CENTEXBEL-VKC

INFO

2021-02 | microplastics!

CONTEXT

A key concern of microplastics pollution[1] is whether they represent a risk to ecosystems and human health. However, there is much uncertainty associated with this issue. Data on the exposure and effect levels of microplastics are therefore required to evaluate the risk of microplastics to environments and human health.

The adverse effects on organisms that are exposed to microplastics can be separated into two categories: physical effects and chemical effects. The former is related to the particle size, shape, and concentration of microplastics, and the latter is related to hazardous chemicals that are associated with microplastics. Though data on microplastic exposure levels in environments and organisms have rapidly increased in recent decades, limited information is available on the chemicals that are associated with microplastics.

Microplastics can contain two types of chemicals:

(i) additives and polymeric raw materials (e.g., monomers or oligomers) originating from the plastics, and

(ii) chemicals absorbed from the surrounding ambience.

Additives are chemicals intentionally added during plastic production to give plastic qualities like color and transparency and to enhance the performance of plastic products to improve both the resistance to degradation by ozone, temperature, light radiation, mold, bacteria and humidity, and mechanical, thermal and electrical resistance. They include inert or reinforcing fillers, plasticizers, antioxidants, UV stabilizers, lubricants, dyes and flame-retardants.

The combination of various kind of polymers of different sizes and shapes that are joined to the action of a large amount of additives that originate from plastics results in a cocktail of contaminants that not only alter the nature of plastic but can leach into the air, water, food, and, potentially, human body tissue during their use or their disposal, thus exposing us to several chemicals together.

1 source and recommended reading: A Detailed Review Study on Potential Efects of Microplastics and Additives of Concern on Human Health https://www.mdpi.com/1660-4601/17/4/1212/pdf

Verantwoordelijke uitgever | Éditeur responsable | Responsible editor: Jan Laperre, directeur generaal
Redactiecomité | Comité de rédaction | Redation Committee: Jan Laperre, Stijn Devaere, Eline Robin
Tekstredactie en lay-out | Rédaction et mise en pages | Editing and graphics : Eline Robin
Fotografie | Photographie | Photography : Marc Van Hove

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Centexbel-VKC commits to Zero Pellet Loss

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By signing the Operation Clean Sweep® (OCS) commitment at the beginning of this year, Centexbel-VKC recognises the importance of preventing spillages into the environment and commits to the following six actions:

1. Improve worksite set-up to prevent and address spills
2. Create and publish internal procedures to achieve zero industrial plastic material loss
3. Provide employee training and accountability for spill prevention, containment, clean-up and disposal
4. Audit performance regularly
5. Comply with all applicable state and local regulations governing industrial plastics containment
6. Encourage partners (contractors, transporters, distributors, etc.) to pursue the same goals.

Operation Clean Sweep® is an international programme designed to prevent the loss of plastic granules (pellets, flakes and powders) during handling by the various entities in the plastics value chain and their release into the environment.

PLASTIC PELLET LOSS

WHAT ARE THE IMPACTS AND POSSIBLE ACTIONS?

There is a growing concern about the presence of plastics in the environment. **Plastic litter** could end up in soils, waterways and eventually the ocean, contributing to global pollution. The majority of plastics pollution is caused by mismanaged waste. There is also an increased interest in how **microplastics** contribute to this environmental issue. Marine scientists have reported more frequently that birds, turtles and fish ingest a wide variety of plastic objects which can be harmful to their health or even fatal. The vast majority of this waste (80%) originates from land. Most of these items are debris of used consumer goods, potentially carelessly thrown away or non-intentionally lost.

PLASTIC PELLETS

A RAW MATERIAL NOT TO BE WASTED

Part of this litter, however, consists of pellets meant to be manufactured into plastic products. While consumers are responsible for the proper disposal of used products, the plastics industry must, for its part, ensure containment of the products it handles, namely the plastic pellets, flakes and powders.

OPERATION CLEAN SWEEP® (OCS) AIMS TO PREVENT DISCHARGE INTO WATER FLOWS AND TO THE MARINE ENVIRONMENT.

PLASTIC PELLETS IN THE ENVIRONMENT

In Europe, the majority of plastics raw materials take the form of either round or oval granules of approximately 2-5 mm in diameter, known as pellets or powder (< 1 mm). Flakes consist of mixed plastics materials of various sizes, produced through the recycling of plastics waste.

In response to public concern over wildlife and human exposure to microplastics, numerous scientific studies are being carried out to assess the magnitude of this problem. A 2019 study by the Science Advice for Policy by European Academies (SAPEA)[1] observed that microplastics are found in different concentrations across diverse environmental compartments, accumulating in marine and coastal areas, in freshwater environments and ecosystems.

While the deterioration of larger plastic items into microplastics often contributes more to marine litter than pellet loss, there is now growing evidence that pellets are also found in large quantities in the marine and terrestrial environments. According to a 2018 study by Eunomia, plastic pellets are estimated to be the second largest source of microplastics entering the aquatic environment in the EU, with an annual median emission of 41,000 tonnes (ranging from 3,000 to 78,000 tonnes).

The Plastic Leak Project[2], a multi-stakeholder initiative co-founded by Quantis, also developed a methodology to map, measure and forecast plastic leakage through the whole life cycle of products , including pellets, and identify their pathways into the environment.

Concerning losses along the plastics value chain, a background document on pre-production pellets compiled by the OSPAR Commission [3] assessed that estimated total pellets losses in Europe amount to between 16,888 tonnes and 167,431 tonnes per year. It is important to note, however, that estimates vary as to the exact magnitude of the problem, since there is currently no standardised methodology to measure pellets flow and losses at industrial sites.

As part of its monitoring and assessment programme, OSPAR also works on the development of environmental quality indicators for the North Sea, measuring plastic particles ingestion by different marine species. The results of the OSPAR monitoring programme on the accumulation of plastics in the stomachs of Northern fulmars found that 93% of these seabirds had ingested plastics. However, the current 2007-2016 analyses show significant declines in both the ingested plastic mass ($p<0.001$) and the annual percentage of birds with over 0.1g of plastic ($p=0.002$).

These results show an encouraging positive decreasing trend but greater efforts towards plastic pellets containment remain necessary to achieve good environmental status in different European geographical areas.

To sum up, the fight against pellet loss in the environment must be scaled-up, along with ongoing industrial efforts to tackle the problem at source. This calls for additional and coordinated actions in the implementation of the OCS programme by plastics producers and the entire value chain.

SOURCES OF PELLET SPILLS

The typical route for pellets starts at a production facility. Pellets are then packaged either for storage or for transportation to plastics converters or other customers e.g. via logistics hubs. The type of packaging must be carefully selected based on customer needs, mode of transport and compliance with safety requirements in accordance with industry standards (e.g. food and healthcare requirements). There are four main types of packaging used: 25 kg bags stacked on pallets, octabins (large carton boxes), “big bags” (large plastic bags), containers or silos.

Pellets can be transported between different actors along the value chain mainly by road, rail or sea. Converters then receive the pellets in either of the packaging types described above. The pellets are fed into heat extruders or injection moulding machines, to be melted and formed into parts, pipes or other finished goods. In some cases, pellets are not directly sold to converters by the producers. Trading companies and distributors may buy pellets in large quantities and store them in warehouses for re-sale in smaller quantities to converters.

