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PPI STATEMENT AB

Microplastics and Plastic Piping for Potable Water

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For over 70 years, the Plastics Pipe Institute (PPI) and our members have been dedicated to promoting the safe use of plastic piping systems. In doing so, a commitment to health and safety has always been our highest priority. Working with third-party certifiers, plastic pipe and fitting producers in the potable water industry demonstrate compliance with drinking water requirements and earn certifications, through testing and unannounced plant audits. These show that their materials and finished products satisfy the requirements of national and international health standards such as the Safe Drinking Water Act (SDWA) (www.epa.gov/sdwa) and those of Health Canada.

Plastic piping is extensively used for a wide variety of potable water applications, including municipal water distribution and hot- and cold-water plumbing distribution. This PPI Statement addresses concerns about the risk of microplastics originating from piping materials Polyethylene (PE), Crosslinked Polyethylene (PEX), Polyethylene of Raised Temperature Resistance (PE-RT), Polypropylene (PP), and Chlorinated Polyvinyl Chloride (CPVC) used in these applications.

Microplastics are tiny pieces of plastic that come typically from larger objects when they are broken down by sunlight, oxygen, or friction. It has been estimated that the majority of microplastics are from laundry (34.8%) and wearing of tires (46.2%)[i]. People are exposed to microplastics when they breath air and dust, drink liquids, and eat food. Microplastics (MP) are typically defined as plastic particles below 5mm in diameter (about ¼ inch) and include nanoplastics that are typically defined as having dimensions in the range of 1 to 1,000 nm (0.000 001 to 0.001 mm)[ii]. Microplastics in the environment are the subject of increasing discussion and research.

It is important to differentiate between durable plastic products and disposable plastic products when considering sources of microplastics. Durable plastic products, i.e., those that do not wear in their intended application, are not considered significant contributors of microplastics during their service life.

This statement addresses three questions:

1. Are plastic pipes a meaningful source of microplastics in drinking water?
2. Are microplastics toxic to humans?
3. What are PPI member companies doing to minimize microplastics in the environment?

[i] *Microplastics in drinking-water*, World Health Organization, Geneva, Switzerland, 2019.
[ii] *Dietary and inhalation exposure to nano- and microplastic particles and potential implications for human health*, World Health Organization, Geneva, Switzerland, 2022.

Are plastics pipes a meaningful source of microplastics in drinking water?

There are reports of microplastics within source waters and water distributed by water treatment facilities. Studies reporting microplastics in drinking water may not represent typical North American water treatment practices and are also frequently criticized for their sampling and measurement methodologies. The World Health Organization (WHO) study *Microplastics in Drinking Water*, 2019 reviewed studies of the efficacy of drinking water treatment and, while noting that treatments varied, concluded that "conventional drinking water treatment (coagulation, sedimentation and filtration) is designed to remove particulates and is therefore expected to effectively remove microplastics, particularly when optimized to produce treated water of low turbidity." [iii]

One German study examining the microplastics generated through the distribution system consisting of metal and plastic piping concluded that "the overall mean of 0.7 microplastics/m^3 (conversion 0.003 microplastics/USgal) indicates a low contamination of drinking water with microplastics (>20 µm) and a negligible human exposure via drinking water directly." [iv] Similarly, another German study found "At house connections and in the transfer station, no microplastics ≥10 µm were detected in the drinking water of the medium-sized German city investigated" where "pipelines in the municipal network are made of gray iron cast (60.6%), ductile iron cast (16.6%), high density polyethylene (PE-HD) (21.8%), concrete (0.7%), and 0.5% of unknown material."[v]

Based on PPI's literature search of North American and European literature, there is no indication that plastic piping is an important source of microplastics in drinking water. Most existing plastic piping systems for potable water distribution and plumbing applications are designed for 50+ years of service. In fact, there are case studies of plastic potable water piping that have been in service for 60 years or more. Plastic pipes are selected for water service due to their known resistance to corrosion and erosion, and smooth inner pipe walls that do not promote tuberculation and bacterial growth. Erosion of the pipe wall material, which would be necessary to create microplastics from pipes, would result in significant reduction of the pipe wall that is not consistent with 50+ years' service and field evidence. It is important to differentiate between engineered, long-lasting plastic products, such as plastic piping and other plastic constructions materials, and disposable plastics or materials with short lifetimes when thinking about microplastics.

