Bund für
Umwelt und
Naturschutz
Deutschland

BUND

FRIENDS OF THE EARTH GERMANY

Microplastics and other synthetic materials in cosmetics

4th of July 2019

The cosmetics and personal care industry uses synthetic polymers (plastics) in a variety of products. These synthetic polymers are used in different sizes and shapes. The UNEP refers to sizes from a few millimetres down to the nanometres range[1]. Synthetic polymers serve as abrasives in exfoliators, binding, film forming and bulking agents in shower gels, shampoos, creams and decorative cosmetics (Tab.1). The plastic content in a product can vary between less than 1 % to over 90 %[2].

Figure 1: Moulding compounds in the plastic industry

Source: PlasticsEurope

What are ‚microplastics'?

Particles are classified by size class, ranging from millimetres to micrometres down to the nanometre scale. Microplastics are scientifically defined as firm, insoluble, particulate and non-biodegradable synthetic polymers, which are less than 5 mm in size[3]. However, under the size of 1000 nm, particles are referred to as nanomaterials. These are, due to their nature, considered as highly critical and underlie already – in contrast to synthetic polymers in general - a declaration requirement for cosmetics. In the course of BUND's research on cosmetics, synthetic polymers labelled as nanoparticles were only sporadically found in the list of ingredients. The BUND 'product list' includes all synthetic polymers, which are poorly water-soluble, insoluble or swellable in water. The structure of polymers is often sensitive to environmental influences, e.g. salinity, which among other things can cause clumping and changes in environmental behaviour. Since degradation paths and the effects of liquid plastics on the environment are unknown and a removal from the environment is not possible, the input has to be prevented as a precautionary measure. Unfortunately, neither the size nor the form of the synthetic polymers used, are evident from the list of ingredients the manufacturers provide on the product packaging.

[1] UNEP 2015
[2] UNEP 2015
[3] UNEP 2015; Leslie 2014

Table 1: Overview of synthetic polymers used in cosmetics and their functions

Plastic	Function
Acrylates Copolymer	Binding agent, Film forming agent
Acrylates/C10-30 Alkyl Acrylate Crosspolymer	Emulsion stabilizer, Film forming agent, Viscosity controlling agent
Nylon-6	Bulking agent, Viscosity controlling agent
Nylon-12	Bulking agent, Viscosity controlling agent
Polyacrylate	Viscosity controlling agent
Polyethylene	Abrasive agent, Film forming agent, Viscosity controlling agent
Polyethylenterephthalate	Film forming agent
Polymethylmethacrylate	Film forming agent
Polypropylene	Viscosity controlling agent
Polystyrene	Film forming agent
Polyurethane	Binding agent, Film forming agent
Polyquaternium	Film forming agent

Source: EU Cosmetic Ingredient 'CosIng'

From the bathroom to the oceans

The synthetic polymers contained in personal care products reach the sewage plants through local wastewaters. Here, a fraction is withheld in the sewage sludge, whereas the rest passes the filters and reaches rivers and oceans[4]. As studies have shown, more than 90 plastic particles per litre can be found in treated wastewater[5]. Mainly very small particles were found in the drains of sewage plants[6]. Once they reach the ocean, these plastic particles cannot be removed. Since they are highly durable, they contaminate the oceans for centuries.

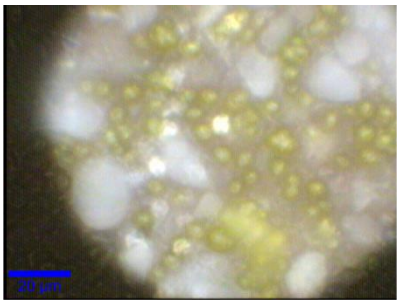

Figure 2

Unicellular microalgae (green) between microplastic particles (acrylate/C10-30 alkyl acrylate crosspolymere)[7]

Environmental problems

Research has shown that microplastics are widely spread in water bodies as well as sediments. These substances have been found in surface waters, shallow waters[8], deep sea sediments[9] and in the digestive tracts of various organisms in these habitats[10]. Microplastics can be differentiated in primary and secondary microplastics. Primary microplastics are particles

