State of the Science for Microplastics in Biosolids

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Microplastics (MPs), polymeric particles which occur at a size range between 5,000 µm and 1 nm per regulatory definition by California State Water Resources Control Board, are associated with public health concerns and increasing environmental concentrations even in the unlikely event should plastic production and consumption cease today. Currently, the public's exposure is estimated at the ingestion of a credit card equivalent per person each week with sources including seafood, food packaging, bottled water, tap water, and even water infrastructure. Therefore, it is no surprise that microplastics are present ubiquitously in the environment and wastewater including via human excretion. MP contamination may pose considerable challenges for industries as these particles fragment into infinitesimally smaller size fractions, with nanoplastics being considered by US EPA as the potentially most concerning size fraction for human and aquatic health.

Recent research suggests that microplastics might have various impacts on wastewater treatment previously unknown: reduction of methane production in anaerobic digesters, plastic leakage from epoxy coatings, pipes, and pipe fittings, harbor for pathogens to evade disinfection, and becoming a carrier of attached toxins, such as per-and polyfluoroalkyl substances (PFAS).

Regulatory developments are gaining momentum in Europe and North America. California decided on a precautionary regulatory framework when recently proposing total maximum daily loads (TMDLs) for microplastics in ambient waters.

Research is in the process of quantifying different microplastic size classes reliably and defining treatment efficacies of conventional and advanced wastewater treatment processes for their removals.

Removed plastics from the wastewater liquid stream typically end up in the solids process stream along with microplastics partitioning to the solids. Microplastics are generally not removed during digestion and first studies indicate the potential for agricultural crop uptake of nanoplastics. Evidence of microplastic accumulation in agricultural soils is solidifying through international studies. A At this time, California is the first state in the US to regulate non-degradable plastics in composts.

Canada and certain European countries have proposed or established limits for plastics contamination in biosolids and compost as well. These limits typically focus on the macro and mesosize fractions of plastics. Smaller size ranges of microplastics that research is indicating may be taken up by agricultural crops are not yet addressed, as analytical method development is lagging.

The occurrence of microplastics has been linked with PFAS contamination. Both contaminants can co-occur because: 1) polymeric PFAS such as polytetrafluorethylene (PTFE) and polyvinyl fluoride (PVF) degrade into microplastics, 2) water-resistant coatings on polymeric clothing items release PFAS-laden microfibers, 3) PFAS adsorb onto microplastics, and 4) the propensity for fluoridated plastics such as polyethylene (PE) and polypropylene (PP) of all sizes to release PFAS. This last reason was recently discovered by the US EPA This presentation will bring these scientific, analytical, regulatory, and treatment developments to the attention of utilities, designers, and regulators. Source control options will be discussed along with recommended monitoring and mitigation strategies.