Assured Biosolids Limited (ABL) Biosolids Assurance Scheme (BAS) Position Statement on the potential impact of microplastics on biosolids recycling to agricultural land

Executive summary

- While the increasing quantity of plastic produced and used globally invariably means plastics are finding their way into wastewaters, there is no evidence to indicate that microplastics associated with biosolids pose any significant risk from an environmental and human health perspective.
- The UK Water Industry and other organisations are continuing to undertake research to further our knowledge on the impact of microplastics in the environment for example through phase 4 of the Chemical Investigation Programme and UK Water Industry Research (UKWIR) projects.
- However, plastic contamination must be moderated at source as extracting substances from wastewaters is challenging and will be extremely costly for the water consumer. However, the water industry is continuing to investigate methods to remove microplastics from sewage sludge and/or biosolids.
- There is an urgent need for action across the whole supply chain (e.g. manufacturers and sellers of products containing plastics supported by researchers and regulators) to understand the issues associated with microplastics and find sustainable solutions to this important issue.
- In the interim the industry continues to beneficially recycle biosolids to agricultural land, which is consistent with a Circular Economy and is the best practical environmental option in most circumstances.

Introduction

The increasing amounts of plastics produced globally each year, combined with their potential impact on the environment has resulted in a large amount of public and media interest. Much of the interest in the fate of plastics, including microplastics, has focused on the marine environment. However, there has been increasing interest in the terrestrial environment that has included their concentration in biosolids (i.e. treated sewage sludge) and their potential impact when treated and recycled to agricultural land. Despite this interest, there are still significant gaps in the scientific understanding of microplastics; for example there is no internationally recognised definition of what a microplastic is. Although the most commonly used definition in scientific literature is synthetic or polymeric particles between 1µm and 5 mm in diameter. In terms of the scale of the issue, it is estimated that around 42,000 tonnes of microplastics are released into the environment each year in the European Union (EU), the largest source being granular infill material used on artificial turf pitches. Microplastics are particularly problematic as they are resistant to microbial and other forms of breakdown, meaning that it is predicted to take 300 – 500 years for a typical (polyethylene) microplastic particle to completely breakdown.

Microplastics are typically split between primary and secondary. Primary microplastics are plastics that were manufactured to be small in size. Secondary microplastics are plastics that have degraded from larger pieces via chemical, physical or biological processes to become smaller in size. Due to the ubiquity of plastics within the environment, some microplastics ultimately find their way into wastewater; the main sources in wastewaters are from tyres, fibres (from polyester, nylon and acrylic

clothing – i.e. microfibres), cosmetics and exfoliants (i.e. microbeads), certain industrial processes and fragmentation or degradation of larger plastics. It is worth noting that a ban on the sale of products containing microbeads came into force in the UK in 2018.

Microplastics in biosolids and other sources

Various studies have shown that wastewaters contain both primary and secondary microplastics (such as hygiene and cosmetic products, synthetic textiles, run off from industrial businesses, etc.). Recent studies have shown that > 90% of microplastics from treated wastewater are retained in the solid (sludge) fraction, however, most studies have focused on a limited number of works. Analysing for microplastics in any medium is difficult, but particularly so for wastewaters and sewage sludges where there is no standard accepted methodology. Plastic production has continued to increase year on year, with over 400 million tonnes of plastic being produced annually. It is estimated that over 9 billion tonnes of plastic have been produced in total, with almost 80% in landfill or still in the environment (the remainder being recycled or incinerated). As such, despite not having accurate figures on microplastics in the environment, it would seem logical that the amounts of microplastics in wastewater have been increasing in recent years. Calculations have been attempted based on analysis of limited treatment works, but there have been significant variations in quantities found. It is clear more research is required to determine types and quantities of microplastics in UK biosolids and the affect this may have on agricultural land and the wider environment.

Biosolids are by no means the only potential source of microplastics introduced to agricultural land. Given that most non-farm organic materials recycled to land (e.g. compost and anaerobic digestate) contain plastics, it would be reasonable to assume they also contain microplastics. Other likely sources include irrigation (especially from surface waters), littering, atmospheric deposition and through degradation of plastics used in agriculture (e.g. covering crops, polytunnels, protective fleece, covering/wrapping silage, agricultural packaging such as feed and fertiliser bags). However, as with biosolids there is a lack of reliable data on the types and quantities of all microplastics that are being inadvertently introduced to agricultural land.

Potential risks associated with microplastics

Recent research on microplastics split concerns between physical and chemical effects. Physical effects are when the small size of microplastics block ducts, damage tissue or cause the plastics to accumulate in tissues or organs. Many studies have been undertaken finding microplastics in marine organisms (e.g. plankton, bivalves, fish, crustaceans), including experimental evidence of microplastics moving between levels in the food chain. There have been less studies in the terrestrial environment; however, new research has started to emerge regarding the effect of microplastics in the environment. Studies have begun looking into the impact of microplastics on human health via trophic transfer within the food chain. Other studies conducted indicate that there could be some potential impacts and negative effects on soil health and crop productivity by crop uptake of microplastics, but it is a topic which requires further investigation.

Impacts to soil physiochemical properties include but are not limited to; altered soil structure, nutrient immobilisation, contaminant transport or absorption, direct toxicity and influence of soil microbial communities. A study concluded that certain microplastics in certain soil conditions can impact soil enzymes such as urease and phosphatase which play a role in Nitrogen and Phosphate recycling as well as alter carbon and nutrient cycling through dissolved organic matter. Other studies have found

that microplastics alter soil pH in varying conditions such as in alkaline soils they increase soil pH and in acidic soils they lower pH.

