Microplastics:

What the laboratory can offer

SCLF 2024

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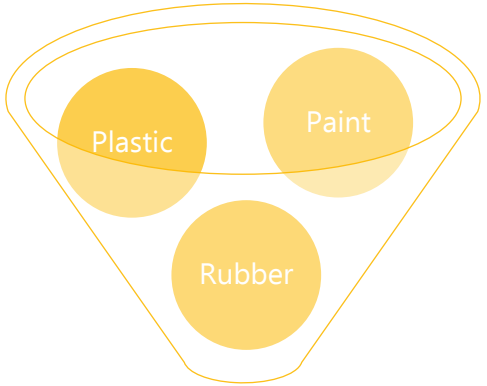
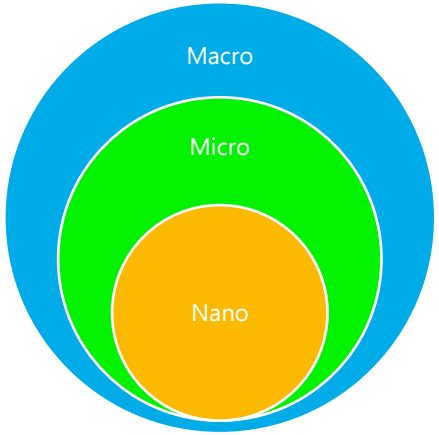
SUMMARY

1. What are microplastics
2. Sampling considerations
3. Preparation overview
4. Analysis techniques
5. Microplastic as vectors research
6. What ISO/CEN are working on

MICROPLASTICS: WHAT ARE THEY?



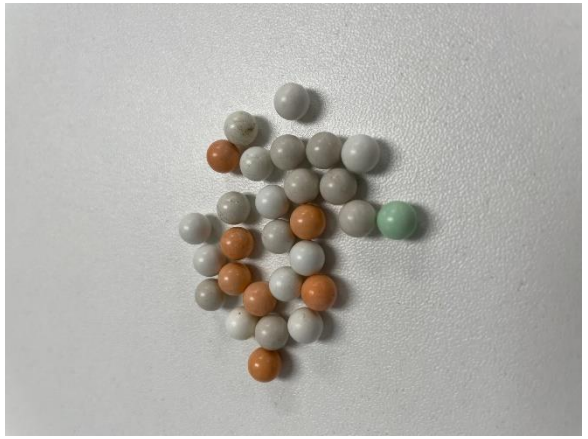


Microplastics

BSI Standards Publication

Determination of the ultimate aerobic biodegradability of plastic materials under controlled composting conditions — Method by analysis of evolved carbon dioxide

Part 1: General method (ISO 14855-1:2012)



Just because it says 'biodegradable' doesn't mean it won't be around for years and degrade into microplastics. The yellow plant food prills in the image have been in my garden for over 5 years now!

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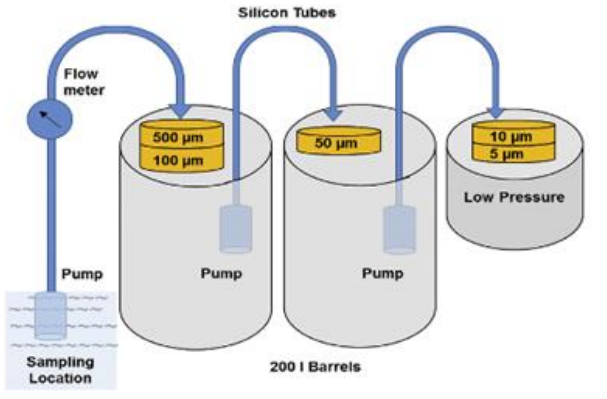
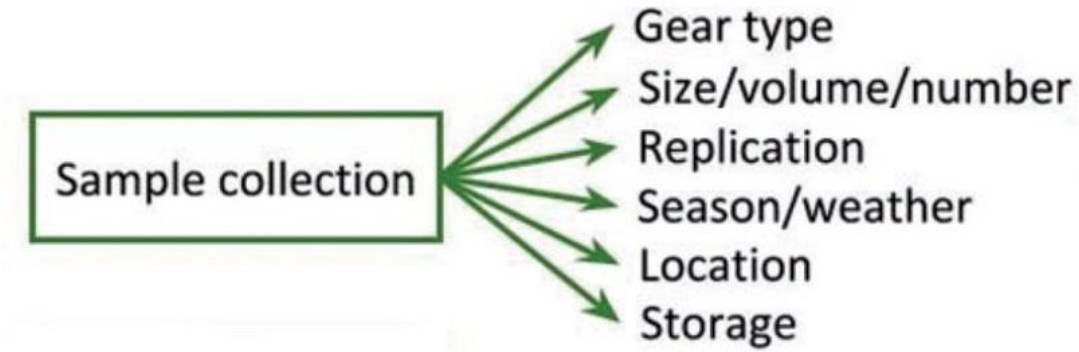
SAMPLING CONSIDERATIONS