During mechanical recycling of plastic goods, most plastic waste is transformed into similar raw materials such as pellets or flakes. These materials will follow the same cycle.

Whilst high environmental, safety and quality management controls are applied throughout the plastics industry, unintentional loss of pellets can occur at different stages along the value chain.

1 https://www.sapea.info/
2 https://quantis-intl.com/strategy/collaborative-initiatives/plastic-leak-project/
3 https://www.ospar.org/

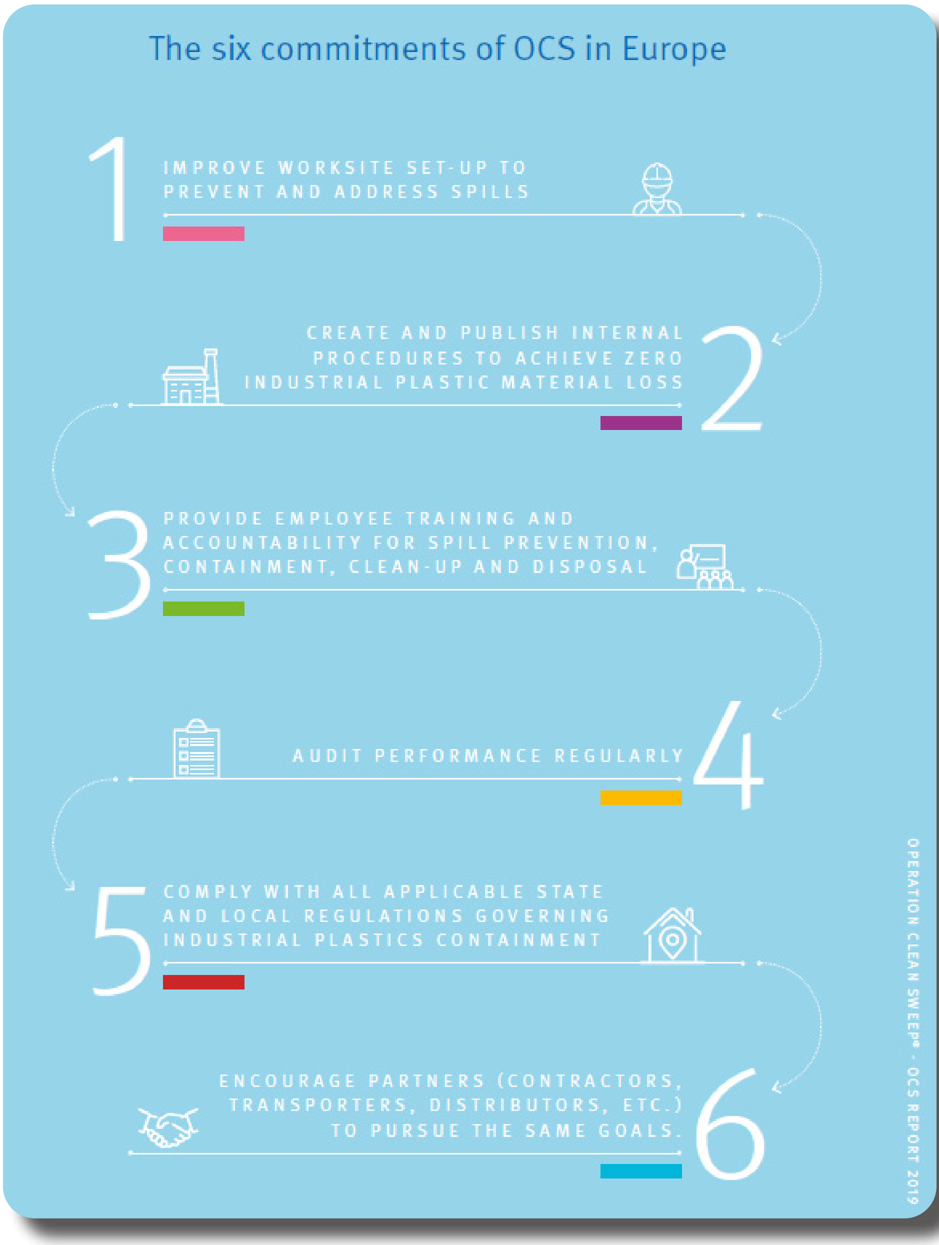
Spills which occur in closed areas with no possible route into the environment will be contained. However, when spillages occur outside of a closed area, pellets may end up being washed down drains and into waterways before eventually flowing into the ocean. This can lead to severe environmental and social impacts. It is therefore important for all workers handling pellets to be trained to quickly react and take the appropriate measures in order to contain these spills. Pellets loading and unloading operations account for the highest risk of loss at all stages of the value chain.

In order to further accelerate and strengthen the OCS programme, PlasticsEurope has committed to initiate the development of an OCS certification scheme with third party auditing. The OCS certification scheme enables the plastics industry and all value chain handlers of pellets to transparently and jointly demonstrate their efforts towards zero pellet loss into the environment. PlasticsEurope believes that this approach is the most effective and efficient approach to achieve zero plastic pellet loss.

This is also fully in line with future measures and actions to curb microplastics pollution proposed in the EU Plastic Strategy which was published in 2018 – development of measures to reduce plastic pellet spillage (e.g. certification scheme along the plastic supply chain and/or Best Available Techniques reference document under the Industrial Emissions Directive).

