In focus

Microplastics in food and beverage products

Act now to get ahead of evolving regulatory requirements

leatherhead food research

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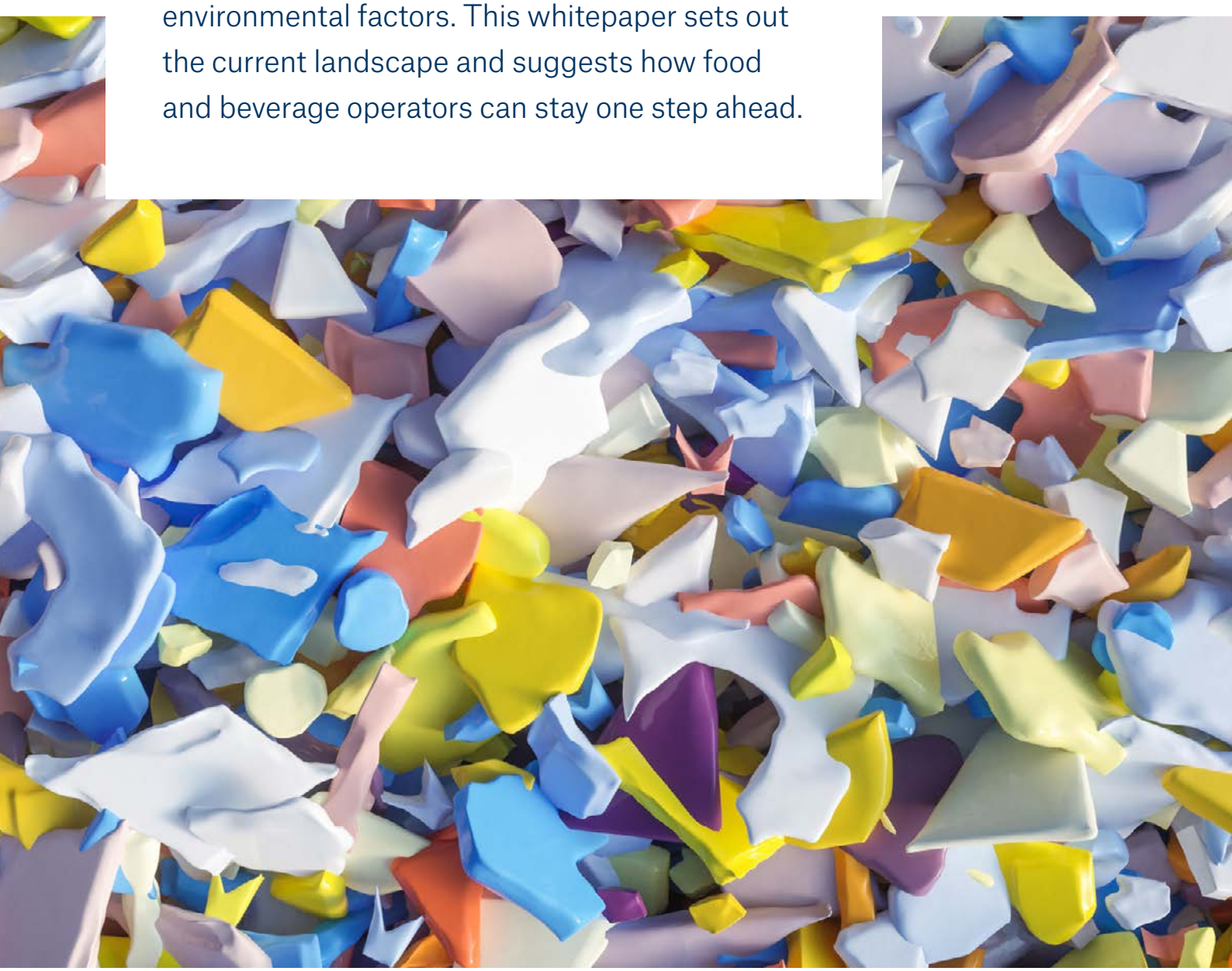
Microplastics have become a hot topic, and forthcoming EU regulation surrounding their intentional use in products will have an impact on the food and beverage industry. It's also highly likely that future regulations will focus on microplastic contamination in the food chain, whether caused by manufacturing processes or environmental factors. This whitepaper sets out the current landscape and suggests how food and beverage operators can stay one step ahead.