C.G. Bannick et al. (2019) *Water Research*. 149: 650-658



https://www.nhbs.com/manta-trawl-net

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MICROPLASTICS: HOW TO ANALYSE

- Microplastic analysis is highly complex and many different techniques have been used. Basic workflow is:
  - Filtering
  - Flotation
  - Digestion
  - Counting
  - Identification

MICROPLASTICS: HOW TO ANALYSE

- **Filtering**
  - Sample is reduced in size between largest and smallest particle of interest by wet sieving. This makes the sample (especially soils and sediments) more manageable

- **Flotation**
  - Post filtering and drying, sample is floated in a solution of suitable density (1.6g/ml).
    - PP 0.91g/ml
    - PVC 1.38g/ml
  - Be careful of methods using salt solutions for flotation (1.2g/ml)
  - Sodium heteropolytungstates (Fastfloat) – 2.8g/ml

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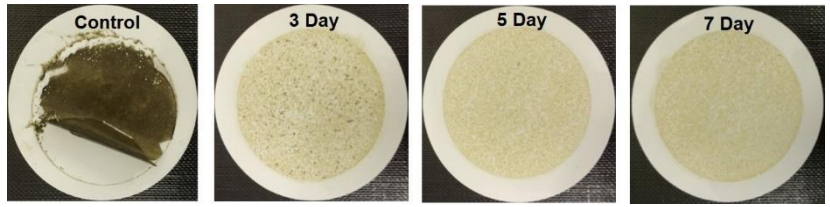
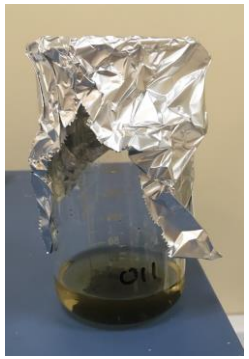
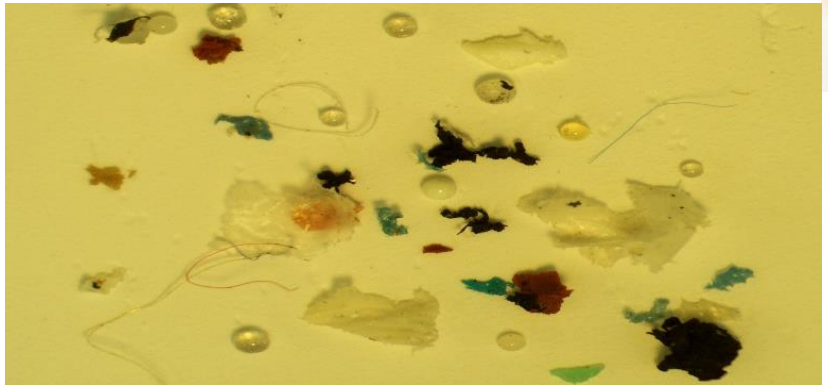
MICROPLASTICS: HOW TO ANALYSE

- **Digestion**
  - After flotation then you will still have organic material present (such as cellulose). A digestion technique is required to remove such material
    - Hydrogen peroxide/$FeS0_4$ (Fenton Reagent)
    - Enzymic
    - Alkali/acids
    - Schweizer's Reagent $[Cu(NH_3)_4((H_2O)_2])OH_2)$
- **Counting**
  - From digestion the particles are filtered and ready for counting







