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Contaminants Present in Organic Waste: International Review

Prepared for Ministry for the Environment

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1.0 Audience and the Purpose of the Report

1.1 Introduction

MfE commissioned Eunomia Research & Consulting, Whetū Consulting Group, and Massey University, to examine issues of contaminants in organic waste. The project aims to understand and address the challenges posed by contaminants in our organic waste material streams in order to mitigate risks to soil, human and animal health and expand end markets for processed organic waste. The project outputs will build on existing knowledge and standards and provide clear action recommendations for addressing the contaminants challenge.

The report is one of a series in the project's three phases:

Phase 1: Review of Regulations and Guidelines

- Establish framework
- Review of NZ standards regulations and guidelines
- Review of international practice (this report)
- Gap analysis

Phase 2: Engagement and End Markets

- Develop stakeholder engagement plan
- Tangata Whenua engagement
- Industry engagement
- Analysis and reporting

Phase 3: Recommendations

- Draft recommendations
- Review by Tangata Whenua and industry
- Final recommendations

1.2 Purpose

This report reviews international practice around management and control of contaminants in organic waste streams. It is not intended to be comprehensive but to provide a synthesis of how these issues have been tackled in different jurisdictions. It attempts to draw out lessons that can be applied to the New Zealand context.

2.0 Introduction

Conceptually it is possible to attempt to control contamination at several stages in the chain, and this chapter is structured on this basis. Defining product standards – either as minimum standards, or maximal permitted levels of contamination for outputs that are not classed as 'products' - is a common approach and is dealt with first. While this approach typically focuses on the output material, it can also involve regulation of the way in which outputs are subsequently applied (particularly with practices like land-spreading).

However, such an output-centred approach can be replaced (or more often supplemented) with direct process controls or standards for treatment of organic material. Finally, attempts to control contamination can focus on input streams and processes. Most obviously this relates to collection approaches (and the behaviour of those disposing of waste into them), but approaches can also include actions further upstream which seek to change product design, so that items or materials are less likely to be included in a waste stream or will no longer count as contaminants if they do occur.

The nature of 'contamination' and how it can be best regulated may also change at these different stages. At collection stage, interventions typically focus on particular items (or item and material combinations) that cause problems later and do so in terms that make operational sense for individuals, households, and businesses. In controlling contamination in processes and, especially, outputs, the focus starts to move increasingly to substances, whether these are material (e.g., microplastics), chemical, or biological in nature.

Regulation of contamination is very often product, process, or waste stream specific rather than a comprehensive regulation of all routes for organic waste management, with specific stream sometimes posing unique challenges, or falling under scope of different regulation at different stages in the value chain. For example, biosolids have unique features which set them apart, but other streams, such as post-consumer food waste are also subject to more specific regulation or restriction on use or treatment in many jurisdictions. Individual waste streams recur more than once in subsequent sections in cases where there is scope to regulate at multiple stages of the waste value chain.

3.0 Tackling Contamination by Defining Product Standards

Product standards can include requirements on outputs, processes, or inputs, but all relate to controlling how the end product can be classified and used.

3.1 Regulation and Voluntary Approaches

Countries have used a range of different approaches to defining organic waste (termed 'biowaste' in Europe and the UK) products in ways designed to directly or indirectly control contamination. Both mandatory (statutory) and voluntary approaches have been used, and consideration may need to be given to both objective standards and building market confidence in the product.

There are certain characteristics that tend to be covered by the different approaches; in this respect, it is noted that statutory limits are more frequently used to define the precautionary elements of the management system, such as heavy metal contamination limits in place for compost products in most European countries, for example.

In contrast, an earlier review of the international practices on compost production nonetheless considered that voluntary standards defining quality assurance schemes play an important role in developing the confidence in the product[1]. They do this by setting standards that go beyond what is controlled by the regulator, so that the quality achieved conforms to that demanded by the market when it comes from a product ready for sale. In Europe some of these standards have been in place for several decades in countries with relatively advanced biowaste management sectors, such as Germany and Austria.[2] A combination of voluntary schemes supported by mandatory elements commonly has been used to this effect.

It is important to note that requirements placed in statutory standards are likely to be less easy to change than is the case with voluntary standards, since what is contained within them typically has some form of legal status. Limits of this nature are likely to be need some considerable negotiation with stakeholders to put in place and will also require greater input from government regulators.

