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European Commission

Initial Statement§ by the Group of Chief Scientific Advisors

A Scientific Perspective on Microplastic Pollution and its Impacts

Starting Considerations

Concern about the presence of microplastic particles[1] in soil, air and water and their effect on biota and human health is increasing among scientists, policy makers and the public. This is due to steadily improving knowledge of the scale and impacts of pollution by plastic in general and by microplastics in particular, either intentionally produced or formed by the degradation of larger plastic items. Heightened media attention to marine and land-based plastic pollution with images of floating garbage patches, littered beaches, entangled and suffocated animals and zooplankton ingesting plastic particles is also contributing significantly to public awareness.

This concern is welcome as it creates awareness of wider environmental issues such as global climate change, and stimulates change towards dealing with plastics as part of a circular rather than a linear economy. However, action needs to be guided by scientific evidence and directed towards effective and proportionate mitigating measures.

There is a consensus that plastic pollution must be curtailed and where possible eliminated altogether. For the mostly invisible[2] microplastic component of this pollution, such a view is reinforced by multiple potential negative impacts on biota and ecosystems for which empirical evidence is slowly emerging. A consequence of this is a rise in legislative and other measures by public authorities such as the EU Plastics Strategy[3] launched in January 2018, and voluntary actions by businesses, interest groups and citizens (Dauvergne, 2018a, 2018b). Most attention has so far has focused on water-borne microplastics resulting from the break-up of discarded larger items and microbeads found in a variety of products.

As is often the case in an emerging field of science where evidence is limited, the negative impacts of microplastics are not fully understood. Very few publications to date report dose-response relations over a range of microplastic concentrations as is normally done in risk assessment studies (Lenz, Enders, & Nielsen, 2016). Moreover, most evidence of negative impacts on biota such as inflammation, disruption to growth or reproduction and other bio-toxicological responses have been found in laboratory studies at particle concentrations higher than those in the majority of habitats (e.g. Wen et al., 2018; or references cited in the following review articles by Galloway et al., 2017; Revel et al. 2018; Wright & Kelly, 2017). While increased microplastic concentrations may arise from rapidly growing plastics production (Backhaus & Wagner, 2018) it is currently unknown whether toxicologically-relevant concentrations of microplastics exist or will be reached in the future. Indeed, while the environmental concentrations of small (< 100 µm) more toxicologically-relevant microplastics are largely unknown, they are probably higher than established concentrations of larger microplastics[4].

§More detailed Explanatory Note and Scientific Opinion to follow

[1] In the size range from 5 mm down to the nanometre (nm) scale

[2] The smallest size visible to the naked eye is about 0.1 mm or 100 micrometres (µm or microns)

[3] A European Strategy for Plastics in a Circular Economy

[4] Current EU chemicals regulation considers that it is not possible to establish safe 'thresholds' for certain types of

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We, the Group of Chief Scientific Advisors, consider that all current scientific knowledge and present knowledge gaps on the topic should be taken into account when shaping actions and policy measures. This should entail consideration of what science says about the ecological and health risks of all sources and types of microplastic pollution and the environmental compartments (air, soil or water) where they are found - notably those that are most abundant (synthetic fibres, tyre abrasion, break-up of macroplastics, etc.). It should also consider scientific studies of how the views and actions of citizens and policy makers are influenced by a wide range of factors – scientific, economic, psychological, cultural, etc. (Sedlak, 2017), including how risks and interests are perceived (Anderson et al., 2016; Völker et al., 2017).

Based on the above considerations and a discussion with scientific experts in the field[5], we have decided to look at the health and environmental impacts of microplastic pollution. Our input to both policy and the public discussion will be driven by scientific argument and evidence (Rist et al., 2018). We intend to draw on all relevant published findings as a basis for formulating our advice.

The policy & broader context for microplastic pollution

From an efficiency and 'better regulation' perspective, it is the responsibility of the Commission to critique its policy actions with a view to maximising public good outcomes. This means taking into account in a fair and balanced way all evidence and arguments, especially in cases where public opinion and interest groups call for a specific course of action which might not be the best. It is also important to monitor and critique actions already launched to ensure that the right targets were chosen and, if not, to correct this. Evidence-based scientific advice plays an important role in this regard alongside social, economic and political considerations.

In a situation where the implementation of the Plastics Strategy looms large on the EU policy agenda, scientific advice will be of benefit to several on-going[6] or forthcoming initiatives of relevance to microplastics. The on-going reviews by the European Chemicals Agency (ECHA) of the scientific bases for, and socio-economic consequences of, introducing restrictions on deliberately added microplastics and oxo-degradable plastics are particularly pertinent. Looking beyond the Plastics Strategy, such advice may have a bearing on REFIT[7] legislation reviews (e.g. of the water framework directive which originally did not consider plastic pollution), and other regulatory initiatives such as the revised drinking water directive and others.