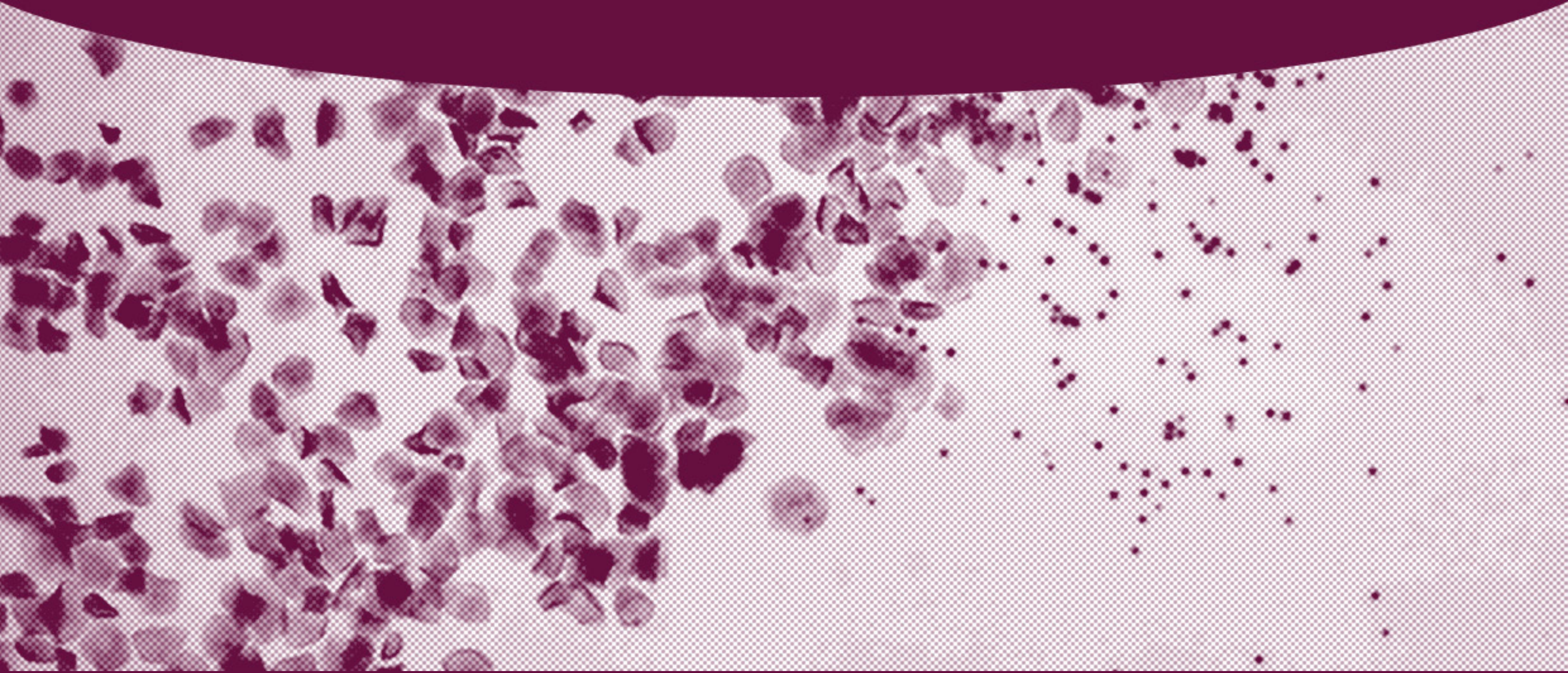
The OCS certification scheme sets common requirements (based on the six pillars of the OCS pledge) that will be audited regularly by accredited third parties. PlasticsEurope is currently working with the full plastics value chain on the development of this OCS certification scheme in view to have it ready by 2022.

Source text and image below: OCS REPORT 2019



INTERESTED IN JOINING OPERATION CLEAN SWEEP®?

Read more on http://www.opcleansweep.eu or contact Stijn Devaere



Microplastics: sizes & sources

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ECHA defines microplastics as "[...] solid plastic particles composed of mixtures of polymers and functional additives. They may also contain residual impurities. Microplastics can be **unintentionally** formed when larger pieces of plastic, like car tyres or synthetic textiles, wear and tear. But they are also **deliberately manufactured and added to products** for specific purposes, such as exfoliating beads in facial or body scrubs"[1].

Whereas the the European commission[2] and the US National Oceanic and Atmospheric Organisation (NOAA[3]) claim that pieces of plastic debris of less than five millimeters in length are called "microplastics", ISO/TR 21960:2020 distinguishes between microplastics "any solid plastic particle insoluble in water with any dimension between 1 µm and 1 000 µm (=1 mm)" and large microplastics, being "any solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm."

PRIMARY SOURCE OF MICROPLASTICS

PRIMARY MICROPLASTICS are directly released into the environment as small particles coming mainly from the laundering of synthetic clothes, vehicle tyre abrasion during driving, and personal care products such as facial scrubs.

EUROPEAN BAN ON INTENTIONALLY ADDED MICROPLASTICS

In September 2018, the European Parliament called on the European Commission to introduce an EU-wide ban on intentionally added microplastics in products such as cosmetics and detergents by 2020, and to take measures to minimise the release of microplastics from textiles, tyres, paint and cigarette butts.

On 30 January 2019, the ECHA published a proposal for restricting the use of microplastics, alongside restriction proposals for formaldehyde and siloxanes D4, D5 and D6. The proposal is based on the findings of the Chemicals Agency's assessment of the health and environmental risks posed by those microplastics that are intentionally added to products.

The assessment found that intentionally added microplastics are most likely to accumulate in the ground, via the particles concentrated in sewage sludge, which is often used as a fertiliser. A much smaller proportion of microplastics is released directly into rivers, lakes and seas.

Because microplastics and nanoplastics (even smaller particles resulting from the degradation of microplastics) are so small, they are easily ingested and can then enter the food chain. The potential effect on human health is not well understood.

Overall, the risks from products that release microplastics to the environment are not adequately controlled, according to the ECHA assessment. However, several EU Member States have already introduced bans on some uses of microplastics, mostly in wash-off cosmetic products.

1 https://echa.europa.eu/hot-topics/microplastics
2 https://ec.europa.eu/environment/efe/news/new-rules-proposed-curb-microplastics-2019-04-24_en
3 https://oceanservice.noaa.gov/facts/microplastics.html

The ECHA proposal is targeting a much wider range of products: including cosmetic products, detergents and maintenance products, paints and coatings, construction materials and medicinal products, as well as materials used in agriculture and horticulture and in the oil and gas sectors.

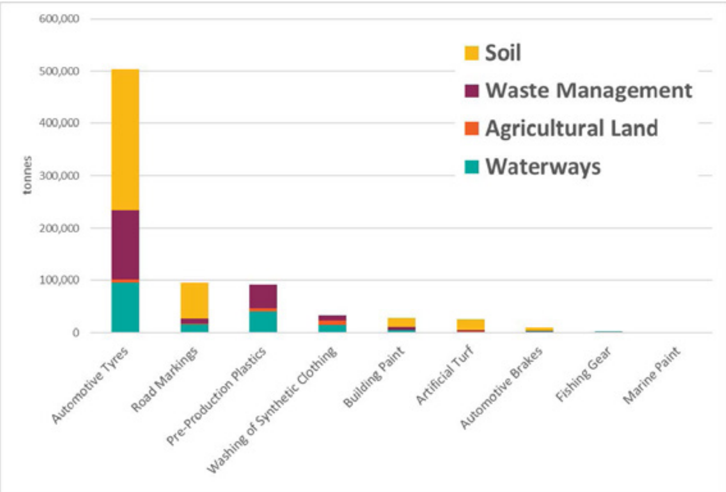
The implementation of the restriction is expected to be cost-effective in all sectors, including agriculture, identified in the proposal as the biggest source of intentionally added microplastics.

"BANNING THE USE OF MICROPLASTICS IN PRODUCTS SUCH AS COSMETICS AND DETERGENTS ACROSS THE EUROPEAN UNION WOULD PREVENT 500,000 TONNES OF MICROPLASTICS FROM POLLUTING THE ENVIRONMENT OVER 20 YEARS", ECHA SAID[4].

SECONDARY SOURCE OF MICROPLASTICS

SECONDARY MICROPLASTICS originate from the breakdown of larger plastic items, such as plastic bags, bottles and fishing nets, and account for between 69 % and 81 % of those found in oceans where they are ingested by marine animals.

This source includes microplastics that may be generated as a result of poor or non-existent waste management or as a result of the degradation of larger plastic waste are covered by other initiatives under the Commission's Plastic Strategy[5] to reduce macro plastic litter (which can break down over time to form microplastics).



SOURCE GENERATION AND FATE OF MICROPLASTICS FROM WEAR AND TEAR IN THE EU

The figure shows that tyres, road markings, pre-production plastic pellets and washing of synthetic textiles are all large sources of microplastics emissions into the environment.