Chemical effects can be split into direct and indirect effects; direct effects result from the degradation of the plastic, causing the release of potentially harmful chemicals and; indirect effects are where potentially harmful chemicals absorb onto the microplastic and are released later. These chemicals are typically from additives used during the plastics production or from the environment. Some types of plastics have been shown to have high sorption capacity for a range of persistent organic pollutants. This is confirmed by studies which have found microplastics from beaches around the world containing a range of persistent organic pollutants (e.g. PAHs, dioxins and furans, PCBs, pesticides). It is unclear if microplastics are a source of chemical exposure in the marine and terrestrial food chains.

Microplastic contamination is increasing worldwide and more studies are investigating potential risks. Some (but by no means all) studies have found that microplastics can affect soil physiochemical properties, but the extent is unknown and requires further study as well further research to monitor and evaluate the direct impact and potential biological and ecological risks. Through phase 4 of the Chemical Investigation Programme the water industry is investigating these and other concerns.

Controls on microplastics

In 2018, the UK Government banned the manufacture and sale (including imports) of cosmetics and personal care products containing microbeads. However, as detailed above there are multiple sources of microplastics, meaning for the majority of them, a ban on production/sale is not possible (e.g. microfibres, tyre fragments). Wastewater and sludge treatment operations include screening processes to remove larger material. However, screening processes are unlikely to work for microplastics. As such, the emphasis must be placed on prevention/reduction at source; this may include requirements for improved filtration in clothes washing machines and increasing public awareness. A Private Members' Bill was introduced in 2022 that would require manufacturers to fit filters to catch microplastics; at the time of writing it was awaiting it's second reading in parliament. A report published from Business in the Community (BITC) concluded that contamination must be moderated at source as extracting substances from wastewater treatment processes is challenging and will be costly for the water consumer. Moreover, the report found that a collaborative approach was necessary to prevent the use of pollutants by designing out hazardous elements and preventing pollutants entering the wastewater system.

The EU launched its Plastics Strategy in early 2018 following its action plan for the Circular Economy. As part of this, the EU Commission started the process to restrict the use of intentionally added microplastics (e.g. microbeads in personal care products) across the EU. The strategy also endorses an industry agreement between European industry associations connected with the production and maintenance of clothing, which aims to address the release of microplastics from textiles into the aquatic environment as well as calling for other cross-industry agreements. In late 2018 the EU Commission launched a Circular Plastics Alliance (CPA) to help increase the recyclable content in plastic products by mobilising action from all stakeholders such as plastic producers and designers as well as through brands and retailers. This is in line with the European Plastics Strategy. The key objective of the CPA initiative strives to achieve the target set by the Commission to get ten million tonnes of recycled plastic into new products in the single market by 2025. In 2019, a resolution was adopted by the United Nations Environment Assembly regarding marine plastic litter and microplastics which stressed the importance of sustainable management of plastics and microplastics through

numerous pathways including but not limited to waste management and international cooperation for effectively preventing pollution from marine litter. This requires member states to reduce discharge of microplastics by phasing out of products containing microplastics, fostering innovative designs to reduce microplastic release by improving waste management and prevent losses via the manufacturing and supply chain. The UK Water Industry is working with Government, the Environment Agencies, industry experts and other stakeholders to assess the sources, types, concentrations and impact of microplastics on the environment and human health. The UK Water Industry Research (UKWIR) is currently undertaking a study specifically investigating microplastics throughout the water and wastewater processes. The BITC initiative complements the work being conducted by the UK Water Industry and Governmental bodies whereby collaboration between the various stakeholders and businesses to identify the current problem and explore potential solutions is the only way to achieve a positive outcome. The approach of focusing on inputs is key to a long-term solution, however, the water industry is also investigating options to remove microplastics (along with other contaminants) from sewage sludge and/or biosolids.

Conclusions

It appears that the types and quantities of microplastics entering wastewater treatment have increased, primarily due to the growing use of plastics in domestic products combined with a lack of consumer awareness of their fate, and a large proportion of these are deposited in biosolids. Further action is needed to prevent microplastics entering wastewater to mitigate the quantity of microplastics entering the environment. Additional research is required to investigate the concentration of microplastics as well as the identification of types, size, shape, composition, etc. that will allow greater understanding of their fate and behaviour within soils.

However, there is currently no evidence to indicate that recycling biosolids to agricultural land poses any significant risk from an environmental and human health perspective. The UK Water Industry supports investigative research while continuing to beneficially recycle biosolids to agricultural land, which is consistent with a Circular Economy.

Due to a shortfall in information and the level of public and media interest, further research is required to generate a robust evidence-base including:

- Research on microplastics in wastewater sludge and biosolids and their potential impact on the environment and human health and;
- Reviewing new evidence as it arises and responding accordingly and;
- Regularly consulting with food chain stakeholders and keeping them and other interested parties informed on progress.

There needs to be a cross-sector approach involving not just the Water Industry, but all sectors (e.g. manufacturers, researchers and regulators) to understand the issues associated with microplastics and find sustainable solutions to this important issue. Collaborative meetings conducted by BITC are a good example of how businesses should work together to ensure that biosolids can continue to be recycled to agricultural land in a safe way. Also, it is important that the water industry continue to investigate methods to remove microplastics from sewage sludge and/or biosolids.

Assured Biosolids will review this position statement as further evidence becomes available.