

Abstract

Moisture absorption is known to detrimentally affect the mechanical integrity and durability of polymeric materials. Consequently, accurately characterizing the moisture diffusion into these materials is critical when predicting their service life behavior. The hindered diffusion model (HDM), that is, Langmuir-type absorption, has been widely used to successfully describe both Fickian and anomalous absorption behavior of polymeric materials. In this article, proper use of both exact and approximate solutions of the HDM model is illustrated on two material systems: nanoclay/epoxy composites and thin epoxy laminates. A parameter recovery technique, based on a modified version of the steepest descent search, is shown to accurately recover all absorption parameters simultaneously from experimental data. The absorption behavior predicted by the recovered parameters is then validated by long-term absorption data not used in the recovery process. The errors induced by approximate solutions are observed to be material-dependent and could be substantially larger compared to the exact solution. In addition, a novel method to computationally accelerate the recovery of the absorption parameters is proposed. The new technique uses the approximate absorption parameters as the initial guess. It is shown that this approach substantially reduces the computational effort by decreasing the number of iterations without compromising from accuracy. POLYM. ENG. SCI., 2016.