Several other sources have been identified, but are found to emit less. Artificial turf is relatively small source, however emissions are from a relatively small number of large point sources (pitches) with annual emissions of 1-5 tonnes each, whereas automotive tyre wear emanates from millions of vehicles all throughout Europe's road systems.

credits: Eunomia modelling

IMPACT ON THE ENVIRONMENT, ECONOMY AND HUMAN HEALTH

Whilst there are significant concerns around the suspected environmental impacts of microplastics in the marine (and other) environments there are also wider impacts to consider which have yet to be studied in detail.

The full consequences of any potential long-term impacts at a species level are yet to be established but these could have social impacts as well as human health impacts. A negative perception of seafood for health reasons could have a large impact on industries and countries that rely on fishing for income. The public response may or may not be proportional to the actual risk. There also may be a danger of fish population reductions which would also affect fisheries negatively; this is unlikely in the short term, however.

Tourism can be impacted in areas that are prone to accumulation of microplastic debris. Small islands that are directly in the path of strong currents often find their beaches covered in micro and macro plastics that were not emitted in the locality. The Canary Islands are one such example33 of this, where a large proportion of the sand can often be comprised of microplastics. With constant accumulation from prevailing currents it is almost impossible to maintain a clean beach. This can have negative impacts on tourism for these places. Again, this magnitude of this problem has not been studied in any detail.

Other impacts associated with negative public perception may also develop over time. Consumers may begin to choose alternative products that reduce microplastics emissions. For example, choosing cotton for their garments rather than synthetic based fibres. Although this sort of widespread shift has yet to be seen it would have a large impact on the textiles industry. The knock-on impacts are also not yet established as there are other negative environmental impacts associated with, for example, cotton, such as water and land use—comparing microplastics impacts with wider environmental impacts is almost impossible at this stage so identifying alternatives is fraught with uncertainty. Nevertheless, it is possible that public perception could lead to unexpected trade-offs in the future.[6]

4 https://www.reuters.com/article/environment-plastic-eu-idUSKBN28J1EE
5 https://ec.europa.eu/commission/publications/documents-strategy-plastics-circular-economy_en
6 Eunomia: Investigating options for reducing releases in the aquatic environment of microplastics emitted by (but not intentionally added in) products, 2018

Prestandard Study & Testing

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ALTHOUGH further research is needed into the exact nature of the ecological and health risks of microplastic pollution, we already know that these risks will only increase if microplastic pollution continues at its present rate.

As a precaution against future risks, the European Commission's Group of Chief Scientific Advisors[1], informed by a scientific evidence review report by the Scientific Advice for Policy by European Academies (SAPEA) consortium, makes the following recommendations:

1. Broaden existing policy to prevent and reduce microplastic pollution in both marine and freshwater environments, and in air and soil, and prioritise substance- and context-specific measures for high-volume, high-emission sources;
2. Ensure that any new measures are of benefit to society by undertaking cost/ benefit and similar analyses; and
3. Develop a co-ordinated international response consisting of research collaboration (including filling knowledge gaps on nanoplastic pollution), data sharing and standards development for measurement, monitoring and risk assessment.

These recommendations complement the work already set in motion by the **European Plastics Strategy**[2] that was set up with the aims of ensuring that by 2030 every piece of plastic packaging can be reused or recycled, as well as of reducing the consumption of single-use plastics and the use of microplastics.

PN MICROPLASTICS

Centexbel has submitted a prestandard study proposal to the FOD economy on microplastics to develop a standardised method to determine the particle size and define a classification system.

The results of **PN Microplastics "Determination and identification of microplastics released during clothes washing"** will substantiate the European standard CEN TC248 WG 37 & ISO TC38 WG 34 "Microplastics from textile sources".

The objective of the project is the quantitative identification and analysis of microplastics from the washing of clothes. This will be achieved by developing a reliable method for the recovery of these microplastics, as well as optical and chemical analysis methods.

We will mainly focus on synthetic garments, which are the main vectors of these microplastics, but we will also take into account mixed garments, i.e. garments made of synthetic and natural fibres.

1 https://ec.europa.eu/info/news/european-commissions-chief-scientific-advisors-call-wider-evidence-based-policy-response-pre-empt-growing-risks-microplastic-pollution-2019-apr-30_en
2 https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf

TESTING @ CENTEXBEL

RECOVERY OF MICROPLASTICS

WASHING MACHINE

An industrial washing machine allowing to program different conditions and washing cycles is provided with a sample collecting outlet to analyse the release of microplastics from garments.

FILTRATION

Microplastics can be recovered with filters of different compositions and porosities.

CENTRIFUGATION

Microplastics can be recovered by centrifugation: this method reduces the chances of contamination.

ANALYSIS OF MICROPLASTICS

INFRARED ANALYSIS

IR analysis works on the principle of light absorption in the infrared range. The wavelengths at which light is absorbed depends on the composition of the material (in particular its chemical bonds). It is therefore possible to determine the composition of the material from these wavelengths.
This analysis is carried out on microplastics collected after filtration or centrifugation.

OPTICAL MICROSCOPE

This type of analysis allows us to observe the microplastics collected after filtration or centrifugation. It enables us to determine the number, shape and size of the microplastics.

HYPERSPECTRAL IMAGING

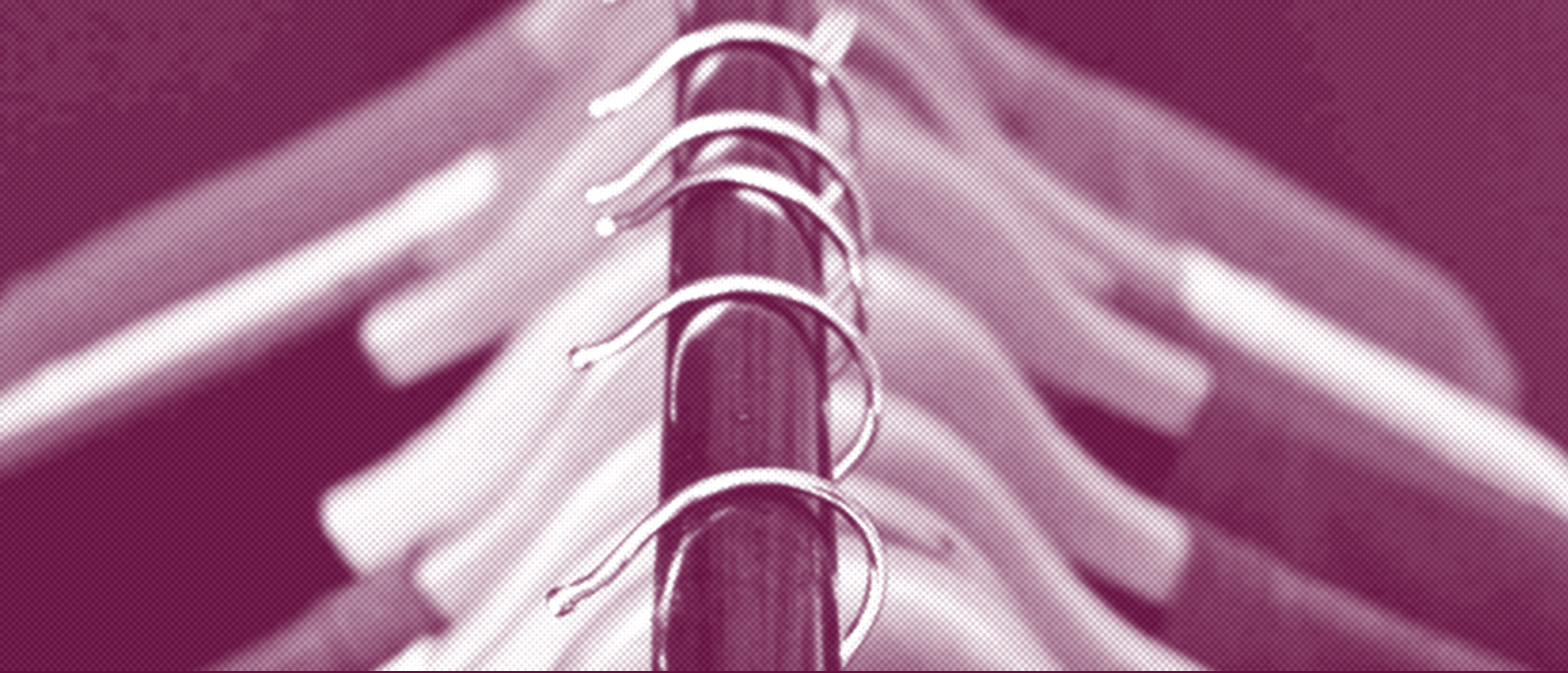
With this technique we obtain an image of an object at different wavelengths (in our case: infrared) to produce a complete reflectance spectrum for each pixel of an image; this enables us to determine the chemical composition of the surface being photographed. An image analysis program can be coupled to this system to determine the number, shape and size of the microplastics.
This analysis is carried out on the microplastics collected after filtration or centrifugation.