The plastic piping industry is highly regulated within the USA and Canada with systems of codes, standards, and third-party certifications which are extremely rigorous with regards to pipe materials (ingredients), production controls, and finished products. Related to drinking water safety, all plastic pipe, tubing, and fittings and system components must comply with federal regulations. NSF/ANSI/CAN 61 "Drinking Water System Components - Health Effects" is the nationally recognized standard in the United States and Canada for evaluating the human health effects of drinking water materials, components, and devices, and ensuring that approved

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[iii] Boucher, J. and Friot D. (2017), *Primary Microplastics in the Oceans: A Global Evaluation of Sources*, Switzerland: IUCN. 43pp.

[iv] S.M. Mintenig, M.G.J. Löder, S. Primpke, G. Gerdts, *Low numbers of microplastics detected in drinking water from ground water sources,* Science of The Total Environment, Volume 648, 2019, Pages 631-635, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2018.08.178

[v] Felix Weber, Jutta Kerpen, Sebastian Wolff, René Langer, Vanessa Eschweiler, *Investigation of microplastics contamination in drinking water of a German city*, Science of The Total Environment, Volume 755, Part 2, 2021, 143421, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2020.143421

materials are safe for drinking water. Through these certification processes, certifiers know exactly what materials are used in each pipe or tubing formulation, and the safety of these products is repeatedly verified through frequent unannounced plant inspections and testing of collected samples on a regular basis.

Plastic piping systems have always been designed to provide safe, reliable supply of drinking water without the historic problems of corrosion, leakage, mineral build-up, release of metallic elements into drinking water, or any combination thereof, which may affect the water potability. Plastic piping systems are specified by engineers for their performance and are chosen by builders, plumbers, and homeowners for their reliability and safety. There is no evidence that plastic pipes and fittings are a meaningful source of microplastics in drinking water.

In fact, most plastic water pipes are highly recyclable at the end of their service life.

Are microplastics toxic to humans?

There is no clear evidence that microplastics have an impact on human health. Research has examined whether microplastics are directly toxic, whether microplastics act to convey toxic chemicals and whether microplastics lead to toxic biofilms. The 2019 World Health Organization (WHO) *Microplastics in Drinking-Water* report[iii], concluded:

- "Although it is not possible to draw any firm conclusion on toxicity related to the physical hazard of plastic particles, particularly the nano size particles through drinking-water exposure, no reliable information suggests it is a concern. Humans have ingested microplastics and other particles in the environment for decades with no related indication of adverse health effects. In addition, drinking-water treatment is effective at removing particles. Although there is only limited quantified evidence on microplastic removal across water treatment processes, conventional drinking-water treatment (coagulation, sedimentation, and filtration) is expected to effectively remove microplastics since conventional treatment is designed to remove particulates, particularly when optimized to produce treated water of low turbidity. Advanced treatment, particularly membrane filtration, would be expected to achieve 100% removal of particles >0.001 μm for nanofiltration, >0.01 μm for ultrafiltration and >1 μm for microfiltration."
- "The substantial margin between a theoretical conservative exposure to a range of chemical contaminants detected in microplastics through drinking-water and the level at which no or limited adverse effects were seen, indicates there is a low health concern for chemicals associated with microplastics. Applying assumptions with higher particle numbers in smaller size ranges does not change the conclusions."
- "The risks from pathogens in microplastic-associated biofilms is considered far lower than the well-established risk posed by the high concentrations and diversity of pathogens present in human and livestock waste, which often make their way into drinking-water sources with inadequate treatment. Further, the relative surface area for attachment and transport of microorganisms, including pathogens, is far lower for microplastics based on the concentrations reported in drinking-water and drinking-water sources compared to the concentrations of non-plastic particles that contribute to normal turbidity in water. For microplastics that are not removed during drinking-water treatment, these particles also provide an extremely small surface area for the development of biofilms compared to drinking-water distribution systems and therefore, the relative significance of microplastics-associated biofilms is still likely to

be negligible. Regardless of source, drinking-water treatment is largely designed to remove particles and the use of both clarification processes and disinfection, including disinfection in distribution systems, will reduce the potential for any pathogens to be present in drinking-water."