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MICROPLASTICS: ANALYSIS TECHNIQUES

- **Identification**
  - Numerous techniques for the identification of the type of polymer each particle are available:
    - Fourier Transform Infrared Spectroscopy
    - Agilent Laser Direct Infrared (LDIR)
    - Raman Spectroscopy
    - Pyrolysis GC/MS
    - SEM-EDX
  - Each technique have their pros and cons. Consider what is important to find out:
    - Polymer type
    - Particle size
    - Particle shape
    - Colour
    - Polymer weight

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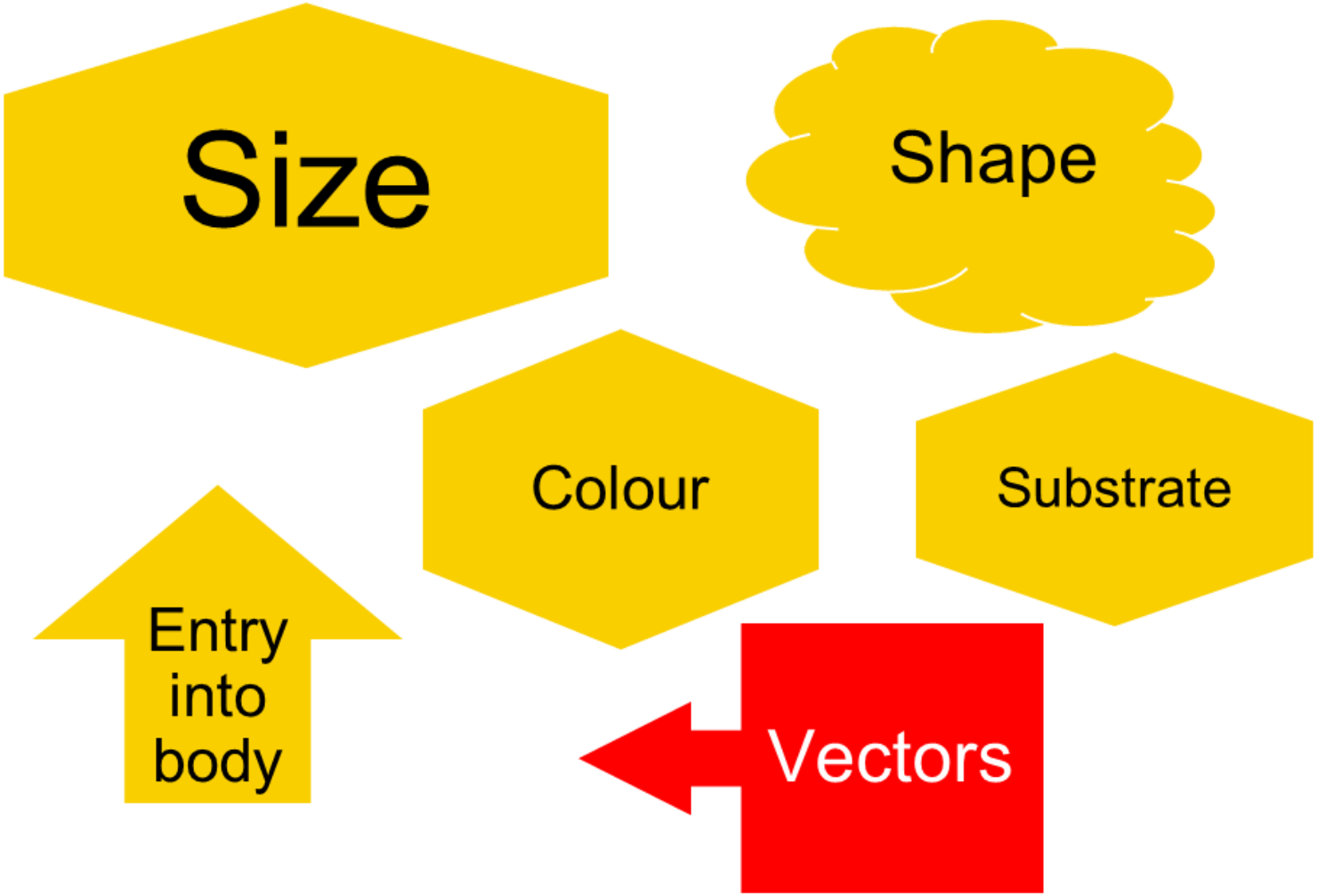
MICROPLASTICS: WHAT SHOULD WE CONSIDER



