PLASTICS AND MICROPLASTICS IN DIGESTATE BIOFERTILISER

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Contents

Legal Disclaimer:

Biofertiliser producers are not legally obliged to obtain accreditation. Accreditation is voluntary for those producers who wish to benefit from membership of the Bioenergy Association Accreditation Scheme.

Please note that the terminology 'digestate biofertiliser' and 'biofertiliser' are used interchangeably within this document.

The purpose of this document is to assist producers demonstrate their facility meets industry best practice in the production of Fertmark certified digestate biofertiliser.

Compliance with this publication cannot confer immunity from legal obligations.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application. In addition to the requirements of this, for application in New Zealand attention is drawn to the following statutory requirements:

Animal Products Act 1999

Animal Products Regulations 2021

Agricultural Compounds and Veterinary Medicines Act 1997

Biosecurity (Ruminant Protein) Regulations 1999

Resource Management Act 1991

Document Control

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It must be reviewed and updated as it is considered appropriate.

Triggers for review could include new information from research including field trials, pollution incidents, a change in the market, a change in legislation or case law.

Updates to will only be made if approved by the Bioenergy Association.

Each version of the document will have a version number and a control sheet which will record its status and a brief comment about the changes that have been made to it.

The document and any associated papers will be published on www.biogas.org.nz

Version	Status	Bioenergy Association approval	Date	Significant changes from previous version
1	Consultation draft			

Executive Summary

The topic of plastic and microplastics in digestate is an emerging issue for the recycling of organic waste into beneficial end products. This technical note reviews the current science and knowledge base about plastic and microplastics and the prevalence of these in digestate. The Digestate Biofertiliser Certification Scheme (DBCS) recognises that quality limits exist for plastic content in digestate, however there are differences between countries about what amount of plastic is acceptable. There are no regulations in any country that control the acceptable level of microplastics in digestate. Furthermore, there is a lack of agreed standardised methodology for testing microplastics in digestate. Interventions are available at all points in the value chain that can minimise the occurrence of plastic (and therefore microplastic) in the digestate.

As the authors of the DBCS, the Bioenergy Association has researched the latest scientific evidence to inform the quality standards for plastic and microplastic for the biofertiliser. The findings and recommendations presented in this Technical Note represent current international knowledge and management practices for minimising plastic and microplastic in digestate. The DBCS will continue to watch developments from around the world and in New Zealand for the most up to date information on these contaminants.

1.0 Plastic

- Commonly plastic enters the input stream as a residue from food packaging or gross contamination.
- The type of feedstock influences the degree of plastic contamination of the digestate.
- Contamination in USA is similar to that in Europe. Italy has low (1.5%) plastic contamination in food scrap collection because of compostable bag liners, reusable containers and decontamination equipment at the AD facility. (*USEPA Emerging Issues in Food Waste Management: Plastic Contamination).*
- There is limited data on plastic levels in digestate. The Scottish Environment Protection Agency (SEPA) has found 0.01 – 0.39% dry weight in digestate. Of this, the lower values were found in AD facilities that had post processing screening and accepted only high-quality feedstocks. (*USEPA …)*

Industry standards and regulations for plastics have been implemented in many countries but there remains no clear consensus on what an acceptable level of plastic (and microplastic) contamination in digestate is.

There is no standard test for plastic contamination of digestate in NZ, so the DBCS has used the digestate testing requirements and associated physical contaminant limits from PAS110:2014 (NRM JAS-497/001 [N3]. The contaminant limits are determined using a method involving wet sieving, hand picking of contaminants and gravimetric determination of their % abundance on a fresh weight basis. The particle size is greater than 2mm so this includes some microplastics. The specification limits are based on nitrogen content in the digestate.

The PAS110 test does not segregate plastic from other contaminants such as glass and metal, see Table 1. In a partial data set held by the UK Digestate Certification body REAL, it was found that plastic is the dominant physical contaminant material in 98% of digestate tested (REAL, Plastic Contamination….)

Table 1 - PAS 110 PCs Limits based on nitrogen content of digestate

Total Nitrogen (kg/t)	less than 1	1 to 1.9	2 to 2.9	3 to 3.9	4 to 4.9	5 to 5.9	6 to 6.9	7 to 7.9	8 to 8.9	9 or more
Physical Contaminants (kg/t)	0.04	0.07	0.11	0.14	0.18	0.22	0.25	0.29	0.32	0.36

Further to the limits of physical contaminants in Table 1, the New Zealand DBCS has adopted the SEPA limits for plastic which are stricter than PAS110 (these are 8% of PAS110), see Table 2.

Table 2: Digestate Physical Characteristics

Total N of Biofertiliser	Kg/t	<1	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	9 or more
Total Contaminants >2mm	**Kg/t**	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
Total Stones >5mm	**Kg/t**	3.2	6.4	9.6	12.8	16	19.2	22.4	25.6	28.8	32
Authorised Analysis Methodology NRM method JAS-497/001 declared on a fresh weight basis or Accredited methodology at accredited laboratory (NZS ISO/IEC 17025 and/or recognised by IANZ)											

Current international testing for plastic contamination in digestate does not differentiate between plastic and compostable plastic.