In this respect, ways to combine the voluntary with the statutory approaches – with a view to retaining some flexibility in respect of updates - were set out in the previous review of international compost standards set out by WRAP. The review suggested that,

[1]WRAP (2002) Comparison of Compost Standards within the EU, North America and Australasia: Main Report

[2] Austrian Parliament and the Federal Ministry of Agriculture, Forestry, Environment and Water Management (2001) Ordinance on Quality Requirements for compost from waste, available from: http://faolex.fao.org/docs/pdf/aut90980.pdf; Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, Germany (2012) Translation of the Wording of the Bio-Waste Ordinance as Valid since 1 August 2012, available from: https://www.bmuv.de/en/law/amendment-to-ordinance-on-biowastes-bioabfv-2012

for countries looking to introduce a source-separation system, countries could look to introduce:[3]

> *…. a minimum range of precautionary requirements when it comes to the extent of the legal regulations for biological waste treatment. After a certain period of development and experience with the system, a more practical approach which more accurately corresponds to the country-specific conditions can be developed (and implemented through statutory regulations if so desired). This enables a degree of flexibility to be retained in the system as it develops (the more that is not binding by law, the better from the point of view of flexible development). Evidently, the degree to which this approach is feasible also depends on the degree to which regulators and policy-makers are willing, or able, to retain such flexibility.*
>
> *If the statutory standard is limited to basic precautionary requirements, it ought to be accompanied by a flexible instrument such as voluntary quality assurance systems. If the statutory standard refers to the voluntary standard, the latter becomes "quasi" statutory.*

Such an approach could potentially be considered by the MfE when combining the voluntary and statutory approaches.

3.2 Chemical, Material, and Biological Contamination Controls

Statutory limits covering potentially toxic elements (PTEs) are a key aspect of most compost standards. WRAP's 2002 review of compost standards found that those countries where separate collection is furthest advanced - and where compost production was highest - had statutory limits for PTEs in place in some form[4].

In Europe, historically, the focus has been on soil protection, preventing the build-up of toxicity in the soil through limit values. Limits are commonly in place in European countries where biowaste collection is advanced covering the following:

- Heavy metals – limits for a whole range of contaminants being specified, typically in mg/kg dry matter (dm) of compost;
- Physical contaminants - often these are specified down to a specific size (e.g. > 2mm) for key materials such as plastics and glass;
- Weeds – restrictions on the presence of weed seeds are in place for some;

[3] WRAP (2002) Comparison of Compost Standards within the EU, North America and Australasia: Main Report
[4] WRAP (2002) Comparison of Compost Standards within the EU, North America and Australasia: Main Report

- Other types of contaminants e.g. persistent organic pollutants – typically specified in mg/kg dm of compost. This is usually related to specific pollutants, e.g. DEHP in Denmark. The approach may also vary depending on the compost class - Austria has specified limits for PCB and PAH for mixed waste compost (from MBT plants) but not for compost produced from source segregated feedstocks.

Limits are typically set for the concentration that is permitted within the compost or soil product output. The product limits may be further supported by complementary standards on the loading of contaminants per unit area.

Some standards also include limits on pathogens such as E-coli and Salmonellae; this may also be tackled through the sampling and testing regimes.

Contamination limits may need to be considered alongside nutrient loading levels. There are typically controls on the amount of key nutrients that can be spread on land – this is particularly the case with nitrogen. This, in turn, may limit the amount of soil products that can be spread within a certain time frame – particularly where these contain readily available nitrogen, such as raw digestate. In many cases, the nutrient loading levels may trump the contamination limits. In this respect, biowaste legislation may be set to work in tandem with fertiliser legislation – this is the case in Germany with its respective biowaste and fertiliser ordinances. Further related controls could consider the rate of application of the product – this was the intention of the draft of the European second biowaste directive (which was not implemented). Application rates are a key element of the biosolids standards and "obligations for use" are included, which specify the type of soils where spreading can occur[5]. The legislation for biosolids is often covered in different legislation to that covering the compost produced by source segregated biowaste – this is the case in Germany, for example, where biosolids are covered in separate legislation on sewage sludge rather than in the Biowaste Ordinance[6].

Regulatory regimes may require the assessment of the heavy metal content to be standardised against a specified organic matter content. As compost matures over time, the level of organic matter declines – a mature compost might have only 30% compared to a level of 60% in a fresh product. In effect, the heavy metal content becomes more

[5] Collivignarelli M, Abba A, Frattarola A, Miino M, Padovani S, Katsoyiannis I and Torretta V (2019) Legislation for the Reuse of Biosolids on Agricultural Land in Europe: Overview, *Sustainability*, 11, pp6015

[6] Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, Germany (2012) Translation of the Wording of the Bio-Waste Ordinance as Valid since 1 August 2012, available from: https://www.bmuv.de/en/law/amendment-to-ordinance-on-biowastes-bioabfv-2012

concentrated as the compost approaches maturity. More clearly defined standards – such as the German Biowaste Ordinance - therefore include this type of stipulation[7].

In practice, approaches to the regulation of these statutory limits can vary between countries. It is therefore not enough to compare maximum allowable concentrations for a common range of heavy metals in composted materials as a means for comparing the product standards in different countries. Such comparisons also need to take into account the approach to implementing the limits in standard. It is thus important to compare tolerances around the limits alongside what has been defined as the actual limits. General approaches to managing these aspects are:

- fixing a comparatively low but strict limit, but allowing considerable variation around that limit, or
- establishing a moderate limit and allowing relatively little deviation from it.