Plastic in our food and drink

It's well known that plastics and microplastics have become a serious environmental contaminant. Reliable research shows that microplastics have entered the food chain too. Politicians, regulators and scientific communities are currently discussing the possible health implications of this. Meanwhile, the media and the public are demanding information on how plastics and microplastics are impacting their lives (IFT, 2019; BFR, 2019).

In this whitepaper, we consider potential repercussions for the food and beverage industry. We look at emerging regulations, which are likely to become more stringent over time. And we outline steps that food and beverage operators can take to identify any microplastics present in their product portfolio.

Microplastic consumption

In recent years, multiple investigations have shown evidence of microplastic contamination in food and drink.

According to Kuna and Sreedhar (2019) various studies reported:

- up to 600 particles of microplastics per kilogram of salt
- up to 660 microplastic fibres per kilogram of honey
- and around 109 microplastic fragments per litre of beer

Seafood has also been found to contain significant levels of microplastics. One study reported that fish, mussels and oysters harvested for human consumption contained 0.36 - 0.47 particles. Based on average consumption, the report's authors concluded that Europeans ingest approximately 11,000 microplastic particles per person, per year (Van Cauwenberghe and Janssen, 2014).

Finally, a study by the Medical University of Vienna demonstrated the presence of up to nine different types of microplastics in human faeces (Schwabl *et al.*, 2018), most likely due to consumption of contaminated food.

Primary and secondary microplastics

The microplastics found in products can broadly be separated into two categories: primary and secondary.

Primary microplastics are manufactured and added to commodities for a specific purpose. One example is the microbeads used in toothpastes and cosmetics to act as abrasives. They end up in wastewater streams that are eventually discharged into rivers and oceans.

Some countries have banned the use of these plastic particles. For instance, the US Government's Microbead-Free Waters Act of 2015 prohibits the manufacture, packaging and distribution of rinse-off cosmetics containing plastic microbeads. Other countries have followed suit, including the UK with its Environmental Protection (Microbeads) (England) Regulations 2017. (Annex I of this whitepaper lists further national regulations on microplastics, either in force or notified.)

Secondary microplastics originate from the degradation of larger plastics. Common sources include plastic waste in landfill, which slowly degrades into smaller particles and permeates the groundwater system. Another source is clothing. When clothes are washed, they shed fibres which break down into plastic particles and enter the global water cycle.

Primary microplastics

Emerging EU regulations

A study of primary microplastics instigated in 2015 prompted the European Commission to request a restriction dossier from the European Chemical Agency (ECHA). This marked the beginning of a restriction procedure under Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

A proposal was published in 2018, which focused on restricting intentional use of microplastics as per the scope of the original request. ECHA's Committee for Risk Assessment (RAC) supported the proposal and the Committee for Socio-economic Analysis (SEAC) published a draft opinion for consultation. The consolidated opinion of both committees is expected by the end of 2020.

Specific transitional arrangements for the food industry are not mentioned in the REACH proposal. As such it is assumed that upon entry into the force, any relevant restrictions will apply immediately.

The evolution of EU regulatory framework on microplastics in food

REACH and its take on microplastics

REACH is an EU regulation adopted in 2006 surrounding the registration, evaluation, authorisation and restriction of chemical substances.

Its aim is to protect human health, the environment and the internal market, with provisions underpinned by the precautionary principle. REACH replaced the more ad-hoc approach of previous EU regulations on chemicals, based on responding to emergent problems. It is complemented by the classification, labelling and packaging of substances (CLP) Regulation.

REACH Regulation (EC) No 1907/2006 defines a microplastic as:

a material consisting of solid polymer containing particles, to which additives or other substances may have been added, and where ≥ 1% w/w of particles have (i) all dimensions 1nm ≤ x ≤ 5mm, or (ii), for fibres, a length of 3nm ≤ x ≤ 15mm and length to diameter ratio of >3.

Substances used in food or feedstuffs can be restricted under REACH, but there are certain exemptions. Regarding microplastics, one such exemption would include naturally occurring polymers that have not been chemically modified (other than by hydrolysis), and (bio)degradable polymers.

What the REACH proposal means for the food industry

Food receives relatively little direct attention in the REACH microplastics proposal. Where it is mentioned, the focus is on supplements and medical food where *'microplastics are used in the formulation of food complements (e.g. vitamins) as a 'controlled-release' agent, and to hide unpleasant taste.'*

Any future EU restrictions on microplastics under REACH will harmonise conditions of manufacture, market placement and use of specified microplastics. It's understood that Member States will retain the right to self-regulate and determine whether their national measures are compliant.