A study by WRAP (Plastics in Compost and Digestate) found that it is currently not possible to suggest evidence-based limits for plastics in compost and digestate. There is a need to standardise analytical techniques and reporting metrics. Some test methods report on fresh weight such as PAS110, but outside the UK results are reported on a dry weight basis, and others, such as Germany report on the number of plastic pieces per area.

2.0 Management Controls to Minise Plastic in Digestate

- Central government bans on different types of plastic, eg, numbers 3, 4, 7 as well as plastic bags, takeaway plates and cutlery, etc reduce the amount of plastic in circulation in society.
- Central government standardisation of kerbside food scrap collections make it clear that no plastic or compostable packaging is accepted. Only material that originated as a 'food' from a household kitchen is suitable for collection.
- It is important that the AD facility has a contract with its suppliers (waste companies, local councils) that has an agreed quality standard and contamination limit.
- Kerbside food scrap collections by councils have regular inspections on the contents of the bin and tagging of the bin to indicate materials which do not comply.
- Education and outreach programmes to inform and encourage correct use of kerbside collections.
- Stakeholder meetings, eg packaging manufacturers
- Depackaging equipment, screening of digestate before and post pasteurisation
    - Combination of screening pre and post maturation are capable of meeting the lower SEPA limits (*WRAP plastics in compost and digestate)*

- The issue of plastic (and microplastic) contamination in the incoming feedstock and end product is identified in the QA and HACCP documentation at the AD facility with adequate processes to monitor and measure plastic.

3.0 Microplastics

Microplastics (MPs) are derived from the physical, chemical or biological breakdown of plastic into smaller fragments. Plastics have been found in freshwater, marine and terrestrial environments. Research on occurrence of microplastics in food waste derived composts and digestates is at an early stage.

- Anything in size from 1µm to 5mm
- Now ubiquitous in the environment (air, water, food and packaging, soil, personal care products).
- Early evidence suggests that macro (>5mm) and micro (<5mm) plastic is present in many food waste derived composts and digestates. (*Porterfield*)

No country has regulations for the acceptable concentration of microplastics <1mm in soil because there is insufficient data (USEPA). There is no standard method for measuring MPs in digestate (Porterfield et al). Testing in these matrices is challenging, requiring separate extraction and identification/quantification techniques.

It must be noted that digestates (and compost) represent only two potential sources of plastics in soils. Others include sewage sludges, runoff from roads, aerial deposition and littering. (Tompkins, 2022).

In NZ, the Eunomia report to MfE recommended a standard method of analysis is needed to develop the science that will set thresholds for microplastics <1mm. Work is required to establish a NZ testing system.

Research is underway at the University of Auckland to identity and test for microplastics. Recent study looked at presence of microplastics in the coastal marine environment. It indicated the widespread occurrence of microplastics in sand and seawater from Auckland beaches. The research team utilised advanced laser direct infrared imaging techniques to identify plastics, including polyethylene terephthalate (PET), nylon, polyurethane (PU) and polyethylene (PE), which are widely used in packaging, coatings, footwear and textiles.

Controls and management of microplastics in digestate are the same as for plastic, see above.

4.0 Microplastics and Human Health

Plastics are generally considered to pose a low risk to human health, however the additives used in the manufacture (e.g. plasticizers) or those that become adsorbed from the surrounding environment (e.g. heavy metals) have been associated with human health effects although an understanding of the role MPs play in transferring them to humans is still in its infancy. The characteristics and levels of chemical contaminants associated with MPs in New Zealand are unknown and require study. (ESR Microplastics in the Diet)

In 2018, NZ Food Safety undertook a literature review of the occurrence of microplastics in food and to identify what work is needed to determine dietary risks with microplastics in the environment. The study concluded that the dietary risk to microplastics cannot be determined at this moment. For example, the MP loads in shellfish in NZ is highly uncertain as there are currently no data available

for the levels of MPs in shellfish grown in NZ waters. It is expected that seafood is the greatest source of MPs in the diet, however an increasing number of studies are showing their presence in other food sources.

ESR undertook a health risk assessment on microplastics in 2022 and found that there was limited conclusive evidence related to the health effects of MPs on human health and therefore the risks remain unclear and further research is required.

5.0 References

USEPA – Emerging Issues in Food Waste Management: Plastic Contamination.

Porterfield, Hobson, Neher, Niles, Roy: Microplastics in Composts and Digestates – a Review

University of Auckland https://www.auckland.ac.nz/en/news/2023/12/18/microplastics-pollution-auckland-coastal-environment.html Contains link to study

ESR Health Risk Assessment: Microplastics December 2022

Eunomia Contaminants Present in Organic Waste: Phase 3 Management Framework and Thresholds Report. Prepared for MfE.

NZ Food Safety, Risk Profile: Microplastics in the diet. Olga Pantos (ESR), Peter Cressey (ESR), Jeane Nicolas (NZFS).

REAL, Plastic contamination in end of waste compost and digestate products in England.

Tompkins, D. Tackling Plastic Contamination

WRAP Plastics in Compost and Digestates