

**Title: “Analysis of persistent organic pollutants in plastic pellets recovered from UK Shorelines: implications for health risks, ecotoxicology and spill response operations”**

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Plastic pellets (commonly referred to as nurdles) are now commonly found on beaches and shorelines around the world, with their presence being the result of a combination of chronic pellet losses from the plastics industry including plastics manufacturers and converters, and from acute pellet losses from ship-sourced spills and from land-based incidents such as road and rail crashes which occur during transport of the pellets along the supply chain.

To better understand the potential impacts on human health and the environment, as well as the implications for those responding to deal with pellet contamination, samples of plastic pellets recovered from around the UK, as well as virgin ‘control’ pellets have been obtained and analysed for a wide range of pollutants including heavy metals, polycyclic aromatic hydrocarbons (PAH), per and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs), flame retardants and other persistent organic pollutants (POPs).

Pellet samples from 6 sites were collected and prepared for analysis in the laboratory using a combination of sieving and manual picking, followed by rinsing off of external contamination (e.g. wood, sand etc), drying and grinding.

For organics analysis the ground homogenised pellet samples were subject to solvent extraction followed by analysis using GC-MS, GS-MS-MS, LC-MS-MS and GC-FID techniques. Metals were analysed using ICP-OES and ICP-MS following microwave digestion with Nitric acid/Hydrogen peroxide.

Total (USEPA 16) PAH concentrations of up to 455 µg/kg were recorded in the pellet samples with the highest individual compound concentration returned for pyrene at 69 µg/kg. Of the PCB congeners analysed the maximum total PCB concentration recorded was 488 µg/kg and the highest individual congener was PCB110 at 54 µg/kg.

Of the pesticides analysed the highest concentration recorded was for DDT at 220 µg/kg in the pellet sample obtained from the River Itchen in Southampton.

Elevated concentrations of other persistent organic pollutants including PFOS (up to 0.22 µg/kg), HBCDD (up to 210 µg/kg), Dieldrin (up to 18 µg/kg) and PBDE (up to 1400 µg/kg for PDBE209) were identified in the pellet samples analysed. Of the heavy metals analysed, only Cadmium and Chromium returned concentrations significantly higher than the control sample analysed.

The pellets and the associated pollutants are able to enter food chains once ingested by fish or birds and these compounds have the potential to bioaccumulate once ingested, potentially leading to early mortality.

With respect to spill response operations, there are potential health implications of exposure to the persistent pollutants, with appropriate personal protective equipment required, and there could also be implications for the end point of any recovered pellets associated with the final recovery (e.g. through recycling) or disposal of the pellets.