National legislation may provide a higher level of protection as per Article 129(1) REACH regarding response to an urgent situation to protect human health or the environment. As such, we'd encourage food and beverage operators to actively monitor the situation in markets of interest.

Where food and beverage products contain primary microplastics, it will take time to develop and transition to suitable alternatives such as biodegradable polymers. Therefore, we advise organisations that might be affected to conduct an assessment of their product portfolio.

Five-step assessment for food business operators in the EU

1. Ascertain whether any products make intentional use of microplastics.
2. Consider whether any intentionally used microplastics match the REACH proposal's definition of microplastic.
3. If the definition is met, do any exemptions apply (e.g. is it a naturally occurring polymer)?
4. If no exemptions apply, is the restriction applicable (e.g. is the concentration of microplastics above the specified threshold)?
5. If the restriction would apply, action is needed to either remove or replace the microplastics before the new restrictions come in to force (currently anticipated to be 2022).

Scientific understanding of microplastics in the food chain, and the potential health risks, is still evolving. However, there is increasing evidence of microplastic contamination in food, due to environmental presence as well as manufacturing processes.

To understand the scope and routes of contamination, and the level of uptake by humans, it's necessary to investigate a wide range of products. This demands precise analytical tools and robust methodologies. Given the small size of microplastic particles, identification relies on characterisation methods to indicate which chemicals are present. This helps identify the source of the contamination and informs steps to reduce the risk posed to humans (IFT, 2019).

Sampling for microplastic contamination

One such study focused on soft drinks, cold tea and energy drinks in Mexico. It measured the occurrence of microplastics as well as their shape, size, surface morphology and polymer composition.

Microplastics were detected in 48 out of 57 samples tested. Various forms (fibres and fragments) and sizes (0.1 - 3 mm) were identified. Colours included blue, red, brown, black and green, in quantities up to 28 ± 5.29 particles/L. Micro-Raman spectroscopy identified the particles as polyamide, poly(ester-amide), acrylonitrile-butadiene-styrene and poly(ethylene-terephthalate). This indicated that the beverages were contaminated with microplastics of synthetic textiles and packaging origin.

Another widely used tool for analysing microplastics is Fourier-transform infrared spectroscopy (FT-IR). This method analyses and records the absorbance of energy by chemical compounds present in a sample, creating a spectrum with individual peaks corresponding to specific bonds in the chemical compound. An FT-IR instrument can measure particles of various sizes, and an FT-IR infrared microscope identifies particles as small as 250 - 5 µm (0.25 - 0.005 mm), making it useful in microplastics analysis.

When analysing food, an important factor is sample preparation. Different types of food present a unique problem for analytical scientists: each sample matrix must be prepared to ensure a clean and interpretable infrared spectrum is produced.

Bottled water vs tap water

One of the most recent studies investigating microplastics performed by PerkinElmer, Inc., Seer Green, UK, analysed microplastics present in five anonymised samples of bottled water.

The bottled water was filtered to obtain infrared-ready samples. Using a Spotlight 400 FT-IR imaging system the samples were analysed to identify the particles present. Every sample was found to contain tens of plastic particles. They varied in size from 20 - 200 µm (0.02 - 0.2 mm), with other fibres identified that were larger than 2 mm in length.

It's important to note that plastics are commonly used in the construction of water bottles. Lids are typically constructed from polyethylene, the bottle itself is usually PET, and the label can be made of various materials including polypropylene, coated paper, or other polymers (IFT, 2019). The presence of these plastics in water samples has led to the suggestion that manufacturing processes could be the source of contamination. However, additional chemical compounds were identified in the water samples analysed by PerkinElmer. The majority of these were cellulose-based materials, such as cellulose and cellulose acetate. Additional polymeric particles detected included polyamide and polyvinyl alcohol. In fact, only around 5% of the particles identified from the water samples were polyethylene, polypropylene or PET. The presence of other chemicals indicates that contamination is not solely due to manufacturing processes and instead occurs prior to production (IFT, 2019).

The study went on to compare the bottled water samples with tap water from the UK-based laboratory. It found the tap water contained hundreds more fibres and plastic particles per sample volume than any of the bottled waters. Interestingly, the identified contaminants were the same as those present in the bottled water samples. This provides further evidence that the presence of microplastics in bottled water is due to widespread microplastic contamination (IFT, 2019).

