kg
Benzo(ghi)perylene	1533 µg/kg
Dichloromethane	66 µg/kg
Chloroform	11 µg/kg
Carbon tetrachloride	5 µg/kg
1,1,1-Trichloroethane	4 µg/kg
Pentachlorophenol	22 µg/kg
1,2,3-Trichlorobenzene	0.4 µg/kg
1,3,5-Trichlorobenzene	0.4 µg/kg
1,2,4-Trichlorobenzene	1.4 µg/kg
1,2,3/4,5-Tetrachlorobenzene	1.2 µg/kg
1,2,3,4-Tetrachlorobenzene	0.4 µg/kg
Pentachlorobenzene	0.8 µg/kg
Hexachlorobenzene	3.9 µg/kg
Total PCBs	2205 µg/kg
PCB 28	598 µg/kg
PCB 52	331 µg/kg
PCB 101	205 µg/kg
PCB 138	414 µg/kg
PCB 153	432 µg/kg
PCB 180	225 µg/kg
Benzene	108 µg/kg
Toluene	655 µg/kg
o,-m,-p-Xylene	247 µg/kg
2,3,7,8-TCDF (dioxin)	0.8 ng/kg

Contaminant kinetics

It takes a few days until plankton organisms have filtered the particles and incorporated the toxins into their body fat and tissue: In the southwards flow of the waters of the Hudson off the coast of New Jersey, the highest levels of mercury in copepods have not been found directly in front of the river off New York but 150 km south, off Atlantic City.

Many copepods are then captured by mysidae, krill and smallest fish like the juveniles of atlantic herring - and in each step of the foodchain the toxin concentrations increase by the factor of 10. The milk of mothers (*Homo sapiens*) consuming fish and related products like margarine and eggs in such areas have so high toxin levels that it would be impossible to sell such milk on markets - their babies have much more birth-defects and/or retarded brains and have later difficulties to learn and/or reproduce. Many die at an early age.

Filter of krill: The first degree filter setae carry in v-form two rows of second degree setae, pointing towards the inside of the feeding basket. The purple ball is one micrometer in size. To display the total area of this fascinating particle filtration structure one would have to tile (http://www.ecoscope.com/krill/filter/filter7/index.htm) 7500 times this image.



Filter of krill

Filter basket of a mysid. These 3 cm long animals live close to shore and hover above the sea floor, constantly collecting particles. Mysids are an important food source for herring, cod, flounder, striped bass. In polluted areas they have high toxin levels in their tissue but they are very robust and take a lot of poison before they die. Such filter-feeding organisms are the reason that much of the materials we throw in the oceans comes back to us in our food.

Filter basket of a mysid.

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