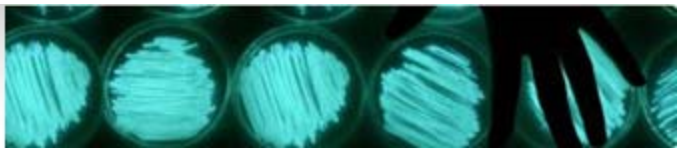


PORE-FLOW: A CFD Software for Liquid-Infiltration/Wetting Simulations in Industrial Porous Media

OTT ID# 1179

TECHNOLOGY

PORE-FLOW is a comprehensive CFD simulation focused on modeling liquid infiltration/wetting problems encountered in industrial porous media like those found in mold filling simulations in Resin Transfer Molding (RTM) to make polymer composites, as well as wicking into porous materials.

The Finite Element/ Control Volume (FE/CV) method is implemented in the code to simulate flow behind a moving-boundary. The algorithm is efficient and robust for solving the moving-boundary problems in complex domain geometries. The geometry may be 2D or 3D and the mesh may be structured or unstructured, giving maximum flexibility to the user. The porous-medium flow in the code is governed by either Darcy's law or Brinkman equation depending on user's choice. Besides the porous-medium flow, PORE-FLOW can also solve open-channel fluid flow problems governed by Stokes or Navier-Stokes equations. The heat flow as well as certain types of reactive flows can be simulated by the code. Some specific applications of the code include isothermal/non-isothermal mold filling in Liquid Composites Molding process involving single- or dual-scale fiber preforms, permeability prediction in stitched or woven fabrics, mold filling in Injection Molding process involving thermoplastics, and general laminar flow with/without moving-boundary.

MARKETS

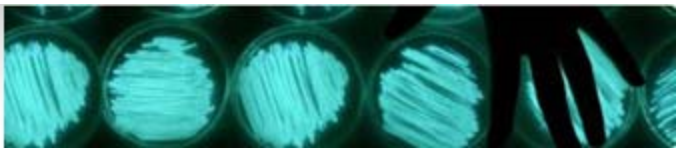
Applications such as aerospace and aviation continue to demand lighter weight and higher strength components. As a result, engineers are using polymer composites to meet such demands. Designers are often using woven and stitched fiber mats to pack more fibers in the polymer composites parts to achieve the targets of ever lighter weights and ever higher mechanical properties. However, the flow physics employed in current RTM mold-filling simulations do not have latest physics developed at UWM for modeling such dual-scale fiber mats. As a result, current simulations such as Moldflow are inaccurate in such applications. PORE-FLOW addresses this issue by incorporating the latest flow-physics needed to model resin flows accurately in woven and stitched fiber mats.

Wicking flows into porous substrates is important in applications where a liquid needs to be absorbed, or applications where a liquid needs to be moved through a wick. PORE-FLOW can accurately model such wicking flows driven by suction pressure applied at the moving liquid fronts in porous media.

PORE-FLOW can be used by RTM mold designers in a variety of industries, including aerospace, automotive, boat-building, and sports equipment manufacture. It can also be used by engineers dealing with wicking flows into porous substrates in industries such as manufacturers of incense dispensers, disposable sanitary products and paper.

FEATURES/BENEFITS

- Optimization of mold design in RTM, thereby lowering design costs, reduced prototyping costs, and minimized rework of molds
- Visualization of filling of a mold or a porous substrate for various injection scenarios
- Visualization of zones of partial saturations created in dual-scale porous media due to liquid flows
- Identification of dry spots in RTM molds
- Estimation of clamping pressures in RTM molds
- Modeling of reactive, exothermic flows in fibrous porous media
- Visualization of liquid-front motion during wicking flows in porous substrates with 3-D geometries



- Capability for optimizing the shape of porous substrates used in wicking/wetting applications
- Numerical estimation of permeability (for flows) in fabrics
- Modeling flows accurately in interfaces between open-channel and porous-medium regions
- Modeling Injection Molding type flows
- Ability to integrate with other CFD tools-FEM meshes can be created using ANSYS, and postprocessing can done with software such as TecPlot

INVENTORS

Dr. Krishna Pillai and Mr. Hua Tan

Dr. Pillai is Associate Professor in the College of Engineering and Science, Department of Mechanical Engineering. He is also the director of Laboratory for Flow and Transport Studies in Porous Media. PORE-FLOW software is based on his research in processing of polymer composites and plastics, numerical simulation of injection and transport in porous media, as well as wicking into rigid and swelling porous media

INTELLECTUAL PROPERTY

Copyrighted software

This technology is available on an exclusive or non-exclusive basis

For further information please contact:
Brian Thompson
President
UWM Research Foundation
3230 E. Kenwood Blvd.
Milwaukee, WI 53211
Tel: 414-229-3397
Please reference: OTT 1179.