Irrespective of which approach is used, if the limits and / or the implementation of them is too strict there is a further risk that no product can meet the required specification, which in turn has the result of stifling the market; so defined limits have to be realistic. Enforcement of the standards is achieved by a sampling / testing regime, characteristics of which are set out subsequently in this section.

Given the divergence of standards across Europe at the time, a European Quality Assurance Scheme for compost and digestate products was put in place in 2007, with the aim of harmonising standards on compost quality[8]. It covered compost, digestate, sludges and mulch, and included – for contamination controls – limits for heavy metals, salmonellae, physical impurities and germinable seeds and plant parts. This has been more recently superseded by the EU Fertilising Regulation, which was approved in 2019[9]. However, the existing standards in many European countries were higher than those included in the European standards (including the regulations). Reflecting the national variation, the Fertilising Regulation is optional.

3.3 Distinguishing Different Compost Classes

Some countries define multiple compost classes, which may relate to different types of feedstocks; for example, there could be different standards relating to biosolids outputs from those in place for compost produced from food and garden waste.

[7] Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, Germany ibid.

[8] ECN / Bundesgutegemeinschaft Kompost e.V (2007) European Quality Assurance for Compost: End-of-Waste Workshop on Compost

[9] European Commission (2019) Regulation (EU) 2019/1009 of the European Parliament and of the Council

Within each of those standards, feedstocks may be prescribed still further with the aim of controlling contamination levels. Such controls relating to compost from food / garden waste might be:

- The feedstock is required to be from a source segregated organic waste collection system (collecting food and / or garden waste);
- Paper may not be permitted;
- Some types of wood may be permitted;
- Food residues / by-products may be restricted (sometimes lists are provided).

This type of stipulation is in place for the PAS standards used in the UK for compost and digestate production. Typically, materials for feedstocks are more likely to be ruled in than ruled out, to prevent loopholes.

Standards may relate to specific agricultural systems; a different compost class may be used for organic agriculture compared to conventional. Austria's system developed with three classes of compost, the top grade being suitable for organic farming, and further classes being defined for conventional and non-farming uses. These classes, in turn, have different statutory limits for contamination; this is discussed further subsequently in WRAP's analysis.

In general, the definition of multiple standards within a given country can cause some confusion amongst product consumers; there is a tendency for the highest standard to be preferred, with no market being available for the standards perceived to offer poorer protection.

Feedstock controls often work in tandem with other defined elements of the standard, such as the statutory limits for the potentially toxic elements, with a combination of these being used to define the different classes. This is discussed further in the next section.

A key element is that the compost standard defines the point at which material arising through the waste system ceases to be considered as waste, which, in turn, occurs once the product standard has been met. Outputs from biowaste treatment processes that do not meet the standards, by contrast, may be considered to remain as waste, and are subject to tighter controls; permits may be required to spread such material on land. This is the case in Italy for digestate which has not been through a post-digestion composting stage – with such permits being difficult to obtain.

3.4 Contamination Limits in Place for Different Feedstocks

Contamination limits for selected European countries are presented in Table 1. Data are presented for three countries where biowaste collection is now well established, and where limits have been in place for some time – in the case of Austria, the legislation has been unchanged for more than 20 years. It can be seen from the table that there is considerable variation in these limits. However, as was discussed previously, the values themselves need to be also considered in the context of the regulatory regime that is in place to monitor the limits.

There has been a tendency for the limits on the physical contaminants in compost and digestate to become progressively tightened over time in response to further concerns over the potential for microplastic pollution; this has been the case for both Austria and Germany in the past decade, whilst levels at the European level are also anticipated to be tightened, such as those contained with the EU Fertilising Regulations.

Table 1: Limit Values from Selected European Countries

Parameter	Austria				Germany		Italy		
	Class A + Organic	Class A Agriculture	Class B Reclaim (limit)	Class B Reclaim (guide)[3]	Application rate: 20 tonnes dm / 3 years	Application rate: 30 tonnes dm / 3 years	Green Compost	Biowaste compost	Sludge Compost
Cu, mg/kg dm	70	150	500	400	100	70	230	230	230
Zn, mg/kg dm	200	500	1800	1200	400	300	500	500	500
Pb, mg/kg dm	45	120	200	-	150	100	140	140	140
Cd, mg/kg dm	0.7	1	3	-	1.5	1	1.5	1.5	1.5
Ni, mg/kg dm	25	60	100	-	50	35	100	100	100
Hg, mg/kg dm	0.4	0.7	3	-	1	0.7	1.5	1.5	1.5
CrVI, mg/kg dm	70	70	250	-	100	70	0.5	0.5	0.5
Tl, mg/kg dm[1]	-	-	-	-	-	-	2	2	2
Impurities ≥ 2 mm^2	0.2%	0.2%	1%	1%	-	-	0.5%	0.5%	0.5%
Impurities ≥ 1 mm^2	-	-	-	-	0.4%	0.4%	-	--	
Stones ≥ 5 mm					5%	5%	5%	5%	5%
E-coli, CFU / g	-	-	-	-	-	-	1,000	1,000	1,000

