

ME 250 SEMINAR

Plastic pipes are here to stay, can we predict their lifetime?

High density polyethylene (HDPE) is increasingly used in infrastructure applications with a design service lifetime of several decades. In many cases, the HDPE member is exposed to a corrosive environment, such as in pipes carrying potable water, where the dissolved bleach selectively attacks the loosely packed amorphous phase of the polymer. The failure mechanism of HDPE transitions from a ductile to a brittle mode as the corrosion level increases. In this presentation, I will describe a coupled chemo-mechanical model that can simulate stress corrosion cracking (SCC) in HDPE piping exposed to a bleach solution. The key to the modeling approach is a constitutive model that separately considers the individual deformation and damage behavior of the amorphous and the crystalline phases. The embrittlement caused by corrosion is captured by relating the parameters of amorphous phase to the polymer molecular weight. The material constitutive model and diffusion-reaction model are combined in a finite element (FE) code to investigate the SCC. One of the interesting outcomes of this research is the development of a more traditional crack growth rate curve that can enable designers to predict lifetime of pipe materials in corrosive environments.

THURSDAY, April 8, 2021

ZOOM

11:00 AM - 11:50 AM



Susan Mantell is the James J. Ryan Professor and Head of Mechanical Engineering at the University of Minnesota. Prof. Mantell received her BS and PhD degrees from Stanford University. Her current research focus is on applications of polymers and polymer composites for engineering structures. Prof. Mantell is the recipient of several best paper awards from the American Society of Mechanical Engineering, and has received the National Science Foundation Young Investigator Award. She has also won several student nominated awards for outstanding teaching and received University recognition as the Morse Alumni Distinguished Teaching Professor of Mechanical Engineering.

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