MICROPLASTICS AS VECTOR RESEARCH

Nurdles: the worst toxic waste you've probably never heard of

Billions of these tiny plastic pellets are floating in the ocean, causing as much damage as oil spills, yet they are still not classified as hazardous

Sri Lankan navy personnel clean up a beach polluted by 'nurdles' in the largest plastic spill in its history, from the X-Press Pearl container ship disaster. Photograph: Chamila Karunarathne/EPA

The Guardian
News provider of the year

X-Press Pearl container ship caught fire and sank off Sri Lanka in May 2021 containing 78,000kg nurdles. Nurdles are tiny granules of plastic used to manufacture a wide range of plastic products. As they are a size up to 5mm then they would be classified as microplastics

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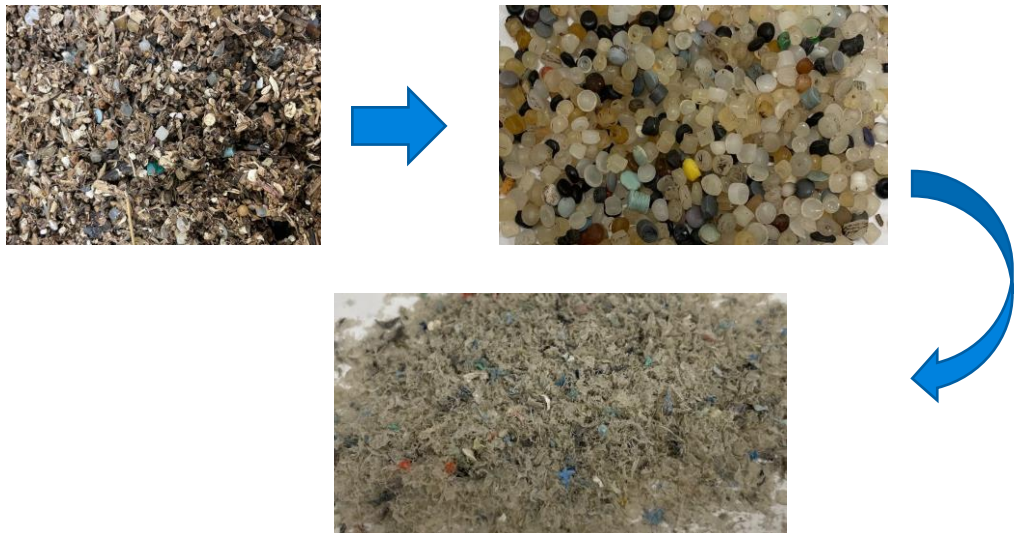
MICROPLASTICS AS VECTOR RESEARCH

- Why work with nurdles?
  - They are microplastics
  - Abundance of them
  - Allows use of current laboratory equipment

- Sample preparation
  - Isolate nurdles (size <5000µm)
  - Rinse off external contamination
  - Dry, grind and homogenise – increase surface area



