Science AMA Series: Ask the Society of Environmental Toxicology and Chemistry (SETAC) anything about Microplastics in the aquatic environment.

SETAC$_{N}orth_{A}merica^{1}andr/ScienceAMAs^{1}$

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Abstract

The Society of Environmental Toxicology and Chemistry (SETAC) is hosting the SETAC North America 38th annual meeting this week and we have tied this AMA to a specific session, "Microplastics in the aquatic environment." Experts from across academia, government and industry are here to answer questions on this topic. Microplastics are in the news regularly, but what do we know about them specifically? Researchers will be presenting on the ecological impacts generally, on oysters, from tires; they will explore how to remove microplastics in wastewater treatment, and so much more. Please note that we are asking members of the society who represent researchers from a variety of disciplines and sectors; the answers are not official SETAC positions. We encourage discussion and debate! Just please keep it professional. For more information on SETAC see http://www.setac.org Post your question and the organizers of the conference will find someone to answer it as soon as possible. Answers to questions will be most active during the session break at 3PM-4PM EST and immediately following 5PM-6:30PM EST, ending at 6:30PM EST.

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SETAC_NORTH_AMERICA R/SCIENCE

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Welcome! Thanks for coming to talk with us about your research!

Where do microplastics come from? I know that we have a horrible record of throwing garbage into the ocean, but I always assumed those were bigger pieces.

Edit: I forgot to ask, how do you feel about Mr. Trash Wheel and Dr. Trash Wheel? Do they work? Are they efficient? Do they help with the microplastics issue too, or are they just for bigger stuff?

PapaNachos

Microplastics are either produced intentionally, as in the case of microbeads in personal care products, or as a result of the breakdown of larger plastic products. In effect, many of these larger plastics you reference will become microplastics over time.

With regards to Trash Wheels, both Dr. and Mr., they are a fantastic effort for several reasons. While it's certain that they won't be able to remove all physical contaminants, they have been tremendously successful in removing mass amounts of debris - over a million pounds removed by Mr. Trash Wheel alone since 2014! On top of their great success in removing these materials, they also do a great job of raising the public's awareness of this important issue.

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PapaNachos

There is also another type of "plastics" which is organic synthetic polymers. These come from for example water treatment plants, polymer flooding, drilling fluids etc. They are the middle ground between "nanoparticles", molecules and plastics and can be considered a type of microplastics as well.

Hi, thanks for coming in! I had a few questions I was hoping you could answer.

Are there different types of microplastics? Perhaps classified by size or material?

You mentioned methods to clean them from waste water. How does that work? Are there methods that would work on the open ocean or perhaps inland lakes? Do these methods cause any new problems?

Do these particles generally gather on the surface or are they spread out through water?

ChemicalFreeJesus

Hello chemicalfreejesus, I am participating at the SETAC MSP r/science AMA and will have a flair up shortly. My topic is dissolved synthetic polymers which is not plastics per se. This already answers your question in a way and there is a lot of varieties of man-made polymers that can fall under microplastics. There is as many kinds of micro-plastics as there is plastics, and then some.

So microplastics are generated from larger pieces of plastic as they wear due to sunlight, radicals, mechanic forces and so forth. As they are weathered the pieces become ever smaller and eventually so small that they are essentially become dissolved in the water. This is the domain in which I am working.

So microplastics can be any piece of material between 1 mm and 1 micrometer, below that the pieces become so small that they have different properties and needs a different approach for characterization. Below 0.1 micrometer they become completely invisible and they behave more like large molecules. For the polymers that I am working with, namely very large molecules, they spread evenly throughout the water and is very hard to detect. On the other hand, larger particles may accumulate at certain locations making visually striking patches of junk.

On the other hand they are not very acutely toxic either, but we have really no clue about how they will stick around in the environment far into the future. As for the types of microplastics, only fantasy limits the possible types of microplastics. In a polymer or plastic, every single macro-molecule is different from one another so the combinations is limitless.

I have no idea about remediation so I'll leave that for the next person.

Hope this helps, Ecotoxicologist and chemist.

EDIT: Just saw a presentations here at SETAC where the author presented his work where they found an equal amount of microplastics uniformly distributed around in the watercolumn of both rivers and lakes.

What does the future of this problem look like? Are there paths and technologies on the horizon that could lead to us cleaning up the environment? Or are things getting worse? Somewhere in the middle? (pollution is slowing down, but we can't get rid of what's already there)

Do these microplastics primarily affect plants and animals or do they also have an effect on humans?