Salmonellae, MPN	-	-	-	-	Absent in 50g	Absent in 50g	Absent in 25g	Absent in 25g	Absent in 25g
PCB, mg/kg dm	-	-	1	1	-	-	-	-	0.8
Notes **1. For compost made with algae** **2. Plastics, glass, metals** **3. If limit value for class B is exceeded, this is to be marked within labelling**									

Sources: Austrian Parliament and the Federal Ministry of Agriculture, Forestry, Environment and Water Management (2001) Ordinance on Quality Requirements for compost from waste, available from: http://faolex.fao.org/docs/pdf/aut90980.pdf; Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (2012) Translation of the Wording of the Bio-Waste Ordinance as Valid since 1 August 2012, available from: https://www.bmuv.de/en/law/amendment-to-ordinance-on-biowastes-bioabfv-2012; CIC (u.d.) Presentation of the CIC's Quality Label for Compost, available from: https://www.compostnetwork.info/wordpress/wp-content/uploads/CIC-QAS-Activity-Report.pdf

The approach taken to managing biosolids varies across Europe; there are some countries where the practice of land spreading is much more common, and others where incineration is the more widely used approach (the latter tends to be the Northern European countries with less soil availability for land spreading). European countries where more land spreading takes place are the UK, Ireland and Portugal.[10] Contamination limits have been set out in a recently published academic paper; this shows that the Portuguese limits, for example, sit roughly mid-way between the top and bottom limits, whilst those of the Netherlands are amongst the tightest. All of them have coverage of heavy metal pollutants but not all of them specify limits for organic compounds. It is noted there are also limits for physical contaminants in some standards (the previously cited paper does not specify which ones). A further source confirms that there can be tighter regional controls in some countries for the spreading of biosolids than is the case at the national level – this is the case in Italy, for example.[11]

Some countries have specific limits for the stabilised outputs from MBT facilities; in some such output is given a specific, lower, compost class: this is the case in Austria, for example, with its Class B compost.

No limits are currently in place within the European standards for persistent organic pollutants such as PFAs. There is relatively little discussion on this in the European context. Commentary on difficulties in setting such limits does exist, however, from entities in the US – where some jurisdictions require some testing for this form of contamination for biosolids in particular. Here the literature confirms that it is highly likely that compost made from biosolids or food waste will contain some PFAs.[12] The difficulty in testing for such contaminants is noted. It is further noted that key sources of PFA contamination include food packaging, such as compostable or bioplastics and pizza boxes (or other coated card items). In the case of compostable plastics, the European approach has been to update EN-13432 (the standard for compostable plastic) to ensure that compostable plastic certifiable to the standard does not contain PFAs; this update was put in place in 2022. This is consistent with an approach suggested by the US Organics Recycling Authority which suggests that PFAs should be removed from product streams likely to end up in composting, rather than imposing limits (which are difficult to monitor) on the compost itself.

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[10] Collivignarelli M, Abba A, Frattarola A, Miino M, Padovani S, Katsoyiannis I and Torretta V (2019) Legislation for the Reuse of Biosolids on Agricultural Land in Europe: Overview, *Sustainability*, 11, pp6015

[11] Collivignarelli M, Abba A, Frattarola A and Benigna I (2020) The reuse of biosolids on agricultural land: critical issues and perspective, *Water Environment Research*, 92, pp11-25

[12] Biocycle (2021) Connections: A Dose of PFAs Reality, available from https://www.biocycle.net/a-dose-of-pfas-reality/

3.5 Sampling / Testing Regimes for the Different Products

Sampling / testing regimes are a further key element needed to implement the standards successfully, thereby building confidence in the product by ensuring limits are respected. Alongside tests on the specific pollutants defined within the statutory limits, testing may also look for the presence of pathogens such as salmonella and e-coli. In some countries germination controls are also used to test for the presence of weeds. Plant growth tests are also used – alongside, in some cases stability testing – to consider the maturity of compost and the extent to which plant growth may be hampered by the application of the product.

The quality of the sampling regime needs to be considered alongside the approach to applying the statutory limits. There are inaccuracies in the testing process; laboratories will be better at this than on-site testing. The stringency of limit values needs to be linked to the quality of sampling process employed. If strict limits are in place the error rate in the associated sampling process also needs to be taken into account. Key considerations include the cost and desired frequency of the sampling regime.