PARTICLE COUNTER

This analysis determines the quantity and size of particles present in the sample collected from the washing machine.

RELEASED MASS

This analysis consists of weighing the microplastics collected after filtration or centrifugation and drying in order to determine the mass of microplastics released during washing. The weight of the filter or centrifuge pot must then be deducted.



Standards to tackle microplastics

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IN 2018 five industry organisations, including Euratex, the European Apparel and Textile Federation, joined forces to tackle the issue of microplastics through the establishment of the **Cross Industry Agreement**[1] in the understanding that, to further global action around microplastics, a **harmonised test method** that would allow the collection and comparison of **globally generated data** was an important first step, in addition to sharing **science-based knowledge** and fostering **research** to find suitable solutions.

As one of the leading European textile research organisations partipating in the Cross Industry Agreement, **Centexbel** is actively engaged in the development of a harmonised test method tackling the issue of microplastic release from textiles, while acknowledging that:

- microplastics come from a number of sources and not just from textile materials
- all textiles release potentially problematic fibre fragments and not just synthetic textiles
- fibre fragmentation can occur during, and be influenced by, all phases of the product life cycle and not just during laundering

On the next pages you will find a survey and short description of the international (ISO and CEN) standards related to the issue of microplastics that are currently being developed.

1 brochure: https://euratex.eu/cia/

CROSS INDUSTRY AGREEMENT

ACKNOWLEDGEMENTS

The research organisations and stakeholders mentioned hereafter participate in the Cross Industry Agreement joint efforts to tackle microplastics by developing a harmonised test method and sharing knowledge to find solutions.

CEN/TC 248/WG 37 -- MICROPLASTICS FROM TEXTILE SOURCES

EN/ISO/WD 4484:2020(E) -- TEXTILES -- MICROPLASTICS FROM TEXTILE SOURCES

PART 2: QUALITATIVE AND QUANTITATIVE EVALUATION OF MICROPLASTICS

Context

Due to the environmental problem represented by microplastics, their number, shape and size are relevant parameters for the assessment of their impact and consequently the **development of a counting technique** is the only logical approach. Moreover, many of the microparticles analysed are not of synthetic origin and therefore there is a need to identify and distinguish them from microplastics.

The method is designed to provide the nature, numerical concentration, surface area and (estimated) weight of the microplastics produced or released by the textile sector and collected in a solid, aqueous or aeriform matrix. Depending on the matrix, pre-treatment of the sample may be necessary to concentrate the microplastics and eliminate inorganic and organic (e.g. biological) contaminants that may interfere with their identification. The method involves a preliminary observation of the sample by an optical microscope and then identification of the microplastics by molecular spectroscopy. The method provides the possibility of using two different techniques of molecular spectroscopy, Micro FTIR and Micro Raman to identify and count plastic particles up to a submicron size. The method is designed to permit the re-evaluation of microplastic counting data when toxicological and environmental impact indications become available.

This standard describes the method of analysis for a single filter. However, errors in the qualitative and quantitative determination of microplastics that may result from: presence of contaminants or variability between different filters imply that replicas need to be performed to establish accuracy and precision. This method provides useful information to assess in detail the effect of different polymers on health and the environment.

It is well known that, due to their lipophilicity, MPs can be vehicles of toxic compounds (e.g. PCBs, PAHs, dioxins) or vehicles of pathogenic microorganisms adhered to their surface and can be assimilated (with their dose of toxicity) and permeate into organisms and cells.

The family of microplastics includes synthetic-based particles such as polypropylene, polystyrene, polyamids, polyethylene terephthalate, polyvinyl chloride, polyacrylonitrile, polymethylacrylate, elastomers and silicone rubbers with dimensions of less than 5 mm (15 mm if fibres). The sources of microplastics are numerous. Their shapes and sizes are also variable. In the case of those released by textiles, the typical (but not the only) morphology is fibrous and their diameter and length may vary depending on the construction parameters of yarns and fabrics or washing conditions.

Scope

This method is applicable to the determination of microplastics (from textile sector) collected in different matrices, (e.g. textile process wastewater, clothes washing water, textile process air emissions, textile process solid waste, etc.).

The method allows obtaining a **qualitative-quantitative analytical determination of the microplastics** able to define the:

- number
- morphology (morphological characteristics)
- dimensional distribution
- the type, chemical origin or nature of polymers and their color, if present.

The method is also able to express the results in terms of estimated surface area and weight of MP per unit sample.

The method allows to express uniquely the results of the quantifications of MP, and therefore with a unit of measurement not depending by the origin of the sample investigated (raw material, manufacturing process, environmental sample (wastewater, e.g. from washing clothes, air, industrial process water, etc.)

The method allows the determination on textile sector samples of matrices of different physical states (solid, liquid or aeriform) for example:

- solid samples from textile production processes
- water samples from the textile production process and/or from the washing of clothing
- air samples for testing the air quality in the workplace of textile companies.

The method, being able to provide information such as size, shape, surface and weight (estimated), will allow to transfer information useful for ecotoxicological assessments to specialists.

ISO/TR 21960:2020 PLASTICS -- ENVIRONMENTAL ASPECTS
STATE OF KNOWLEDGE AND METHODOLOGIES

Context

Plastics materials are highly flexible and universally applicable. They can be found in a diversity of product areas and application sectors. In order to achieve a sustainable management and exploitation of products, safe and efficient manufacturing processes are compulsory within the value chain. In addition, an environmentally friendly use and handling across diverse applications is necessary during consumption, reuse and disposal. This ensures that an effective and qualified management at the product's end-of-life is addressed through proper performed procedures and evaluations.