The relative scarcity to-date of scientific data on the toxicological hazard of microplastics is not a reason to allow their continued release into the environment – better safe now than sorry later when science may be in a position to assess the environmental risks more comprehensively. In other words, absence of evidence is not the same as evidence of the absence of harm. Still, the opportunity cost to society of implementing bans on one type of pollutant and not others should also be considered from objective evidence-based perspectives. The fact that microplastics intentionally added in products are not the largest contributor to microplastic pollution (Scudo et al., 2017) raises the question of where else (e.g.

substances, notably for substances with effects which are difficult to predict over long time horizons or where impacts would be difficult to reverse - so-called Persistent, Bioaccumulative and Toxic (PBT) and very Persistent and very Bio-accumulative (vPvB) substances

[5] See https://ec.europa.eu/research/sam/index.cfm?pg=topics

[6] E.g. the recently-proposed EU Directive on single-use plastics and fishing gear - COM(2018)340

[7] The EC's Regulatory Fitness and Performance programme

unintentionally generated microplastics (Hann et al., 2018)) public policy concerns should focus and with what urgency - based on evidence and analysis of the underlying causes. It is also likely that specific restrictions, when successful, will facilitate regulatory and other voluntary actions aimed at restricting/ eliminating larger emissions.

Complexity of microplastics

The properties of microplastic particles and current knowledge gaps justify concerns with respect to toxicity, mobility, persistence, etc. (Koelmans et al., 2017). From a societal and life-cycle point of view, microplastics cannot be considered in isolation from the overall plastics pollution problem because most microplastics originate from the breakdown of macroplastic items (Kramm et al., 2018), though with some variability between soil, air and water compartments. Furthermore, the umbrella term 'microplastic' describes a very diverse category of materials in terms of the ranges of polymer types, particle sizes (ranging over six orders of magnitude), shapes (from spheres to fibres) and chemical formulations (thousands of different types), which are likely to be found in various context-specific exposure situations (Lambert at al., 2017).

Grouping together particle sizes spanning six orders of magnitude is very crude[8]. This is relevant when considering potential impacts on living organisms due to particles crossing biological barriers (e.g. cell walls, intestinal or blood-brain barriers) , which can only occur for sizes approaching or below the micron scale (Wright & Kelly, 2017). Physical and chemical phenomena such as absorption and adsorption of other pollutants may also become more acute for nano-scale plastic particles than they are for those at and above the micron scale. While much still needs to be learned about the incidence and effects of nano-scale plastic particles, it is likely that science can already provide evidence of relevance to policy, which may suggest the need to distinguish between different components of this very broad microplastics size class. It is also worth noting that larger particles progressively degrade into smaller ones over a long period of time, though certain physical, chemical and biological conditions can accelerate this process.

Other complexities relate to the presence and behaviour of microplastics in different media and their movement between compartments (soil, air, and water). Most scientific studies to date have focused on the marine environment (water column, coasts and sediments), but more and more studies are being published on soil, freshwater systems and the atmosphere. It is also likely that the scientific findings in relation to these and other dimensions of microplastics complexity will suggest the need for specific policy and regulatory responses.

Next steps

In light of the above, it will be useful to provide the Commission by the end of 2018 with an Explanatory Note which captures the different facets of the complexity of microplastics. This Explanatory Note, based on a planned evidence review report by SAPEA[9] giving a state-of-the-art synthesis of relevant published scientific evidence and findings, will be presented in a way to promote a more informed public and policy debate.

The proposed components of the Explanatory Note are:

1) A rapid evidence review, map and summary of the many existing natural sciences reviews and

[8] to give a sense of the range note the following typical sizes: human hair thickness 0.08 mm (80 µm); animal cell 20 µm; blood cell 8 µm; bacterium 1 µm; virus 0.1 µm (100 nm); smallest smoke particles 10 nm; glucose molecule 1 nm; water molecule 0.3 nm

[9] SAPEA is key part of the Scientific Advice Mechanism

overview reports[10] covering exposure, (eco)toxicology, environmental and human health risks and incorporating recent primary literature not covered by existing reviews

2) A digest and analysis of the social and behavioural sciences covering issues such as risk perception[11] by citizens, the behaviour of stakeholders, the political economy and psychology of the microplastic debate, public good, and opportunity cost policy considerations
3) A political and legal sciences analysis of the different national and international legislative/ regulatory/ policy frameworks of relevance – including substance-focused (REACH, drinking water,…) and ecosystem-focused (water framework directive, marine strategy framework directive, …) measures
4) An assessment of relevant modelling approaches and of their potential to shed light on some of the more complex aspects of microplastics including future "what if?" and "under which conditions?" scenarios.

Following on from the Explanatory Note, we would aim to publish a series of recommendations in the form of a Scientific Opinion in spring 2019.

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[10] including meta analyses such as the one by Foley et al., (2018)
[11] Including how it differs from scientific notions of risk as used in risk assessment

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