

Potential for Health Effects of Microplastics: San Francisco Bay Area Example

Usha Vedagiri (usha.vedagiri@wsp.com) (WSP, Rancho Cordova, CA, USA)

Background/Objectives. Microplastics (Mp) are emerging contaminants that are of high public and scientific concern, in part due to the prevalence and visibility of microplastic wastes and discards in the environment. Among the emerging regulatory actions worldwide, California is taking proactive steps to address concerns regarding production, use and release of source materials that may lead to Mp formation and release. There is much information on the occurrence of Mp in environments and laboratory studies that have documented the potential for human and ecological health effects. However, exposure does not equal effects and laboratory evidence of toxicity is not always detectable under field conditions. Differences in definition and measurement of Mp further cloud the issues. This study reviews recently published environmental information on Mp in the San Francisco Bay Area (Sutton et al., 2019), in the context of a proposed risk-based approach for Mp (Brander et al., 2021; Coffin et al., 2021, 2022; Shen et al., 2022), and literature-based effects thresholds (Koelmans et al., 2020, and others). Preliminary findings, uncertainties and recommendations are presented related to Mp distribution in California, exposure potential for human and ecological receptors, and health risk potential in relation to geographic areas, receptors and effects.

Approach/Activities. This study critically reviewed one of the more extensive sets of Mp field data currently available for a surface water body in relation to health-based thresholds presented in recent academic and quasi-regulatory publications. The influence of data reporting methods on data interpretation and estimated exposure concentrations was examined further (e.g., reporting plastics on a mass basis or particle density basis), separation of microparticles data into plastic and non-plastic components, and the classification of Mp by shape (e.g., fibers or fragments). Similarly, the basis of the health effects thresholds was reviewed from the perspective of intended receptor protection goals (e.g., aquatic biota), medium of expression (e.g., physical or chemical stress), and nature of health effects (e.g., survival, growth, behavioral). Finally, a comparison of field data from San Francisco Bay to recently-developed threshold values was performed to identify the potential for health impacts.

Results/Lessons Learned. The comparison of field data to laboratory-derived threshold values revealed some surprising initial findings. Spatial patterns in Mp distribution were noted in Bay waters. All reported concentrations were far below the health-based threshold values, implying that there would be no health concerns. However, several areas of uncertainty related to the conventional dose-response paradigm of risk assessment and the potential for underestimation of risk were noted. The potential for aquatic biota to consume preferred shapes, sizes and colors of Mp (that most resemble their preferred diet) rather than the most abundantly present particles may underestimate the risk potential. The abundance of Mp fibers in the field contrasts with the relative paucity of toxicity information for fibers and contributes significant uncertainty. Overall, this evaluation highlights the difficulties and uncertainties in the current state of interpretation of field-collected Mp data to risk-based thresholds and provides recommendations.