- PAHs
- PFAS
- HBCDD
- PBDEs
- Phthalates
- PCBs
- Pesticides
- TPH
- Metals

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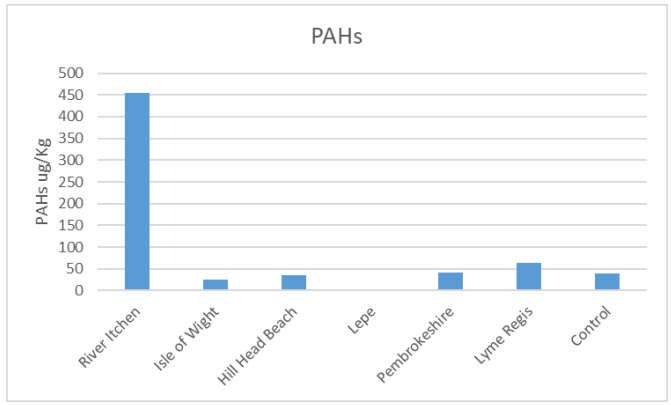
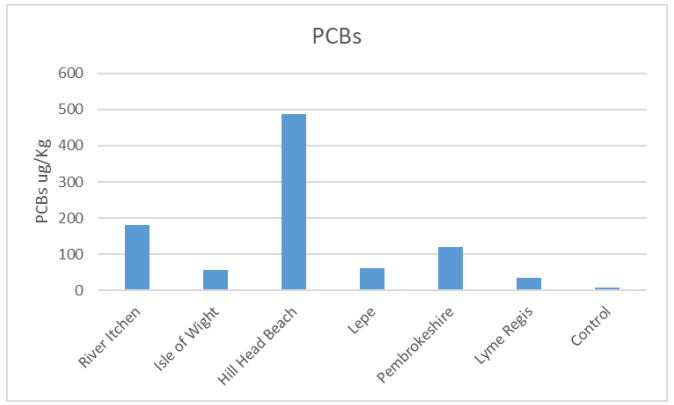
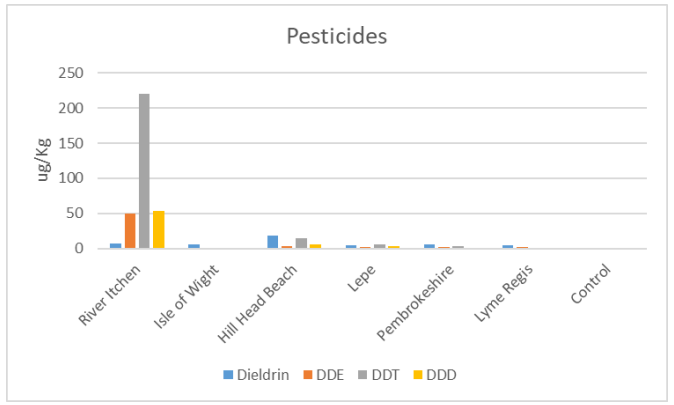
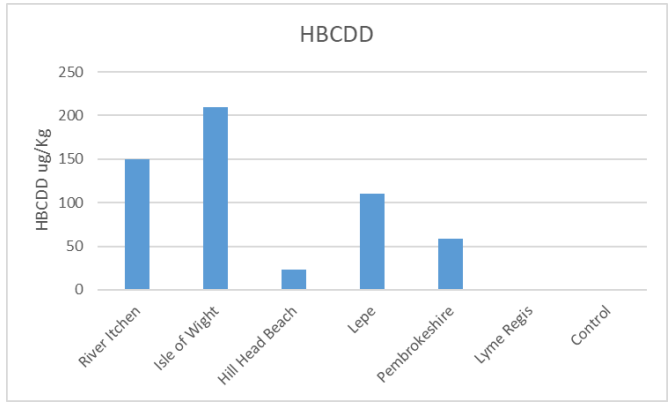
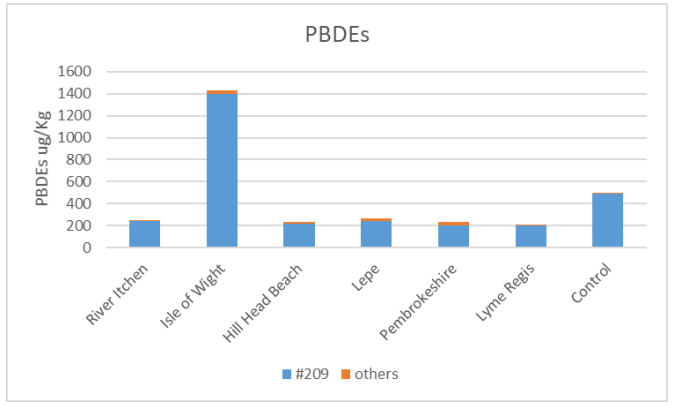
MICROPLASTICS AS VECTOR RESEARCH