If mismanagement happens at any of the above described life cycle stages, the use of plastics and plastics-containing products can create adverse effects to the environment. It has been proven, not least by the United Nations Environment Programme, that discarded products as well as microplastics are found in the environment around the globe, be it on land or water bodies including the sea. There are diverse causes for this such as inappropriate or inefficient waste management infrastructures, improper management of plastics products and their waste reuse or disposal, inefficient wastewater management, etc. Therefore, various types of entries into the environment and diverse constitutions and compositions of the microplastic particles in the environment are to be considered. Littered articles as well as microplastics consists of different kinds of products and come from different waste, e.g. bottles, films, fishing nets, tyres, cosmetics, clothing fibres, etc.

Over extended time in the environment, plastics products and their waste will breakdown into smaller items and finally disintegrate to microparticles. Microplastics also enter the environment directly through its intentional use in some product applications. Microparticles, be it via primary product use or via secondary fragmentation of macro articles, should be considered with special care since they can give rise to adverse environmental impact especially in the aquatic environment and its biota.

This document with its primary focus on plastics, rather than all the other materials, in the environment intends to provide a survey on the international situation of plastics and plastics in the environment with special attention to microplastics in the marine environment, its detection and determination. For this purpose, the document describes the state-of-the art testing methods as well as assessment approaches.

Although this document gives a representative overview of the current knowledge (up to early 2017) and activities about plastics and microplastics around the world, information is predominately generated from the Northern Hemisphere and activities in Europe and North America.

In this way, the document can be recognized as a contribution towards harmonized procedures and measures in order to provide a sound basis for a reliable and verifiable evaluation of the impact of plastics and microplastic in the environment. The document covers the following key items of interest.

- **Status of plastics products and plastics in the environment:** Facts about plastics use and proven findings about the occurrence of plastics and microplastics in the environmental matrix, be it on land and water bodies including the sea.
- **Terminology**: The terms "plastic particles", "plastic microparticles", "microplastics", "plastic nanoparticles" or "solid microparticle" are currently not defined in a consistent way and are, especially in an international context, being used differently. This document makes an attempt towards a globally harmonized terminology.
- **Test methods:** Methods for the detection, analysis and assessment of plastic particles present in the environment, such as aquatic litter, are neither harmonized nor standardized. Simple visual tests, in particular, have proved to be insufficient. This document will describe the sampling, its preparation of samples and further analytics, especially in waters as the main task of this document, since reproducible and verifiable procedures are indispensable to derive valid data for the environmental assessment and on this basis concluding appropriate measures to improve the environmental situation.

Not only has the plastics economy recognized the importance of this topic and started diverse action programmes, which are, for example, compiled through the Global Plastics Declaration Initiative, also political groups (e.g. G 7 and G 20), international organisations such as OECD, administrations of regions and individual countries are increasingly taking care about the serious issue of littered plastic waste and microparticles in the environment. In addition, numerous research activities have also been initiated. All these key stakeholders will highly benefit from a globally harmonized procedure.

This document includes references to studies and investigations in relation with plastics in the environmental matrix and biota, including microplastics. Important is the chapter terms and definitions. It presents the basis for future work in ISO. The description of the size classes is particularly relevant. Reference is made to other classifications of other organizations, for example in the area of Nanoparticles. The references selected within this document reflect the current knowledge without claiming to be complete or fully up-to-date.

Scope

This document summarizes current scientific literature on the occurrence of macroplastics and microplastics, in the environment and biota. It gives an overview of testing methods, including sampling from various environmental matrix, sample preparation and analysis. Further, chemical and physical testing methods for the identification and quantification of plastics are described.

TERMS AND DEFINITIONS ACCORDING TO ISO/TR 21960:2020

POLYMER	chemical compound or mixture of compounds consisting of repeating structural units created through polymerization
PLASTIC	material which contains as an essential ingredient a high polymer (3.1) and which, at some stage in its processing into finished products, can be shaped by flow
THERMOPLASTIC	plastic that has thermoplastic properties
THERMOSET	plastic which, when cured by heat or other means, changes into a substantially infusible and insoluble product
ELASTOMER	macromolecular material which returns rapidly to its initial dimensions and shape after substantial deformation by a weak stress and release of the stress
COMPOSITE	solid product consisting of two or more layers (often in a symmetrical assembly) of, for instance, plastic film or sheet, normal or syntactic cellular plastic, metal, wood or a composite with or without adhesive interlayers
ADDITIVES	chemicals added to polymers to improve/change the individual properties of the specific plastic material
MACROPLASTIC	any solid plastic particle or object insoluble in water with any dimension above 5 mm
MICROPLASTIC	any solid plastic particle insoluble in water with any dimension between 1 µm and 1 000 µm (=1 mm)
LARGE MICROPLASTIC	any solid plastic particle insoluble in water with any dimension between 1 mm and 5 mm
MICROPARTICLE	solid particle insoluble in water in the dimension between 1 µm and 1 000 µm (=1 mm)
MACROPARTICLE	solid particle not soluble in water in the dimension above 5 mm
NANOPLASTIC	plastic particles smaller than 1 µm
LITTER	solid object disposed of or abandoned in the environment
MARINE LITTER	litter found in the marine or coastal environment
WASTE	any material or object which the holder discards, or intends to discard, or is required to discard
ENVIRONMENT	conditions and surroundings that might influence the behaviour of an item or biotic life
AGEING	entirety of all irreversible chemical and physical processes occurring in a material in the course of time
BIOTA	living organisms in the environment

CEN/TC 248/WG 37 -- MICROPLASTICS FROM TEXTILE SOURCES

WI 00248719 TEXTILES AND TEXTILE PRODUCTS — MICROPLASTICS FROM TEXTILE SOURCES PART 1: DETERMINATION OF FIBRE LOSS FROM FABRICS DURING WASHING

Context

There is significant evidence that during laundering of textiles, fibre loss and fragmentation can occur. These fibre fragments find their way through drainage systems into water courses and oceans, whereupon it is suggested that they are ingested by aquatic life (fish, shellfish, etc.). The purpose of this document is to provide a method of assessment, to be used in laboratories, of the degree to which different fabrics shed collectable material including all kind of fibre fragments. The results obtained by using this document will enable manufacturers of textile articles to make an informed choice about the type of fabric to use to reduce/minimise shedding as well as to test different methods of manufacture that minimise fibre loss during use/laundering.

Scope

The method provides a means of systematically evaluating fibre loss from fabrics under defined washing conditions to achieve comparable and accurate results. The method is designed to assess loss from all fibre types.

This method does not reflect real conditions in washing machines/washer-dryers but provides only a mean of systematically evaluating fibre loss from fabrics.