Most standards are accompanied by guidance on the sampling regime which confirms key information such as the frequency of sampling and the timing. In the case of the British PAS100 standard, for example, published documentation confirms the following expectations in respect of the sampling regime to be undertaken by product meeting the standard:[13]

- Sampling is required of all batches that are designated as meeting the standard during the week after the batch has completed the composting process – this may be after particle size screening (if appropriate) and is expected to be before blending with other materials such as wastes, products or additives
- A distinction is made between a validation and a post validation phase, and sampling and testing is further specified along these lines:
    - During validation, the sampling frequency is 1 sample from each of 3 different batches of the compost grade;
    - After validation, during routine operation, 1 sample is needed of every 2500 tonnes of compost grade produced; if less than 2500 tonnes is produced, the frequency is 1 sample representative of 1 compost batch.
- If any sample fails the quality parameters, this would trigger an investigation, and a change in sampling frequency.

[13] Compost Certification Scheme / Renewable Energy Assurance Limited (2020) Guidance on Sampling Composted Materials in Accordance with BSI PAS100:2018 – Version 2

- The guidance also provides detailed specifications on how to take a test, including the amount of sampled material required and when, in the week, this should be taken.

Similar guidance is in place for other European standards – in the case of the German Ordinance, the test specifications are included within the Ordinance itself.

There are also process inspection elements in many standards, such as the German biowaste ordinance; and the same ordinance also includes detailed specifications for carrying out the testing regimes, such as heavy metal content and phytosafety.[14]

[14] Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (2012) Translation of the Wording of the Bio-Waste Ordinance as Valid since 1 August 2012, available from: https://www.bmuv.de/en/law/amendment-to-ordinance-on-biowastes-bioabfv-2012

4.0 Tackling Contamination Via Process Controls

4.1 Biowaste Process Controls

WRAP's 2002 study confirms that controls on the biowaste treatment process are used to help mitigate some aspects of compost contamination, such as pathogen content.[15]

Process controls include regimes controlling temperature over specified time periods (i.e., pasteurisation or hygienisation). In-vessel composting treatment systems may be treated more leniently than windrow systems as far as process controls are concerned, since temperatures in the former tend to be higher. In some countries there are also links to the animal by-product regulations, which act as a further series of controls aimed at reducing the risk of compost contamination. UK regulations require source segregated food to be treated in in-vessel composting systems (and not windrows) for this reason, alongside requiring other process management steps such as foot-washing on entry / exit to the composting halls.

Typical regimes for composting plant require temperatures to remain above 55 degrees C (but below 65 degrees) for a specified period of time, with the length of time over which the temperature needs to be maintained varying across countries. Such stipulations are not, however, included in every standard; some countries (notably Austria) consider there is sufficient protection afforded by output specifications.

Whilst temperature controls are a key aspect of the regime – which typically require the compost reaches a specified temperature for a period of time - it is important to note that higher temperatures might also slow down the composting process itself. Pathogen control is not just about temperature; antagonistic breakdown of the microbial biomass during the compost maturation phase also plays a significant role in eliminating pathogens.

As a result of the variety of biowaste treatment processes available on the market, it is less common to see strict standards on process management, as these have potential to stifle markets; more commonly standards require testing on the outputs (products). In this respect, key tests are for bacteria such as salmonella and e-coli. However, process management standards exist in some countries such as the (voluntary) Dutch KIWA regulations, where there is an intensive internal production control system to be implemented by the plant, with results monitored by the certification organisation.

[15] WRAP (2002) Comparison of Compost Standards within the EU, North America and Australasia: Main Report

5.0 Organics Collection and Other Upstream Controls

5.1 Collection System Controls

Particularly in the case of biowaste collected from householders and businesses, collection system controls can be used with the aim of reducing contamination from non-target materials being placed in such collections. Key aspects include:

- Restrictions on what system participants can put into collections e.g. the types of bags that can be used for collection;
- The ability of waste collectors to reject loads (or bins) due to visual contamination.

In this respect, there are often links to laws on waste management which are in place in many countries, and which control source separation and separate collection. However, while collection design and service provision (for both organic and non-organic waste collection) can help deliver better quality organic feedstocks, in most contexts, correct use cannot be guaranteed. Outside of large-scale industrial waste generators (which are fewer in number and more likely to have more uniform, predictable, and consistently managed waste streams), there is a high level of dependency on human and business behaviour spread across a very large number of individuals, households, and businesses. Education, social norms, and enforcement around a well-designed (i.e. user-friendly) system can all support good behaviours, but are unlikely to eliminate all contamination (e.g. from food packaging waste that is not removed, from food waste container liners that are deliberately added, etc). Particular challenges to implementation are user understanding, especially in relation to 'bio' and 'compostable' plastics, and costs to businesses of de-packaging food before disposal.

5.2 Design and Use Controls on Common Contaminants

In recent years there has been an increasing focus on reducing the contamination of compost / digestate products arising from plastic. A further focus comes from the desire to reduce microplastic pollution, driven, in turn, by concerns on this in the natural environment which have arisen from more recent research on the topic. Plastic packaging is a common source of contamination during the organics collection process, due to both human and business behaviours as discussed above.

