Environment Testing

EnviroNote News

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Microplastics in Biosolids – Is this a Problem we need to be concerned about?

Microplastics (MPs) have become a widespread environmental contaminant, infiltrating both terrestrial and aquatic ecosystems. One major pathway for plastic pollution is wastewater, which largely ends up in wastewater treatment plants (WWTPs). Studies have shown that conventional WWTPs with primary and secondary treatment can remove 60%–80% of MPs from the water phase, with tertiary treatment increasing removal rates to over 90%[1]. However, this means that a significant portion of MPs accumulates in the solid phase, the biosolids. In addition to MPs, biosolids can also contain toxic pollutants such as per- and polyfluoroalkyl substances (PFAS), heavy metals, and organic pollutants such as pharmaceuticals and personal care products (PPCPs), phthalates and flame retardants. This raises concerns about the potential environmental and health risks associated with the use of biosolids where contaminants may enter the food chain.

What to do with Biosolids and how contaminated are they?

Biosolids, the processed remnants of sewage sludge after wastewater treatment, are rich in essential nutrients like nitrogen, phosphorus, and organic carbon. These nutrients enhance soil fertility and boost crop production. For this reason, especially in Australia, the majority (>70%) of biosolids are applied to agricultural fields as fertiliser and a means of increasing the soil carbon.

Global studies have shown that significant amounts of MPs end up in the environment from biosolids with varying concentrations. The occurrence data currently for Australia is very scarce. A study by Queensland Alliance for Environmental Health Sciences (QAEHS) estimates that as much as 4,700 metric tonnes per year are released in Australia alone[2] and another study by Griffith University has shown that the concentration of MPs in the biosolids analysed across NSW, QLD and SA ranged between 11 to 150 MPs/g dry weight[3] with some seasonal variation.

Other disposal pathways for biosolids include pyrolysis, biogas production, landfill, and composting. Outside of Australia, as in the US and Europe, incineration is also a pathway for treatment. However, some analyses of biochar, the product of pyrolysis, have revealed that some plastics remain intact, indicating that they are not entirely destroyed during some processes.

What are the sources of Microplastics in our wastewater?

MPs enter wastewater from various sources, including domestic activities, industrial processes, and stormwater runoff.

A major contributor is the industry, where plastic manufacturing and plastic recycling facilities produce MPs. Additionally, laundromats produce large amounts of microfibres from synthetic fabrics, which can unintentionally be released into wastewater.

Household wastewater is another significant source. Washing machines and personal care products, such as facial scrubs and toothpaste, may contain microbeads that can wash down the drain. Additionally, household cleaning products, polyurethane sponges, toilet waste, and in-sink food waste disposal systems can also contribute to MPs entering the wastewater.

Stormwater runoff further exacerbates the issue. MPs from urban areas, such as small plastic litter and tyre wear particles, are washed off roads and carried into stormwater drains, eventually entering the wastewater system.

Addressing the Issue: Research and Solutions

Microplastic (MP) contamination in biosolids is a growing concern, prompting research efforts to better understand the extent of the problem and develop effective solutions.

A. Accurate measurement of MPs in biosolids is crucial for assessing their abundance and environmental impact. Advanced analytical techniques are being developed to detect, size, and identify MPs, providing valuable data for policymakers and industry stakeholders. There are two primary methods for MP analysis: **vibrational spectroscopy and pyrolysis–gas chromatography tandem mass spectrometry** (Pyr-GC-MS/MS). Vibrational spectroscopy includes both infrared (IR) or Raman light, providing information about molecular structure and composition, delivering detailed data on individual polymer sizes and types, and reporting results as MPs/g or MPs/L. Pyr-GC-MS/MS, on the other hand, measures polymer mass concentrations, viz., µg/g or µg/L and offers bulk analysis by thermally decomposing MPs into characteristic pyrolysis products, which are then separated chromatographically and detected by the tandem mass spectrometer. Both techniques are well established, but they differ in the types of polymers they can identify. Spectroscopy excels at detecting polyurethane (PU), whereas Pyr-GC-MS/MS has difficulties accurately measuring PU and reported levels may therefore be underestimated. Pyr-GC-MS/MS is particularly effective for identifying rubber compounds, such as styrene-butadiene rubber (SBR). By combining these methods, researchers can achieve a more comprehensive assessment of MP contamination in biosolids, overcoming the limitations of single-method approaches.

B. Another crucial approach is addressing the issue at its source. Preventative measures, such as deploying suitable filtration in laundry machines, reducing plastic usage in personal care and cleaning products, and implementing stricter regulations on industrial plastic discharge, can significantly reduce the number of MPs entering wastewater systems.

C. Research is also being conducted on the effects of MPs in biosolids and their potential risks to soil health, crop production, and ecosystems. Understanding how MPs interact with contaminants such as heavy metals and persistent organic pollutants is vital for evaluating their long-term consequences.

D. Finally, remediation strategies are being explored to mitigate the presence of MPs in biosolids. Innovative solutions include advanced wastewater treatment technologies, biodegradation approaches, and modifications to biosolid processing methods to break down or capture MPs before they enter the environment.

Addressing microplastic pollution in biosolids requires a combination of scientific research, technological innovation, and policy interventions to minimise its impact and protect environmental and human health as well as defining a sustainable future.

Eurofins Environment Testing Australia supports many of the analytical needs highlighted in this article, including testing for PFAS, heavy metals, pharmaceuticals, and other emerging contaminants in biosolids. While microplastics testing is still an evolving area, Eurofins is actively engaged through its global network in developing and applying advanced analytical methods to better understand microplastic contamination.

If you'd like to learn more about our capabilities or explore collaboration opportunities in this space, please get in touch with our team.

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