ISO/TC 38/WG 34 -- MICROPLASTICS FROM TEXTILE SOURCES

ISO/WD 5228: 2020(E) -- TEXTILES -- DETERMINATION OF MASS OF FIBRE DEBRIS RELEASED FROM TEXTILE PRODUCTS USING DOMESTIC WASHING MACHINE

Context

Recent studies on environmental pollution have revealed that microplastics are contained in sludge of water treatment plant and marine water, and microplastics are also detected in marine life. This source of microplastics is various plastic products used in human life, and it is thought that it is caused by its disposal of plastic products, abrasion of plastic products during use, etc. A typical source of microplastics is wear pieces of vehicle's tyre which is effluent by rainwater and airborne dust, and it is considered that the waste is discharged to the ocean.

The fibre waste generated when washing clothes, which is essential for human life, passes through the wastewater treatment, flows into the river, then flows out into the ocean. It is considered that the size of fibre waste discharged from domestic laundry is not necessarily less than 5 mm which is called as microplastics, but which are crushed and miniaturized during the path of discharge to rivers and oceans. It is easy to think of becoming a microplastics.

Many papers have been published on the fibre wastes that are discharged from the washing of textile products and are of great concern in the apparel industry. Among them, there is no clear evaluation standard, and therefore they are adopting their own evaluation conditions.

The textile product mentioned here is a finished clothing product such as shirt, pants, fleece, blouse, etc., a textile product such as a blanket, a rug, etc., and does not include a cut test sample of the fabric or the products. Although there are many types of washing machines used at home, ISO has developed the ISO 6330 domestic washing test method, which describes the domestic washing machines and test conditions. In addition, a care label specified by ISO 3758 is attached to textile products worldwide, and this care label defines washing conditions.

The **purpose of this test method is to collect the fibre debris that are discharged from the washing machine by being separated from the textile product during the washing** of the textile product in harmony with those existing standards. The collected fibre debris may later be sent for analysis of components, and the components removed, amount of fibre debris, size, etc. may be analysed. In that sense, this test method implies a pretreatment for the analysis of these discharged fibre debris.

Due to the complicated structure of the washing machine, the fibre debris collected from the washing machine may be a residue generated by incomplete washing of washing machine. Therefore, the cleaning method of the washing machine and the conditions for establishing the test are also important issues. There is also the possibility of debris from textile accessories.

The fibre debris collected by this test method may contain the above-mentioned foreign substances, and the content cannot be analysed by simple fibre discrimination. The fibre debris contained in this content will be analysed by utilizing currently proposed ISO/AWI 4484 as taking harmony with CEN/TC248/WG37.

It is considered that this information can be utilized by the textile industry for the development of clothes, textile products, etc., which generate a small amount of laundry waste.

Scope

This document specifies a method for determination of mass of fibre debris released from outlet of washing machine during washing of textile products in accordance to washing conditions specified in ISO 6330.

This document applies to all textile products which are composed of all fibres such as natural fibres and man-made fibres, including mixture of the fibres.

The textile products applied for this test method are clothing, garments, such as fleece, shirts, trousers, blouse, etc. and rugs, curtains, etc. as end textile products. This document is not applicable to fabrics and cut textile products.

IMPORTANT NOTICE

LAUNDERING ADVICE TO REDUCE RELEASE OF MICROPLASTICS FROM CLOTHING

The internet is packed with all sorts of laundering tips to reduce the release of microplastics from clothing, some of which are based on tests, but with no proper verification of their validity. We would like to point out to our readers that a lot of research and testing is still needed to be able to finalize the necessary CEN and ISO standards verified by round robin (interlaboratory) tests.

HOWEVER, BY CHANGING YOUR WASHING BEHAVIOR, YOU CAN ALREADY MITIGATE THE NUMBER OF MICROFIBERS THAT YOU SEND DOWN THE DRAIN: WASH DIRTY CLOTHES ONLY, ON A LOW TEMPERATURE, USE LIQUID DETERGENT, A SOFTENER AND WASH WITH A FULL LOAD

TO BE CONTINUED ...

The Road to Microplastic Pollution

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PARTICLES from tyre and break wear are a major source of microplastic pollution of remote regions, according to a recent study.[1] In recent years, marine, freshwater and terrestrial pollution with microplastics has been discussed extensively, whereas atmospheric microplastic transport has been largely overlooked.

ROAD TRAFFIC EMISSIONS ARE A MAJOR SOURCE OF MICROPLASTICS

An important source of plastics is road traffic emissions with global average emissions of tyre wear particles (TWPs) of 0.81 kg/year per capita, about 6.1 million tonnes (~1.8% of total plastic production). Emissions of brake wear particles (BWPs) add another 0.5 million tonnes. TWPs and BWPs are produced via mechanical abrasion and corrosion.

Tyres consist of a mix of elastomers such as rubber (natural and synthetic), carbon black, steel cord, fibres, and other organic and inorganic components used to improve their stability; TWPs are produced by shear forces between the tread and the road pavement, generating coarse particles, or by volatilization generating submicronic particles. The wearing process depends on the type of tyre, road surface and vehicle characteristics, as well as on the vehicle's state of operation.

Most car braking systems consist of a disc or drum with either a pair of shoes or pads mounted in callipers. Brake linings consist of binders, fibres, fillers, frictional additives or lubricants and abrasives. Thus, BWPs are a complicated mixture of metal and plastic. BWP emissions depend on the bulk friction material, on the frequency and severity of braking, speed, weight, condition and maintenance of the automobile and the environmental conditions

Previous studies have found that tyre abrasion is one of the most significant sources globally of microplastics in aquatic ecosystems. It's also one of the few sources of microplastics that researchers can estimate global emissions for. About 34% of the emitted coarse TWPs and 30% of the emitted coarse BWPs were deposited in the World Ocean.

The researchers used two different models to calculate how much they are producing in different regions of the world. The most particles are emitted in the eastern United States, northern Europe, major Chinese cities and dense parts of the Middle East and Latin America.

THE STUDY ESTIMATES THAT MORE THAN 3 MILLION TONNES OF MICROPLASTICS ARE PRODUCED FROM TYRE AND BRAKE WEAR

The researchers used a dispersion model to determine where the particles go next. They found that larger particles - those roughly one-fifth the diameter of a human hair - can float in the air for between five and 11 days, but are typically deposited near the place they were produced. Smaller particles, however, can drift on the wind for much longer and often do travel great distances.

1 Atmospheric Transport Is A Major Pathway Of Microplastics To Remote Regions (N. Evangeliou, et. al) 14/7/2020 https://www.nature.com/articles/s41467-020-17201-9

Of these smaller tyre plastics, roughly 57% land in the ocean, making them a major contributor of ocean microplastics. Significant amounts of these tiny particles, the study found, also land on snow and ice surfaces, including in the Arctic. Since the mid-1990s, the Arctic has warmed at a rate more than twice the global average. The region's sea ice cover is also shrinking, and Greenland's massive ice sheet experienced near-record melting in 2019.

Previous studies have found that dark soot particles that land on snow and ice can darken the surface, increasing the amount of heat energy absorbed by the ice and in turn, accelerating melting. And as dark microplastic particles land in the Arctic, they too could be contributing to melting, according to the study:

> "We find a transport efficiency of almost 3.6% for the Arctic (excluding Greenland) and a similar transport efficiency for Greenland. These transport patterns may potentially intensify the climatic risk of microplastic pollution with respect to their ability to decrease the albedo in the Arctic and enhance snow and ice melting. In addition, road microplastics may concentrate in Arctic melt pools, with unknown ecological consequences. TWPs and BWPs constitute ~1.8% of total plastic production, hence the anticipated impact of all microplastics arriving to snow and ice surfaces might be greater."