[4] Leslie 2014
[5] Leslie et al. 2013; 2017; Brandsma et al. 2014
[6] Mintenig et al. 2014; Mintenig et al. 2017
[7] Dr. Ann-Kathrin Kniggendorf, Hannoversches Zentrum für Optische Technologien (HOT)

which already meet the definition criteria (< 5mm) when entering the environment. Primary microplastics Type A are produced in this size fraction. Pellets and powders which are used e.g. in cosmetics and body care products belong to this type. Primary microplastics Type B are created during the operational phase, e.g. the abrasion from tyres or fibres from synthetic textiles that can get into the effluent during the laundry process. Secondary microplastics originate from the breakdown of bigger plastic parts due to weathering processes when being exposed to wave movements and solar radiation[11]. The plastic particles stay in the ocean over centuries, ever decreasing in size and being distributed by the currents. The main input of microplastics into the marine environment, are local wastewaters and rainwater[12]. In the North Sea, up to 10 particles per cubic meter were detected, whereas even 1 million particles per cubic meter could be measured in Arctic sea-ice[13]. Thus synthetic polymers are available for marine organisms like zooplankton, mussels, worms, fish and marine mammals. The smaller the particles are, the higher the likelihood of ingestion. This can happen in a passive way though filtration, or through organism mistaking plastic particles for food, as well as though feeding on other organism which have ingested plastics beforehand[14]. Plastics have direct and indirect effects on organisms. Microplastics bind contaminants which can subsequently be released into the organism[15]. Studies show tissue changes or inflammatory reactions[16] as well as toxicological effects[17] which can lead to internal injuries or even death. Moreover, it has been shown, that plastics affect the hatching of fish larvae as well as their behaviour and food intake negatively and reduces their life expectancy[18]. The ingested plastic material can be passed up through the food chain (Figure 3).

[8]; Hidalgo-Ruz et al. 2012; Lots et al. 2017; Whitmire & Van Bloem 2017
[9] ; Wodall et al. 2014, Fischer et al. 2015
[10] Lusher 2015
[11] Cole et al. 2011; Andrady 2015; Bertling et al. 2018
[12] Browne 2015
[13] www.awi.de/im-fokus/muell-im-meer/mikroplastik.html
[14] Kühn et al. 2015
[15] Teuten et al. 2009; ; Bakir et al. 2014; Rainieri et al. 2018
[16] Von Moos et al. 2012; Qiao et al. 2019
[17] Rainieri et al. 2018
[18] Lönnstedt et al. 2016

