

Project title: Investigating Synthetic Textile and Plastic Biodegradation

Ref: OP2445

Keywords: Microbiome, Landfill leachate, Net Zero, Environmental Policy

One Planet Research Theme:

Climate & Climate Change | Earth System Processes | Anthropocene | Environmental Informatics

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Key Research Gaps and Questions:

- Do synthetic textiles and plastics hold potential to bio-degrade within landfills, contributing to GHG production?
- How does the disposal of textiles and plastic in landfills change microbial communities? -
- Does the presence of textile and plastics enrich for species that degrade these materials or increase methane production?

Project Description:

As part of the United Kingdom's commitment to achieving net-zero emissions, it is crucial to reduce Net Zero GHG CO_{2eq} emissions from all sources. Within the UK emissions from solid waste disposal to land (landfill) biological treatment of solid waste (including anaerobic digestion, composting) incineration (without energy recovery), wastewater treatment, and Energy from waste (EfW) were responsible for 25.6MtCO₂ or 6% of UK GHG emissions in 2021.

The incineration of synthetic textiles and plastics in EfW processes contributes significantly to Net Zero accounted GHG emissions. In contrast the redirection of plastics and the synthetic component of textiles makes no contribution to Net Zero accounted GHG emissions. It is assumed that in landfills synthetic textiles and plastics do not degrade in a manner that leads to the release of GHG, such as methane, and therefore the 'storage' of these materials within landfill does not contribute to GHG emissions. Recent research has uncovered that under the extreme conditions of landfills these materials can fragment over time through abiotic processes forming microplastics which remain contained in the site itself, are exported in leachate, and may be distributed to the wider environment. However, if these synthetic textiles and plastics are degrading within landfill system, they may be contributing to methane emissions and Net Zero.

This project aims to investigate if synthetic textiles and plastics have the potential to biodegrade in landfills partially or fully, in addition to fragmenting forming microplastics. It will characterise landfill leachates specifically quantifying microplastics (and material identification) and characterising microbial communities (DNA sequencing) within the landfill leachate and employ metabolic modelling to evaluate potential for material degradation.

Ultimately, this project will inform DEFRA evidence and policy by re-assessing the viability and environmental implications of directing these materials to landfills.

Prerequisites: enthusiasm, initiative and an ability to undertake independent research; at least a 2:1 honours degree in biology or related subject is expected. For more information, please contact Dr. Iain MacArthur (iain.macarthur@northumbria.ac.uk) and Dr. Lynsay Blake (Lynsay.Blake@defra.gov.uk).