ANALYSIS OF TYRE AND ROAD WEAR PARTICLES (TRWP/TWP) IN THE AQUATIC ENVIRONMENT[2]

In general, the qualitative and quantitative analysis of particles in size ranges from about 10 nm to 5 mm (covering the ranges of microplastic particles) in fresh waters, oceans, soils, biota and all kind of freshwater, estuary and ocean sediments is one of the most complex issues in modern environmental analysis. Analysis of these particles in air samples is comparatively easier and has been developed several decades ago, since atmospheric particulates became of great interest ("smog").

Air analysis is now a standardised methodology and in frequent use. Similar approaches for the aquatic environment are still in their infancy and will need years of development and application checks.

The analysis of particles includes the sampling from the environmental compartments, sample handling and treatment and final analysis. All steps are sources of many errors and deficiencies. There are no harmonised methods available at this date and it is the task of many groups to develop standard operating procedures or even standardised methods. The cut-off size in filtration is one of the determining factors, as many researchers use very different filter pore sizes, from below 1 µm (by membranes) up to meshes with 333 µm openings.

If tyre wear particles are the target, some of the methods for conventional microplastic do not work (like infrared, IR or Raman spectroscopy), due to strong interferences with the other compounds in tyre materials.

Qualitative analysis of TRWP/TWP

The task of qualitative analysis of TRWP is the identification of TRWP in samples, but not their mass or particle sizes and numbers. The results are: presence or absence.

The microscopy methods (light and scanning electron microscopy) are most suited, but the particles can be only identified if they show clear characteristic features like shape, size, colour or any ingredient which can be seen by activation. The main problem in real world samples is the presence of other particles, mostly present in excess.

The optical identification of TRWP is based on the assumption of an elongated shape in the size range from 5 – 250 µm (Kreider et al, 2009), the black colour and the observed inclusion of mineral road particles in the agglomerates. However, black particles are frequently found, not being TRWP and the agglomerates may be not stable in the aquatic samples, due to disintegration, a process not yet studied.

Scanning electron microscopy with the addition of elemental analysis are other approaches to identify and characterise the TRWP. However, the chances for the determination of the mass of TRWP/TWP in samples as well as the size distribution are low or are very time consuming, even for enriched environmental samples.

Quantitative analysis of TRWP/TWP

The quantitative analysis of particles in general needs a well-defined target system:

- Mass determination together with the identity of materials (thus concentration or content in environmental samples)
- Particle sizes and size distribution, particle numbers together with the identity for the different materials in the particles.

The present experience for microplastic analysis in the environment indicates that the different methods are not congruent for the same samples: The calculation of masses of microplastics out of particle types and sizes does not lead to similar results, due to severe limitations of all present methods.

Conclusion

The present methodology for sampling from waters, for sample treatment and for final analysis of masses and single particles of TWP/TRWP is insufficient and neither harmonised nor standardised. There are some recent developments which appear somewhat promising. The different methods under development for microplastics are only partly suitable. The analytical results are needed for validating modelling efforts and for the risk assessment of TRWP in the environmental compartments.

2 https://www.tyreandroadwear.com/wp-content/uploads/2019/10/FINAL-Scientific-Report-on-Tyre-and-Road-Wear-Particles.pdf

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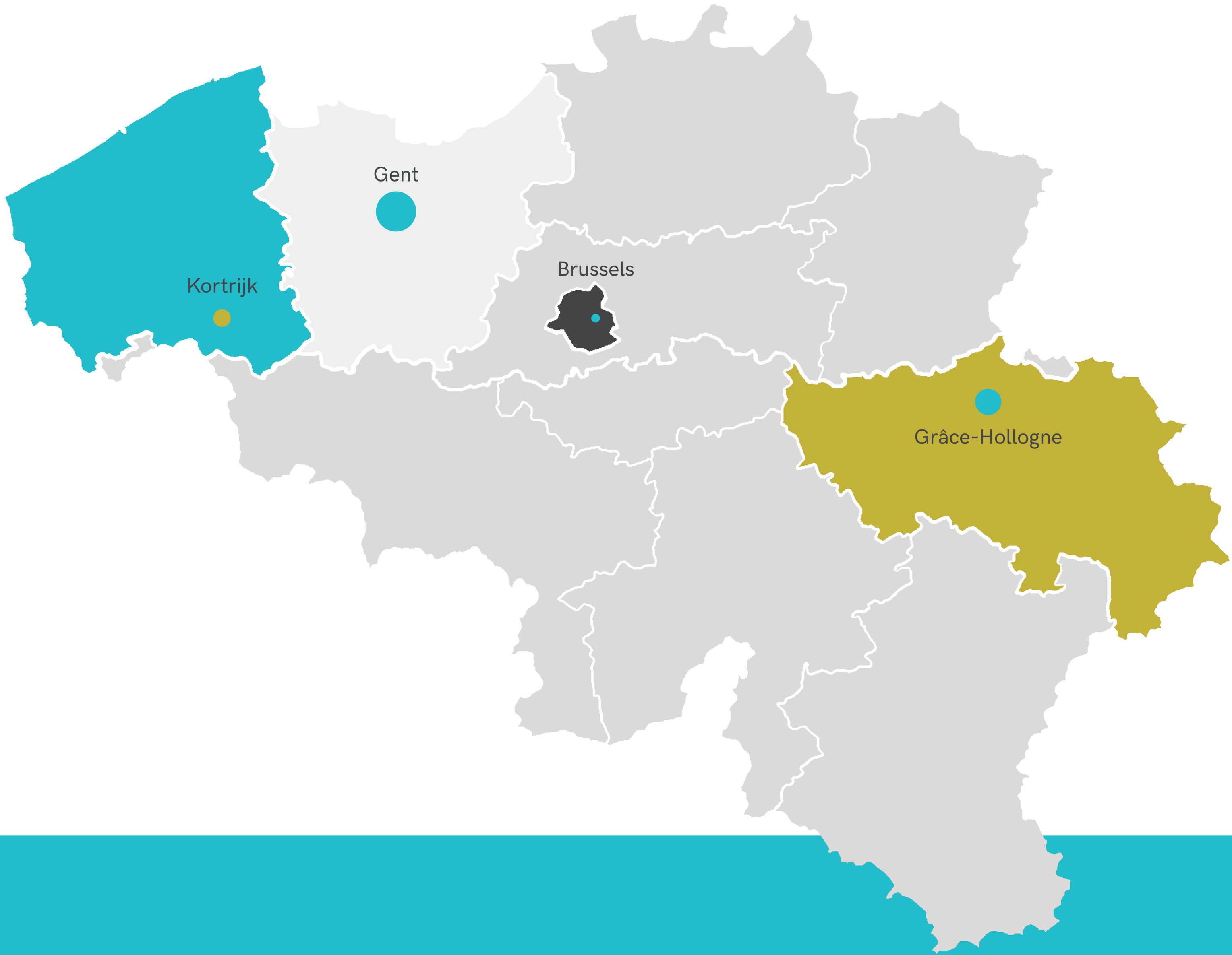

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