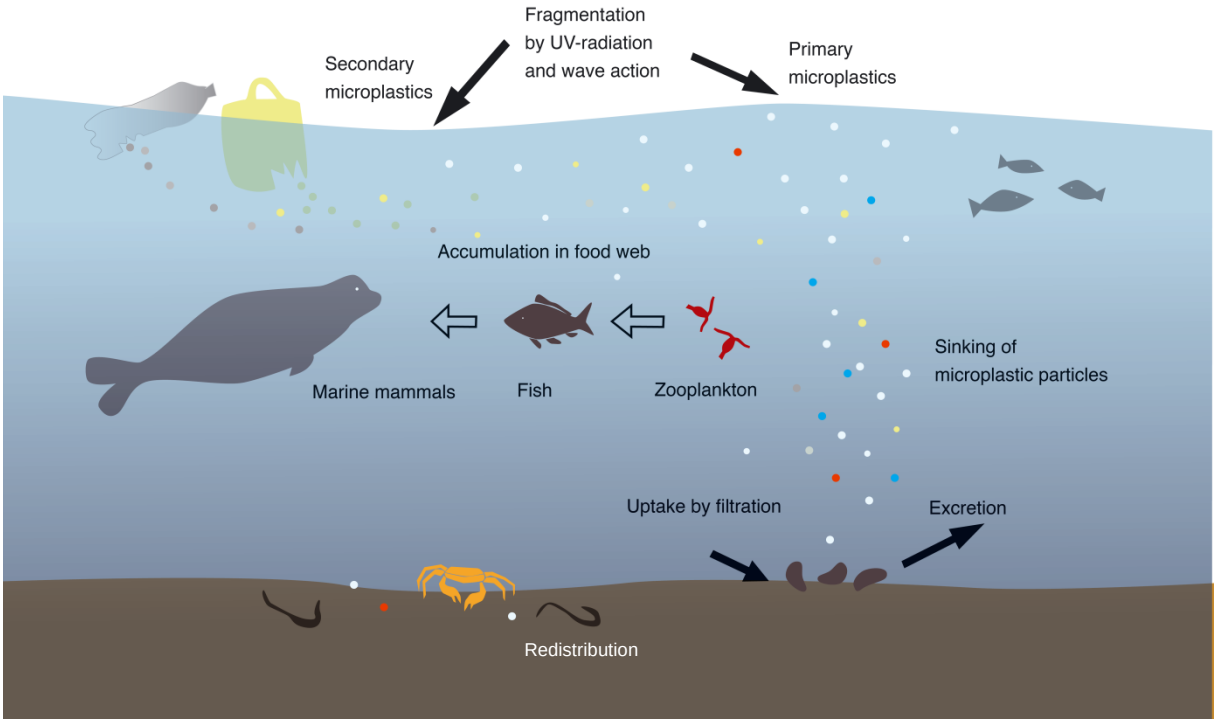

Figure 3: Distribution of microplastics in the marine environment, Source: BUND

Political demands

Cosmetics and body care products are an avoidable source of environmental pollution by plastics. The BUND product list showed that the amount of products, which contain synthetic polymers, did not decrease in the last couple of years. Agreements with the cosmetics industry to voluntarily abandon microplastics in their products are not binding and cannot be relied on. The BUND calls for an EU-wide ban on the use of synthetic polymers of any size and moulding composition in cosmetics and body care products.

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References

Andrady, A. L. (2015) Persistence of Plastic Litter in the Oceans. In *Marine anthropogenic litter* (pp. 57-72). Springer International Publishing.

Bakir, A., Rowland, S. J., Thompson, R. C. (2014) Enhanced desorption of persistent organic pollutants from microplastics under simulated physiological conditions. *Environmental Pollution, 185, 16-23.* Elsevier B.V.

Bertling, J., Bertling, R., Hamann, L. (2018) Kunststoffe in der Umwelt: Mikro- und Makroplastik. Ursachen, Mengen, Umweltschicksale, Wirkungen, Lösungsansätze, Empfehlungen. Kurzfassung der Konsortialstudie. Fraunhofer-Institut für Umwelt-, Sicherheits- und Energietechnik UMSICHT.

Brandsma, S. H., Nijssen, P., Van Velzen, M. J. M., & Leslie, H. A. (2014) Microplastics in river suspended particulate matter and sewage treatment plants. *Amsterdam: Institute for Environmental Studies.*

Browne, M. A. (2015) Sources and pathways of microplastics to habitats. In *Marine anthropogenic litter* (pp. 229-244). Springer International Publishing.

Cole, M., Lindeque, P., Halsband, C., & Galloway, T. S. (2011) Microplastics as contaminants in the marine environment: a review. *Marine pollution bulletin, 62*(12), 2588-2597. Elsevier B.V.

Fischer, V., Elsner, N. O., Brenke, N., Schwabe, E., Brandt, A. (2015) Plastic pollution of the Kuril-Kamchatka Trench area (NW pacific). *Deep Sea Research Part II: Topical Studies in Oceanography, (111),* 399-405. Elsevier B.V.

Hidalgo-Ruz, V., Gutow, L., Thompson, R. C., & Thiel, M. (2012) Microplastics in the marine environment: a review of the methods used for identification and quantification. *Environmental science & technology, 46*(6), 3060-3075. ACS Publications.