One approach being used to reduce the contamination in soil products produced from biowaste that arises from plastic bags is to introduce restrictions on the use of conventional plastic bags. Both lightweight and very lightweight carrier bags in countries where such controls have been put in place are instead produced from compostable plastic polymers such as starch. These bags can be used as a replacement for caddy liners used within the food waste collection since they are often made from similar (sometimes the same) polymers. Effectively this acknowledges the likely limitations of user behaviour and ensures that one of the most common sources of contamination is removed, without requiring actual behaviour changes.

Italy – the European country now collecting the most biowaste - has led the way in this type of control, implementing a ban on the use of conventional plastic carrier bags in 2011. Support for compostable plastic was enhanced by the development of the Consorzio Italiano Compostatori (CIC), which brought together the compostable plastics manufacturers with the biowaste treatment sector. Further support for the regime comes from the development of an EPR system aimed at compostable plastic products, which ensures there is sufficient funding for the cost of treatment via the biowaste systems.

The Italian ban on conventional plastic bags has not been completely successful; in 2020 (the most recent year for which data is available) there was still a significant quantity of conventional plastic carrier bag contamination.[16] The trend is for a reduced level of such contamination, however, and the data shows a steady increase in the quantity of compostable plastic bags (particularly lightweight carrier bags) used to collect the biowaste.

The recently issued (and still draft) EU Packaging and Packaging Waste Regulation aimed at putting in place a European-wide version of this ban for both very lightweight and lightweight carrier bags; currently the ban is likely to only be implemented on the very lightweight bags.[17] Supporting these bans there are standards in place in Europe placed on the compostable polymers, which cover aspects such as contamination levels in the compostable plastic bags, as well as the rate of degradation of the compostable plastic polymer. The key standard in this respect is EN-13432, although other countries such as Italy and Austria also have their own standards covering different types of products and biowaste situations (such as home composting).

Issues with this approach include the extent to which compostable plastics may cause problems with the biowaste treatment system – they cause operational issues in certain types of AD facilities and are therefore typically removed as contamination in this situation.

[16] Consorzio Italiano Compostatori (2020) Ottimizzazione del riciclo dei rifiuti organici: Sintesi dei risultati del programma di monitoraggio CIC – COREPLA (2019-2020)
[17] European Parliament (2022) Revision of the Packaging and Packaging Waste Directive: Briefing

6.0 International Treaties

One of the issues faced when attempting to prevent and mitigate contaminants in organic waste streams is the prevalence of a wide range of substances of concern flowing through the New Zealand economy including primary and secondary micro- and nano-plastic, and persistent organic pollutants (POPs) such as Polychlorinated Biphenyls (PCBs), Dioxins and Per- and polyfluoroalkyl substances (PFAS) (e.g. Perfluorooctanoic Acid [PFOA] and Perfluorooctane Sulfonate [PFOS]).

Most of these substances of concern are imported into Aotearoa as precursors, chemicals, polymers or as manufactured products (such as disposable coffee cups) where they are traded, consumed, and disposed of. All along their full life cycles these substances are released into the environment, including into organic waste and enter our food systems.

These substances are globally ubiquitous, and many are commonly found in household items. Many are also transboundary and are carried across jurisdictional boundaries in or on, migratory species, on tidal, fluvial and atmospheric flows, and via trade and tourism. Substances of concern are a global problem requiring global coordinated responses to assess their safety, sustainability, essentiality, and transparency and those of alternatives and substitutes; to reduce volumes and types produced, to conduct horizon scanning, and to monitor impacts, and support recovery and remediation.

Some of the multilateral environmental agreements that are relevant to substances with the potential to contaminate or pollute organic waste streams are listed below.

6.1 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal aims to reduce the amount of waste produced by signatories and regulates the international traffic in hazardous wastes. 191 countries globally have ratified the convention.

The Basel Convention requires prior approval of hazardous waste imports and exports and requires exporting countries to ensure that hazardous waste will be managed 'in an environmentally sound manner'.

The Convention emphasises the principle of 'generator responsibility' for disposal of wastes and requires parties to minimise the environmental effects of the movement and disposal of hazardous waste.

In addition to the Convention, regional agreements are also enabled. New Zealand is also a party to the Wagani Convention, which essentially prohibits any export of hazardous materials to the Pacific Islands or Antarctica, and the Organisation for Economic Coordination and Development Decision C(2001)107/FINAL (OECD Hazardous Waste Decision), which regulates sending hazardous waste between OECD countries.[18]

In practical terms, in NZ, imports and exports of hazardous wastes require a permit from the Environmental Protection Authority (EPA). The categories of waste and hazardous substances are covered in regulation[19].

