ABSTRACT

Author: Salehi, Maryam. Ph.D.
Institution: Purdue University
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Title: Exploring Contaminant Fate Within Plastic Water Infrastructure: The Nexus of Environmental Engineering and Material Science Frontiers
Major Professor: Andrew Whelton

Plastic pipes are increasingly being used to rehabilitate and construct new potable water systems in an effort to limit cost and avoid metal pipe corrosion drinking water quality and safety problems associated. Despite the explosive growth and installation of plastic pipes, gaskets, coatings, and liners in drinking water systems there are many misconceptions about these materials. Lack of knowledge about the contaminants fate within plastic plumbing materials presents a possible emerging public health problem as polyethylene plastic pipes are being installed in 75% of new building construction, and buried water service.

Water chemistry, environmental engineering, polymer and surface science and principles were applied to conduct this dissertation research and address several knowledge-gaps regarding plastic pipes. This work was enhanced with collaboration with the National Institute of Standards and Technology, University of South Alabama, and Michigan State University. This study was funded by National Science Foundation, US Environmental Protection Agency, US NASA and National Institute of Standards and Technology.

The dissertation research results are transformative and unique and provide new scientific contributions to drinking water safety, polymer and surface science and environmental engineering. Specific contributions include: (1) Discovery that presence of oxidized carbon nanofibers (CNFs) in polyester composite significantly influenced water-composite interactions and organic leaching, (2) Identification of the linkage between fixture water use and drinking water chemical and microbiological quality in a new green building, (3) Discovery that the low density polyethylene (LDPE) surface serves as a nucleation site for $FeSO_4.7H_2O$ crystals, (4) Invention of an ozone based accelerated aging method for LDPE oxidation, (5) Identification of the fundamental role of polymer surface chemistry and water quality on Pb precipitation on

LDPE. This study provides a foundation for continued exploration of contaminant fate in water infrastructure.