3rd High-Level Industry-Science-Government Dialogue

Workshop - Clean healthy and sustainable oceans

Microplastics
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Praia do Baleal Norte, April 2018

< 5 mm

Antunes et al. 2018 [https://doi.org/10.1016/j.marpolbul.2018.04.025]
Direct addition to the environment
Fibres
Potential pathways for the transport of microplastics and its biological interactions.

Size
Density
Abundance
Colour

Ingestion
Active: size selection
Passive: via scavenging or sediment

from Wright et al, 2011
European emissions of primary microplastics (scaled to a global level using PPP-adjusted GDP)

**SOURCE:**
- Land-based - 78 %
- Primary MP - ~8 %
- Ocean-based - 14 %

**“SINK”:**
- Beaches – 5 %
- Ocean surface – 1 %
- Sea floor – 94 %

**Total Plastic Entering the Marine Environment**
- 12.2 Million tonnes per annum

**Primary Microplastic**
- 0.95 Million tonnes per annum
- ~8 %

**Beaches**
- 2.000 kg/km² (5% of total)
- 6,400 T
- 1.7 trillion pieces
- 2.5 kg km²
- 678,000 km²

**Ocean Surface**
- 18 kg/km² (1% of total)

**Sea Floor**
- 70 kg/km² (94% of total)

**Eunomia, 2016**

**Lebreton et al. 2018**
Microplastics size is < 5 mm

<table>
<thead>
<tr>
<th>Size Range</th>
<th>Sediment</th>
<th>Sea surface</th>
<th>Water column</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 µm</td>
<td>[1 - 500 µm [</td>
<td>[500 µm – 5 mm[</td>
<td>&gt; 5 mm</td>
</tr>
</tbody>
</table>

(Adapted from Hidalgo-Ruz et al. 2012)
Realistic concentrations?

**Light microscopy, particles individually analysed μ-FTIR**

Arctic sea ice

<table>
<thead>
<tr>
<th>Size Class</th>
<th>Number of Microplastics</th>
</tr>
</thead>
<tbody>
<tr>
<td>38 - 234 L⁻¹</td>
<td>2 mm – 20 µm</td>
</tr>
</tbody>
</table>

Total number of microplastic pieces in sea ice cores

Obbard et al. 2014

Arctic sea ice

33 - 75,143 L⁻¹

> 500 – 11 µm

Microplastic particles in different size classes in all sea ice cores.

Peeken et al. 2018

**Surface imaging FTIR**
Detecting microplastics

Analytical methodologies

Overview of the most common density separation (outer ring) and (bio)chemical treatment (inner ring) protocols including their reference authors. The % values are related to 67, or 53 articles, respectively, in which density separation or a (bio)chemical treatment are described.

(Renner et al. 2018)
BASEMAN
Defining the baselines and standards for microplastics analyses in European waters

PLASTOX
Direct and indirect ecotoxicological impacts of microplastics on marine organisms

www.jpi-oceans.eu
Microplastics in the oceans – sink is the fate but…

Biofilm communities

Organic debris

Clay particles

Other

DMS (Fronts)

POPs

Metals

Residual monomers
Additives (phthalates, PBDE)

Removal:

Ingestion (translocation) >> Toxicity

Nanofragmentation

Sedimentation (density)

How small? How long?

>> Toxicity

Biofilm and nanofragmentation increases the charge, roughness, porosity and hydrophobicity of the plastic surface and concentrates pollutants. DMS promotes ingestion.

Adapted from Wang et al. 2016
Major challenges

Map sources and understand pathways

• Data on size and quantities (number/mass):
  o what is already in the ocean,
  o river inputs to the ocean, including runoff, storm water and effluents from WWTP
  o retention in estuaries

Chemical and physical processes

• Degradation:
  o how long to degrade,
  o how many particles of what sizes?
Major challenges

**Biologically-mediated processes**

- Changing density - biofilm
- Ingestion — retention?
- Toxicity - Assess harm to organisms
- Trophic transfer – evaluate disturbance at the ecosystem level
- MP/NP and *human health*
- Framework for ecological and human health *risk assessment*

**Linking local to global** - models
Major challenges

**Prevent and reduce impacts**

- Waste management improvement (*recycle more, improve packaging design*)
- Going circular: upcycling and innovation – no litter
- Technology for new materials – Bioplastics...
- Awareness and co-responsibility (and ocean literacy)

- **Sustainable consumption options**
Thank you!