In 2019 the Basel Convention was extended to include imports and exports of certain types of plastic waste. These came into effect from 1 January 2021. Exporters or importers must obtain a permit for any plastic waste that is not 'almost exclusively' one type of polymer. The only exception to this is where the material is a mixture of PE, PP and PET.[20]

6.2 Stockholm Convention on Persistent Organic Pollutants

The Stockholm Convention on Persistent Organic Pollutants is a multilateral environmental agreement that aims to protect human health and the environment by banning the production and use of some of the most toxic chemicals. It became international law and entered into force in New Zealand in 2004.

There are 30 chemicals targeted by the convention. They are grouped according to whether they are to be eliminated, restricted in their use, or whether they are unintentional by-products of specific processes.

New Zealand has a National Implementation Plan (NIP)[21] that sets out how we will meet our obligations.

The convention is implemented here in a number of ways, including:

- The Hazardous Substances and New Organisms Act[22]
- Imports and Exports (Restrictions) Prohibition Order (No 2) 2004[23]
- Hazardous Substances (Storage and Disposal of POPs) Notice 2004[24]
- A range of government agencies cooperate to set rules and implement POPs management.

The management framework includes management and clean up of contaminated land.

[18] Basel Convention | Ministry for the Environment

[19] Imports and Exports (Restrictions) Prohibition Order (No 2) 2004

[20] Imports and Exports (Restrictions) Prohibition Order (No 2) 2004 (SR 2004/202) (as at 01 January 2021) Schedule 3 Matters relating to hazardous waste and waste – New Zealand Legislation

[21] https://environment.govt.nz/publications/new-zealands-updated-national-implementation-plan-under-the-stockholm-convention-on-persistent-organic-pollutants/

[22] https://environment.govt.nz/acts-and-regulations/acts/hsno-act-1996/

[23] http://www.legislation.govt.nz/regulation/public/2004/0202/latest/DLM271701.html

[24] https://www.epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/Policies/Hazardous-Substances-Storage-and-Disposal-of-Persistent-Organic-Pollutants-Notice-2004.pdf

In 2019 two further POPs were added to the convention, dicofol (related to DDT) and PFOA, which is used in firefighting foams.

6.3 Rotterdam Convention on the importation of hazardous chemicals

The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998 (the Rotterdam Convention) is a multilateral environmental agreement, that aims to protect human health and the environment from potentially harmful impacts from trade in certain hazardous chemicals.

New Zealand ratified this Convention on 23 September 2003.

The treaty covers a total of 54 chemicals: 35 pesticides (including 3 severely hazardous pesticide formulations), 18 industrial chemicals, and 1 chemical in both the pesticide and the industrial chemical categories.[25]

Similar to the Basel Convention, the Rotterdam Convention requires countries to provide informed consent before they import chemicals covered under the convention. This means export of such chemicals from NZ must have permission in advance from the receiving country and vice versa. This is implemented through regulation[26] and administered by the Environmental Protection Agency.

6.4 Mandate for the Global Plastics Treaty (UNEP Res. 5/14).

Plastic pollution is increasingly becoming recognised as a persistent and growing problem globally. The United Nations has recognised that rapidly increasing levels of plastic pollution, including microplastics, present a serious transboundary environmental problem. A legally binding international treaty is expected to be negotiated by the end of 2024. Following this it will need to be ratified by each country.

Core elements of a treaty are likely to include a:

- shared global goal/common long-term vision to the plastic pollution problem
- common approach to national action plans covering the life cycle of plastics
- mechanism to harmonise reporting and monitoring of actions and effects of measures
- financial mechanism to deliver technical support and capacity building
- science and knowledge mechanism to provide access to quality-assured information for stakeholders at all levels.

[25] Annex III Chemicals (pic.int)
[26] Imports and Exports (Restrictions) Prohibition Order (No 2) 2004 (SR 2004/202) (as at 01 January 2021) Schedule 2 Rotterdam chemicals – New Zealand Legislation

At the first session of the Intergovernmental Negotiating Committee, Aotearoa New Zealand joined 59 other countries, including Australia, the Cook Islands, Canada, the United Kingdom, Germany, France, and Norway in a group called the High Ambition Coalition to End Plastic Pollution.[27]

The Coalition is committed to develop an ambitious international legally binding instrument and shares a common ambition to end plastic pollution by 2040.

The High Ambition Coalition's Global Strategic Goals are to:

- Restrain plastic consumption and production to sustainable levels
- Enable a circular economy for plastics that protects the environment and human health
- Achieve environmentally sound management and recycling of plastic waste.

6.5 Other Conventions and International Agreements

Other relevant conventions include:

The Minamata Convention on Mercury.[28] This aims protect human health and the environment from the harmful effects of exposure to mercury. The convention places controls on the mining, import and export, storage, emissions from industrial sources and significant releases, as well as contaminated sites and waste mercury. New Zealand signed the convention in 2013 but has yet to ratify it.