Keeping ahead of regulatory requirements

We believe forthcoming regulations surrounding microplastics, such as those outlined in the EU's REACH proposal, are the tip of the iceberg. Furthermore, the food and beverage industry has a duty of care to identify and combat any contamination that could pose harm to consumers.

To understand the scale of microplastic contamination and reduce consumer exposure, food and beverage operators need robust and accurate characterisation tools and methodologies. However, identifying microplastics is just the first step. Once a chemical has been identified, the source needs to be discovered and addressed.

Businesses that are concerned about the impending REACH restrictions or that want to keep ahead of the evolving regulatory framework, can have their product portfolio assessed. This aids compliance with future restrictions, allowing time to reformulate products if necessary. Taking a proactive stance on microplastics is also a positive step from a brand reputation perspective.

Leatherhead Food Research and sister company TSG Consulting are well placed to assess product compliance with REACH restrictions before entry into force. Where existing products are identified as non-compliant with future restrictions, we can advise on remediation measures.

Annex I – National regulation on microplastics in force or notified

Country	WTO notification	EU notification	Product category	Definition of microplastics
United States Microbead-free Waters Act of 2015 (in force)			Rinse-off cosmetic products	Microbead: any solid plastic particle that is less than 5 mm in size and is intended to be used to exfoliate or cleanse the human body or any part thereof
South Korea Proposed amendments to the 'Regulation on Safety Standards etc. of Cosmetics'	G/TBT/N/KOR/672 G/TBT/N/KOR/706		Cleansing products, dental cleansing products	Microbead: less than or equal to 5 mm in size
Taiwan Restrictions on the Manufacture, Import, and Sale of Personal Care and Cosmetics Products Containing Plastic Microbeads (in force)	G/TBT/N/TPKM/249		Cosmetics used for washing hair, bathing, face-washing and soap; toothpaste	Microbead: solid plastic particles used for exfoliation or cleaning of the body wherein the scope of particles' diameter is smaller than 5 mm
Canada Microbeads in Toiletries Regulations (in force)	G/TBT/N/CAN/501		Toiletries, meaning any personal hair, skin, teeth or mouth care products for cleansing or hygiene, including exfoliants	Microbead: plastic microbeads that are ≤5 mm in size, any plastic particle, including different forms such as solid, hollow, amorphous and solubilised
France Decree prohibiting the placing on the market of rinse-off cosmetic products for exfoliation or cleansing that contain solid plastic particles (in force)	G/TBT/N/FRA/170	2016/543/F	Rinse-off cosmetic products for exfoliation or cleansing	Solid plastic particles, with the exception of particles of natural origin not liable to persist in, or release active chemical or biological ingredients into the environment or to affect animal food chains

Country	WTO notification	EU notification	Product category	Definition of microplastics
New Zealand Waste Minimisation (Microbeads) Regulations 2017	G/TBT/N/NZL/77		Wash-down cosmetic products; cleaning products	Microbead: a water-insoluble plastic particle that is less than 5 mm at its widest point
Sweden Draft Regulation prohibiting the placing on the market of rinse-off cosmetics that contain solid plastic particles which have been added for exfoliating, cleaning or polishing purposes	G/TBT/N/SWE/132	2017/284/S	Rinse-off cosmetic products	Solid particles of plastic which are 5 mm or less in size in any dimension and which are insoluble in water
United Kingdom The Environmental Protection (Microbeads) Regulations 2017/2018 (England, Wales, Scotland, Northern Ireland)	G/TBT/GBR/28 G/TBT/GBR/29 G/TBT/GBR/30 G/TBT/GBR/32	2017/353/UK 2018/42/UK 2018/48/UK 2018/208/UK	Rinse-off personal care products	Microbead: any water-insoluble solid plastic particle of less than or equal to 5 mm in any dimension
Belgium Draft Sector Agreement to support the replacement of microplastics in consumer products		2017/465/B	Not settled	
Italy Draft technical regulation banning the marketing of non-biodegradable and non-compostable cotton buds and exfoliating rinse-off cosmetic products or detergents containing microplastics	G/TBT/N/ITA/33	2018/258/I	Exfoliating rinse-off cosmetic products and detergents	Water insoluble solid plastic particles of 5 mm or less, referring to definition in Commission Decision (EU) 2017/1217 of 23 June 2017

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