Research Summary

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Review of existing knowledge – emerging contaminants

KEY POINTS

- **Nanomaterials**

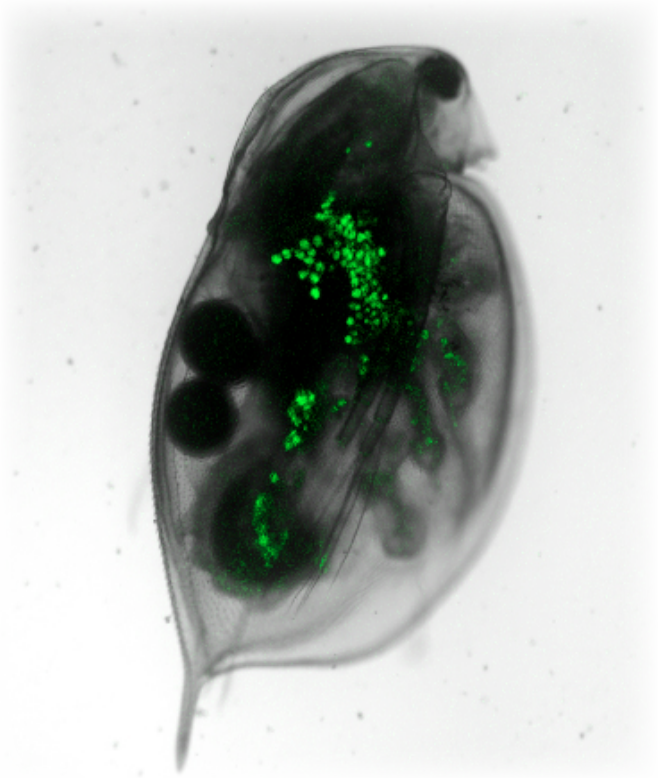
The nanotechnology industry is expanding fast with an ever increasing number of products containing nanomaterials (nanoscale <100nm on at least one dimension). In many cases the lifecycle analysis of these materials (production, use, disposal) is incomplete or lacking, especially for nano-composite materials, where the entry route to the environment is not immediately apparent. It is also becoming clear that there is a lack of understanding concerning how nanomaterials interact with other contaminants. The knowledge gaps we highlight in this report currently make reliable risk assessment difficult or even impossible.

- **Microplastics**

Litter in the environment is not a new phenomenon. However, the realization that microscopic plastic particles (microplastics) <5mm and synthetic microfibres occur in the aquatic environment has recently drawn a lot of public attention. One particular concern is growing evidence for the ability for microplastics to move up the food chain and therefore potentially affect human health. We highlight a number of gaps in our understanding of microplastic behaviour in the environment, particularly their interaction with microorganisms and the ability to sequester and therefore concentrate other non-polar contaminants, thus potentially exposing organisms that have come into contact with microplastics to higher contaminant concentrations. We review a number of NGO supported and Scottish Government initiatives that have led to changes in consumer behaviour and draw attention to the inability to measure the impact of these measures owing to the lack of appropriate microplastic baseline concentrations.

INTRODUCTION

Emerging technologies can deliver great benefits, but may also carry risks to the environment and/or human health. Furthermore, existing contaminants in the environment may increase in importance with our improved understanding of their behaviour and interaction with relevant organisms in a changing environment. Whilst nanomaterials are an example of the former, microplastic particles represent the latter. The present report is the result of a review of the existing knowledge of emerging contaminants relevant to Scotland, with a focus on nanomaterials and microplastics. The aim was to identify gaps in the current knowledge and provide recommendations on research needs to support relevant Scottish Government policies.



POLICY IMPLICATIONS

Nanomaterials

- The lack of detection methods for monitoring the presence of NMs in the environment and in environmental media means that few reliable data[1] currently exist on the quantities released into the environment (it is not actively monitored in Scotland).
- Encourage research to develop environmentally relevant testing strategies to produce the data required to validate risk assessment models for NMs.
- Given the published information available on establishments in Scotland producing or working with NMs it is unlikely that the situation is more acute to what is taking place in other European countries. Although records are not fully available it is expected that the number of establishments which fit into those categories is not very large. Therefore, it is proposed that the situation continues to be monitored and that regulatory developments will follow the lead from the work currently taking place at European level.
- Specific regulations on the production use and disposal of NMs may be required.

Microplastics

- A fully-funded large-scale baseline study for the Scottish marine environment is required in order to separate fresh input from historic material and understand temporal trends.
- Develop standardized methods for sampling, sorting and identification of environmental microplastic polymers. This includes developing categories for reporting that would allow data from different survey types to be compared, similar to the OSPAR beach litter survey. This is currently being discussed at European level with the Austrian EPA as lead, but the timeframe is as yet unclear (SEPA, personal communication). Scotland needs a strong representation in relevant international bodies (OSPAR, GESAMP, JCR, EU-EPA) to help devise these standardized methods suitable for the Scottish situation, which may be very different from other countries in terms of climate, plastic usage and end of life treatment etc.
- More research is required to understand the potential harm of microplastics, including source and fate in the marine environment (trophic mobility), as well as the development of appropriate biomarkers of exposure in marine organisms and implications for human health.
- Instigate studies to better understand how microplastics interact with contaminants in the environment and how they may act as vectors for the potential facilitated entry of chemical pollutants into the food chain.
- Instigate studies to help understand biofilm formation on microplastics and its role in microplastic dynamics.
- Following recent realization that sewage can account for a large amount of particularly fibrous microplastic material, the development of fabrics that release fewer fibres during washing as well as appropriate filters that can remove these microplastic fibres from the sewage stream needs to be encouraged.
- Recent public engagement through investigative media pieces needs to be built on and the reduction of waste encouraged. If alternative materials are not available further incentives for increasing recovery and recycling rates need to be created, such as the one recently piloted by the Scottish Government's Zero Waste initiative.
- Industry and retail need to be further incentivized to use less packaging material.

[1]Nowack, B., *The behavior and effects of nanoparticles in the environment.* Environmental Pollution, 2009. **157**(4): p. 1063-1064.

RESEARCH TEAM AND CONTACTS

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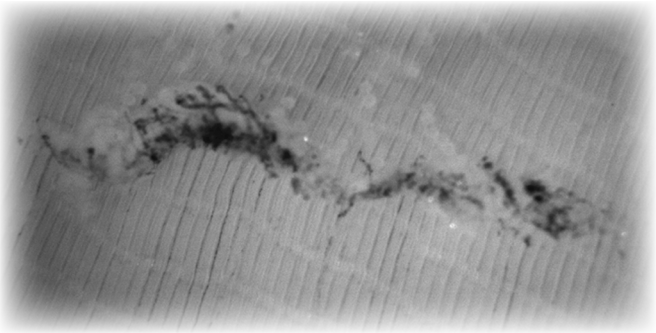

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