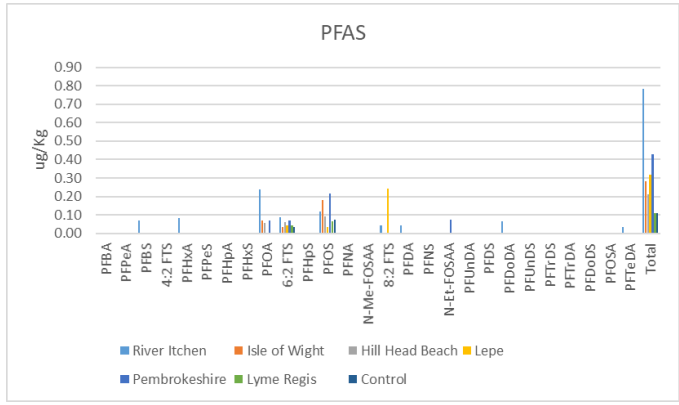












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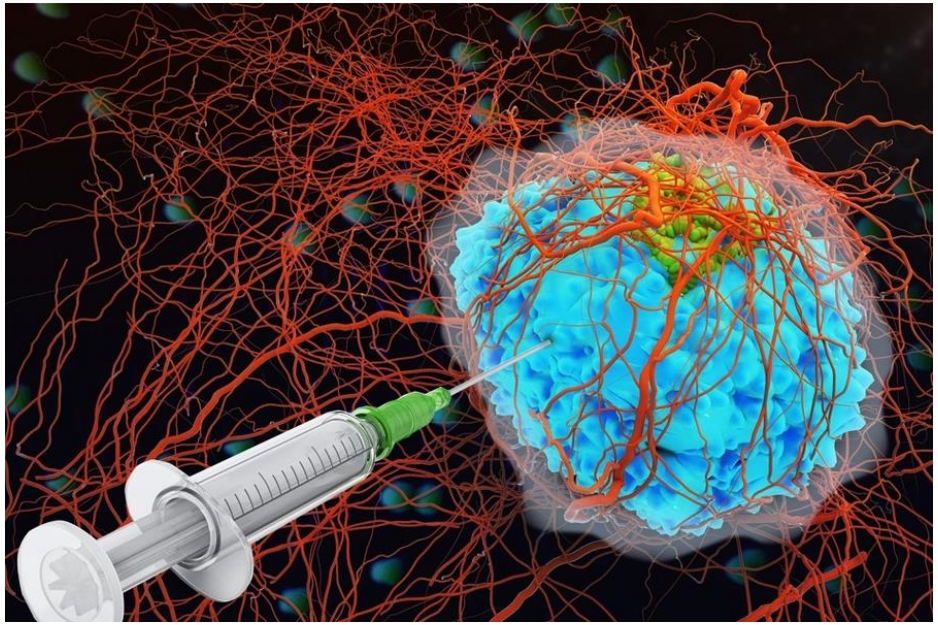
MICROPLASTICS AS VECTOR RESEARCH

Toxicology needs to be considered for micro/nanoplastics where the ‘vectorism’ potentially transfers the chemical directly into the cell



https://news.mit.edu/2019/cytokines-effect-tumors-treatment-0626

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ISO/CEN UPDATE

ISO/CD 16094-1: Water quality — Analysis of microplastic in water — Part 1: General. (Current stage of this document: Deleted)

ISO/DIS 16094-2: Water quality — Analysis of microplastic in water — Part 2: Vibrational spectroscopy methods for waters with low content of suspended solids including drinking water. (Current stage of this document: 40.99 – Draft International Standard approved)

ISO/DIS 16094-3: Water quality — Analysis of microplastic in water — Part 3: Thermo-analytical methods for waters with low content of suspended solids including drinking water. (Current stage of this document: 40.20 – in Draft International Standard ballot)

ISO/PWI 16094-4: Water quality — Analysis of microplastic in water — Part 4: Sample preparation for monitoring of microplastics for waters with low content of suspended solids including drinking water. (Current stage of this document: Preliminary Stage)

ISO/FDIS 5667-27: Water quality — Sampling — Part 27: Guidance on sampling for microplastics in water. (Current stage of this document: 50.00 – Final Draft International Standard)

CEN/TC 444-WG6 'Cross cutting issues': Task Group on Microplastics in soils

British Standards Institution bsi. Committee Member

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