Kühn, S., Rebolledo, E. L. B. & van Franeker, J. A. (2015) Deleterious effects of litter on marine life. In *Marine anthropogenic litter* (pp. 75-116). Springer International Publishing.

Leslie, H. A., Brandsma, S. H., Van Velzen, M. J. M. & Vethaak, A. D. (2017) Microplastic en route: Field measurements in the Dutch river delta and Amsterdam canals, wastewater treatment plants, North Sea sediments and biota. *Environment International, 101,* 133-142. Elsevier B.V.

Leslie, H. A. (2014) Review of Microplastics in Cosmetics. *Amsterdam: Institute for Environmental Studies, VU University Amsterdam.*

Leslie, H. A., Van Velzen, M. J. M. & Vethaak, A. D. (2013) Microplastic survey of the Dutch environment. Novel data set of microplastics in North Sea sediments, treated wastewater effluents and marine biota. *Amsterdam: Institute for Environmental Studies, VU University Amsterdam.*

Lots, F. A. E., Behrens, P., Vijver, M. G., Horton, A. A., Bosker, T. (2017) A largescale investigation of microplastic contamination: Abundance and characteristics of microplastics in European beach sediment. *Marine Pollution Bulletin, 123*(1-2), 219-226. Elsevier B.V.

Lönnstedt, O. M., & Eklöv, P. (2016) Environmentally relevant concentrations of microplastic particles influence larval fish ecology. *Science*, *352*(6290), 1213-1216. AAAS.

Lusher, A. (2015) Microplastics in the marine environment: distribution, interactions and effects. In *Marine anthropogenic litter* (pp. 245-307). Springer International Publishing.

Mintenig, S., Int-Veen, I., Löder, M. & Gerdts, G. (2014) Mikroplastik in ausgewählten Kläranlagen des Oldenburgisch-Ostfriesischen Wasserverbandes (OOWV) in Niedersachsen.

Mintenig, S., Int-Veen, I., Löder, M., Primpke, S. & Gerdts, G. (2017) Identification of microplastic in effluents of waste water treatment plants using focal plane array-based micro-Fourier-transform infrared imaging. *Water Research, 108,* 365-372. Elsevier B.V.

Qiao, R., Sheng, C., Lu, Y., Zhang, Y., Ren, H., Lemos, B. (2019) Microplastics induce intestinal inflammation, oxidative stress, and disorders of metabolome and microbiome in zebrafish. *Science of The Total Environment (662)*, 246-253. Elsevier B.V.

Rainieri, S., Conlledo, N., Larsen, B. K., Granby, K., Barrando, A. (2018) Combined effects of microplastics and chemical contaminants on the organ toxicity of zebrafish (*Danio rerio*). *Environmental Research, 162, 135-143.* Elsevier B.V.

Teuten, E. L., Saquing, J. M., Knappe, D. R., Barlaz, M. A., Jonsson, S., Björn, A., et al. (2009) Transport and release of chemicals from plastics to the environment and to wildlife. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 2027-2045. The Royal Society. *Philosophical Transactions of the Royal Society B: Biological Science.* The Royal Society.

UNEP (2015) Plastics in Cosmetics. United Nations Environment Programme.

Von Moos, N., Burkhardt-Holm, P., & Köhler, A. (2012) Uptake and effects of microplastics on cells and tissue of the blue mussel *Mytilus edulis* L. after an experimental exposure. *Environmental science & technology*, *46*(20), 11327-11335. ACS Publications.

Whitmire, S.L. & Van Bloem, S. J. (2017) Quantification of Microplastics on National Park Beaches. National Oceanic and Atmospheric Administration (NOAA).

Wodall, L. C., Sanchez-Vidal, A., Canals, M., Paterson, G. L. J., Copprock, R., Sleight, V., Calafat, A., Rogers, A. D., Narayanaswamy, B. E., Thompson, R. C. (2014) The deep sea is a major sink for microplastic debris. *The Royal Society Open Science 1*(4), 140317. The Royal Society.