UK Emissions from Novel Sources: Inhalable microplastics: a new cause for concern?

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Plastic in our environment

- Synthetic textiles...clothes, furniture, carpets
- Synthetic rubber...tires, shoes
- Thermoplastic paints
- Construction/buildings
Plastic is really useful
Until we see it like this.......
Plastic debris is a rapidly emerging environmental issue
How long til they’re gone?
Estimated time taken to biodegrade

- Stryrofoam cup: 50 years
- Aluminium can: 200 years
- Nappy: 450 years
- Plastic bottle: 450 years
- Fishing line: 600 years

Exact time will vary by product type and environmental conditions

Source: NOAA / Woods Hole Sea Grant
What is the evidence that microplastics is a human health issue?
Microplastics contamination of bottled water

<table>
<thead>
<tr>
<th>BRAND</th>
<th>PARTICLES PER LITER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqua</td>
<td>0</td>
</tr>
<tr>
<td>Aquafina</td>
<td>2</td>
</tr>
<tr>
<td>Bistoni</td>
<td>0</td>
</tr>
<tr>
<td>Dasani</td>
<td>2</td>
</tr>
<tr>
<td>Epura</td>
<td>0</td>
</tr>
<tr>
<td>Evian</td>
<td>9</td>
</tr>
<tr>
<td>Gerolsteiner</td>
<td>0</td>
</tr>
<tr>
<td>Minalba</td>
<td>0</td>
</tr>
<tr>
<td>Nestle Pure Life</td>
<td>6</td>
</tr>
<tr>
<td>San Pellegrino</td>
<td>0</td>
</tr>
<tr>
<td>Wahaha</td>
<td>1</td>
</tr>
</tbody>
</table>

Test results by bottled water brand. The chart shows the range of particles per liter of bottled water by brand.

325 average across all brands.

Microplastics contamination in German beer

Synthetic particles in German beer

Supermarket fish all had microplastic contamination
Could microplastics be in the air?

Dris et al., Society of Environmental Toxicology and Chemistry, 2016
The potential for microplastics to impact human health

Wright and Kelly, *Environmental Science and Technology*, 2017
Wright and Kelly, *BMJ*, 2017

Cai et al., 2017
The health impact of traffic related particles is well understood.
Are inhalable microplastics affecting our health?
Occupational exposure

- **Flock (nylon) worker’s lung** *(Kern et al. 1998, 2000, 2003)*
  - Cough; chest pain; infection in the airway; tissue inflammation
  - ‘Health hazard exists from occupational exposures to flock–associated dust’ (National Institute for Occupational Safety and Health)

- **Other synthetic textiles** (plastic microfibres) *(Pimentel et al., 1975)*
  - Inflammation around acrylic/polyester/nylon dust; respiratory irritation.
What we would like to understand

• Are inhalable microplastic’s present in the air?

• If so, what are the dominate types?

• At what concentration's are they present?

• How do these concentrations vary by location?
What we would like to understand (II)

- Is microplastic toxicity influenced by the type, or age of the plastic?
- If so, what are the most toxic combinations?
- Are microplastic particles present in human samples – nasal lavage, induced sputum, etc?
- How does exposure to microplastic particles influence their presence – bioaccumulation?
Summary of Reference Plastic Spectra

![Mean Spectrum of Plastic Reference Material](image)

- Polyethylene
- Polyethylene Terephthalate
- Polyamide
- Polyvinyl Chloride
- Polystyrene

Absorbance (a.u.) vs. Wavenumber (cm⁻¹)
Suspicious Fibres and Particles

Domestic Vacuum Cleaner  Volumetric Spore Trap Detector  Multi-Vial Cyclone Sampler
Developing methods for sampling and detection of microplastics in complex samples

Particulate matter

PMMA

PS

PE

Pulmonary tissue (mouse)

PMMA

PS

PE

Wright et al., *Environmental Science & Technology* 2019
Microplastic Toxicity?

• Unreacted monomers, additives, dyes and pigments
  – MPs ingested via mussels contribute est. $3.4 \times 10^{-5}$ g BPA/person/y (Rist et al., 2018)
  – ↑ brominated flame retardants in household dust (210 mg g$^{-1}$) due to abrasion of particles/fibres from treated items (Rauert et al., 2014)
    • Est. contribute up to 15% exposure (Li et al., 2014)
    • Thyroid homeostasis/cognition (Howe et al., 2018)

• Sorbed HOCs/metals...particles?
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