United Nations Strategic Approach to International Chemicals Management (SAICM).[29] This is an international policy framework to promote chemical safety around the world. The SAICM comprises the Dubai Declaration on International Chemicals Management, which secured a high-level political commitment to SAICM, and an Overarching Policy Strategy which sets out its scope, needs, objectives, financial considerations underlying principles and approaches, and implementation and review arrangements. Objectives cover risk reduction, knowledge and information, governance, capacity-building and technical cooperation, and illegal international traffic.

International Panel on Chemical Pollution (ICP).[30] The goal of the IPCP is to collect scientific knowledge about issues of chemical pollution and to provide summaries and interpretations of the available knowledge for decision makers and the public. The focus is on several major groups of chemicals such as: pesticides and biocides; pharmaceuticals; industrial chemicals such as solvents, flame retardants and plastic softeners; and unwanted by-products such as polychlorinated dibenzodioxins and furans.

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[27] HAC Homepage - High Ambition Coalition to End Plastic Pollution : High Ambition Coalition to End Plastic Pollution (hactoendplasticpollution.org)
[28] Homepage | Minamata Convention on Mercury
[29] Overview (saicm.org)
[30] IPCP | The International Panel on Chemical Pollution

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).[31] This is an independent intergovernmental body established by States to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development. It was established in Panama City, on 21 April 2012 by 94 Governments. The IPBES works in the following areas:

- Assessments: On specific themes (e.g. "Pollinators, Pollination and Food Production"); methodological issues (e.g. "Scenarios and Modelling); and at both the regional and global levels (e.g. "Global Assessment of Biodiversity and Ecosystem Services").
- Policy Support: Identifying policy-relevant tools and methodologies, facilitating their use, and catalyzing their further development.
- Building Capacity & Knowledge: Identifying and meeting the priority capacity, knowledge and data needs of our member States, experts and stakeholders.
- Communications & Outreach.

6.6 Commentary

If the treaty on plastic pollution eventuates, and even more if the aims of the High Ambition Coalition are achieved, the outcome could be a significant reduction in the aggregate volume of global plastic production, prohibitions and restrictions on the production and consumption of the most hazardous polymers, associated chemicals, and products and their releases into the environment all along the full life cycle of plastics. An ambitious and effective treaty would require a science policy interface (SPI) as a subsidiary body under the treaty. The SPI could be mandated to develop safety, sustainability, essentiality, and transparency assessment criteria for, inter alia, feed stocks, polymers, associated chemicals, products, technologies (including extraction, production, manufacturing, delivery, management, remediation and recovery), systems, and services. These assessments would support a hybrid regulatory approach to establish open and adaptive lists for the annex of the treaty. Lists could include those substances, products, technologies, and systems/services that are assessed to require prohibition, restriction, permission, or exemption.

The SPI under the Global Plastics Treaty and the newly forming Science Policy Panel (SPP), Chemicals, Waste, and Pollution mandated under the United Nations Environment Assembly would complement one another. The SPP would ensure that the functions of the SPI under the global plastics treaty coordinated with, and complemented the functions of the SPIs of other multilateral environmental agreements to avoid duplication or conflicts.

[31] IPBES Home page | IPBES secretariat

7.0 Conclusion: Good Practice Elements and Priorities

The 2002 review by WRAP suggested that PTE standards should be the main focus of the precautionary (statutory) standards if their aim is to protect soil quality, and they should be set with tolerances in place which can be determined by the strictness of the standard. The standards set should be achievable using good practice composting methods and they should be set in such a way that they can be standardised (e.g. with reference to organic matter content).[32] Alongside this, attention needs to be paid to testing regimes, including the cost of such regimes and the desired frequency of testing. Different standards are likely to be needed for different feedstocks. Good practice includes some specification as far as the presence of weeds is concerned, although the approach here may vary in importance depending on which compost / soil product application is under consideration.

The precautionary principle is needed as far as physical impurities is concerned – the trend is for limits in many countries with more established biowaste collection regimes to become tighter over time as more is understood regarding the potential impacts on the environment of microplastic pollution. In this context, support for the use of compostable plastics for products such as carrier bags is worth exploring with its potential to decrease the level of conventional plastic contamination in compost, although appropriate treatment systems also need to be in place to be able to accommodate such a shift. Such products need to be subject to quality standards, similar to that for compost itself, to limit contamination from substances such as PFAS.

Finally, it is important to be aware that putting strict statutory limits in place – which are very difficult to achieve - is likely to result in relatively little compost or soil product being produced, therefore limiting the development of the market. In this respect, aspects of the voluntary standards – put in place for aspects other than the control of PTEs - can help market development by setting standards that go beyond what is controlled by the regulator, so that the quality achieved conforms to that demanded by the market when it comes from a product ready for sale.

[32] WRAP (2002) Comparison of Compost Standards within the EU, North America and Australasia: Main Report