Both directly and indirectly.

ImKnotJesus

Littering is a big problem and this is an area where we need technological innovation. There are citizen science apps and initiatives that help track and clean-up litter. There are still questions about the effects on human health and whether it or not it bioaccumulates (builds up in our body). There are studies that suggest polycyclic aromatic hydrocarbons (which make up microplastics) do not tend to build up, which is promising. Most research has focused on the effects in plant in animals, not sure about any evidence about effects on humans. At SETAC, we focus mostly on environmental species, so microplastics remain a hot topic!

Are plastics made out of hemp a good alternative?

-lestat-

Yes, definitely! There is a strong drive to develop plastics and polymers which are biodegradable, but also have the properties needed for their applications.

I bet that if you do a search on google scholar you'll find a lot of proposals on how to do this with Hemp. For now, plastics with oxygen in their polymer backbone are generally bio-degradable, almost all biopolymers have this feature and are all readily biodegradable.

In hemp you definitely have some biopolymers that could be extracted and used like cellulose, but the question remains whether it will be stable enough for its intended use.

As a med student, I was wondering what recommendations you could give to me that I can communicate to future coworkers and patients about proper disposal of meds. And are the primary problems you see from hospitals or individual patients? Thanks for doing this AMA!

cubantrees

Obviously, disposing pharmaceuticals correctly (bringing them to a designated site for proper disposal) is important for limiting the load of pharmaceuticals going into wastewater treatment plants. We consider hospitals as point sources - that is, there is a measurably higher concentration of many pharmaceuticals entering the wastewater system compared to background levels. However, patients excreting pharmaceuticals is generally a larger total contaminant mass, with the exception of some pharmaceuticals used primarily only in hospitals (like imaging dyes).

Hi and thanks for joining us today!

What are the top products still legally using microbeads that ultimately end up in the environment?

PHealthy

Good questions, will see if we can get a hold of someone to answer this for you within due time

Hello! I have a few questions in regards to the presence of microplastics in the Great Lakes. I know that much work is needed in regards to refine our understanding on the impacts of microplastics on freshwater ecosystems, but I'm wondering 1.) What are the primary sources of microplastics effecting the Great Lakes (primary vs secondary), and 2.) have any studies been conducted examining the harm

they present to lake species, especially those of conservation concern?

Thank you.

EntomoNerd

1. The primary sources are cosmetics and beads. Fibers from synthetic clothing and washing are also a major contributor. Secondary is breakdown from foams, packaging and plastic bags. A major source is flushable vipes which are entirely synthetic.
2. Species are limited to laboratory scale toxicity testing on shrimp and water fleas (Daphnia). Acute toxicity (<96 h) for all of these are essentially non-toxic (>10-100 g/L). Toxicity of lake species are at the very focus of many current ongoing studies which we will see published soon.

Hello again! One more quick question: what, of any, guidelines or polices are in place involving microplastics and the protection of freshwater systems?

EntomoNerd

We'll try finding someone to answer that when the coffe break in between the session starts.

A recent USGS study found microbeads to be the least prevalent plastic pollution in the Great Lakes. Yet, they receive a majority of media coverage.

Do you believe we need to do a better job educating the public on significant sources of microplastic pollution such as fleece clothing, cigarette butts, and diapers?

adenovato

Well, these are all visually striking examples that is already being taken seriously on this conference at least. That is going to result in a lot of public awareness in a couple of years. Also, people can see these things with their own eyes and become annoyed/aware.

What we need is education on the things that we can't see, such that sub micron-plastics/nanomaterials that is not visible but more numerous.

What is more important is what happens in other countries where education on these matter is lacking completely and science is still in it's cradle. Take for example Nigeria, a country of around 200 million, where the public has zero awareness on environmental issues at all and use a "modern" amount of plastic on a daily basis to be thrown right into the nearest stream (according to a lecturer working at the college of fisheries in Lagos sitting right next to me). We share the same ocean and this is going to take time and is going to take a lot of effort!

A team from Newcastle University discovered microplastics in the stomachs of deep sea trench-living creatures in the Pacific.

How does this change our understanding of the prevalence of microplastic pollution and should distribution models be updated to include this new data?

adenovato

We'll try to get back to you with a member with some specific insight on this before this session ends.