In 2022, the World Health Organization (WHO) released a comprehensive report on Dietary and inhalation exposure to nano- and microplastic particles and potential implications for human health[ii]. Among the conclusions, the authors included:

- "Microplastics are ubiquitous in the environment and have been detected in environmental media with direct relevance for human exposure, including air, dust, water, food and beverages."
- "Observations from particle and fibre toxicology indicate that only particles < 10 μm (0.01 mm) are probably taken up biologically."
- "… that the available data are of only very limited use for assessing the risk of nano- and micro-plastics to human health."
- In terms of "the quality, reliability and relevance of data on both exposure and effects the quality reliability," "several shortcomings were identified, the most important of which was the heterogeneity of the methods used, including use of "bespoke" methods for analysing data obtained by environmental monitoring and inconsistencies in observations of adverse effects."
- The authors recommended "assessment of the quality of the studies should promote best practices in experimental design to be used in future studies. It is generally recommended that standard methods be developed and adopted to ensure that the research community can reduce uncertainties, strengthen overall scientific understanding and provide more robust data for assessing the risks of exposure to nano- and micro-plastics to humans."

The above conclusions by the WHO point to the difficulties in studying the effects of microplastics on human toxicity, and the lack of coherent and relevant research on the toxicological impact of microplastics on humans and that most existing academic studies have serious gaps in their methodologies. The WHO report is clear that the human digestive system has numerous methods for preventing of the uptake of particulates, including microplastics, and that in-vitro studies are "inadequate for risk assessment because of the use of unrealistic high concentrations and the testing of predominantly of polystyrene beads, which are not considered to be representative of environmental exposure."[i]

At this time, there is not clear evidence that microplastics in the environment have an impact on human health. PPI will continue to monitor academic research on this topic.

What are PPI member companies doing to minimize microplastics in the environment?

The plastics piping industry minimizes microplastics in the environment by making plastic piping products that are durable and provide long-term performance and reliability.

While estimated to only contribute less than 0.1% of plastics in the ocean[iii], PPI and the plastics industry has long supported efforts to implement best practices to eliminate the loss of plastics pellets during transportation and with housekeeping and handling in manufacturing operations. These plastic pellets, sometimes called plastic beads or nurdles, which are the typical format for shipping raw plastic materials by truck or railcar. Plastic pellets have a size that approaches the

upper size limit for microplastics, so are not of concern for human health. Many PPI member companies have taken the Operation Clean Sweep®[vi] (OCS) pledge and many have qualified for OCSBlue designation with the aim of eliminating plastics pellets in the environment. Barriers at plastic pellet transfer points are commonly used to contain any spilled pellets and screens are used to prevent pellets from entering storm and waste drainage systems. For more information on Operation Clean Sweep, see https://www.opcleansweep.org/.

Conclusion

The Plastics Pipe Institute and our members are dedicated to promoting the safe use of plastic piping systems with a commitment to health and safety as our highest priority. Durable plastic piping products, i.e., those that do not wear in their intended application, are not meaningful contributors of microplastics during their service life. The plastics pipe industry has shown exemplary dedication to the prevention of spillage of plastic materials in the environment, and PPI member firms implement best practices to eliminate the loss of plastics pellets during transportation and in manufacturing operations.

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[vi] “Operation Clean Sweep (OCS) was launched in 1991 as a campaign dedicated to helping every plastic resin handling operation achieve zero plastic resin loss. The Plastics Industry Association (PLASTICS) and the American Chemical Council (ACC) invite United States based companies to support OCS and ensure the principles of stewardship are embraced by everyone handling plastic materials.” - Operation Clean Sweep® (opcleansweep.org)