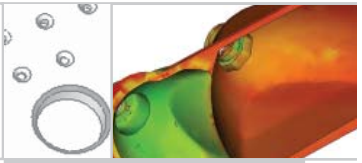
MPI/Simulations for Reactive Molding Processes



Moldflow Plastics Insight simulations for reactive molding processes enable you to simulate the flow and curing of thermoset resins and gain a deep understanding of these complex processes.

You can evaluate manufacturability, minimize cycle times, and optimize processing conditions for thermoset and rubber injection molding, reaction injection molding (RIM), structural reaction injection molding (SRIM) and resin transfer molding (RTM) processes. In addition, optional add-on modules allow you to simulate microchip encapsulation and underfill encapsulation processes.

Capabilities

Supported Model/Mesh Types:

- Finite-element midplane models
- Solids-based Fusion models (add-on option)
- True 3D solid models (add-on option)

FEATURES:

- All MPI simulations for reactive molding processes are integrated with the Moldflow Material Database, which offers many grades of lab-tested thermoset materials
- Mold filling is modeled by a generalized Hele-Shaw flow model for areas without reinforcement and by Darcy's Law for areas with fiber mat reinforcement
- The numerical solution is based on a hybrid finite-element/finite-difference method for solving the pressure, flow, and temperature fields, and a control-volume method to track moving flow fronts
- Material viscosity is calculated as a function of temperature, conversion (extent of cure) and shear rate
- The effect of induction time is included in flow calculations for rubbers and polyester resins
- Special numerical methods are used to track the curing history of material at the flow front (fountain region)
- Curing kinetics are included in the calculations of both flow dynamics and temperature

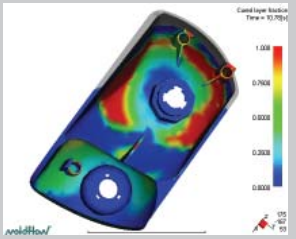
MPI/Reactive Molding

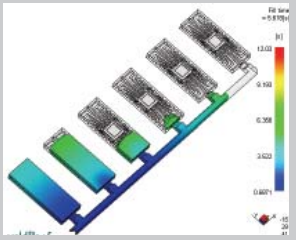
MPI/Reactive Molding allows you to predict how the mold will fill, with or without the presence of fiber reinforced pre-forms, to avoid short shots due to pre-gelation of the resin, highlight potential air traps and identify problem weld lines, balance runner systems, select the proper molding machine size, and evaluate different thermoset materials for various applications.

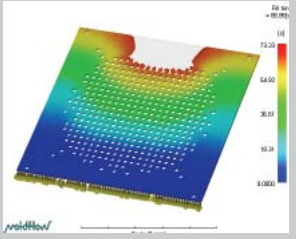
MPI/Reactive Molding is the base module required for all Moldflow reactive molding simulations.

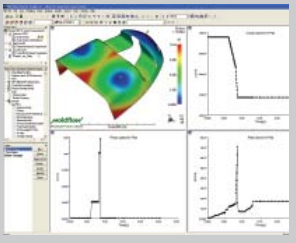
MPI/Reactive Molding Allows You To:

- Predict the flow front pattern to aid in part design and gate placement to optimize cavity filling
- Calculate the conversion (extent of cure) versus time at any location within the mold
- Determine injection pressure and clamp force requirements for proper molding machine selection
- Display injection pressure at any point within the cavity at any time during filling
- Graphically display the temperature change as a result of the reaction kinetics inside the mold at any time
- Detect short shots due to pre gelation conditions









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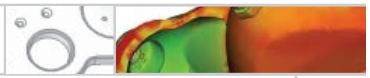
MPI/Simulations for Reactive Molding Processes Features



- Accurately identify weld lines based on part design and gate placement
- Accurately identify air traps for proper mold venting
- Define multiple anisotropic fiber mats with different orientations in the cavity for RTM and SRIM process simulations

MPI/Reactive Molding Results:

- Fill time
- Pressure
- Weld lines and air traps
- Bulk conversion
- Bulk temperature
- Conversion
- Orientation (at core and skin)
- Shear rate
- Temperature
- Thickness of cured layer
- Velocity

MPI/Microchip Encapsulation

MPI/Microchip Encapsulation is an optional add-on module that extends the capabilities of MPI/Reactive Molding to simulate the encapsulation of semiconductor chips with reactive resins.

The encapsulation process provides protection from hostile environments, facilitates heat dissipation, and enables electrical interconnection of the chips. MPI/Microchip Encapsulation provides the tools to help you design the encapsulation package, tool, leadframe and wires, and to optimize processing conditions, Including mold temperature, filling time, ram-speed profile, and curing time.

MPI/Microchip Encapsulation Allows You To:

- Calculate the temperature and degree of cure of the preform material in the pot prior to transfer to the mold cavities
- Balance the runner system for multicavity systems
- Calculate global flow field values for velocity, temperature, and degree of cure at each time step
- Determine the local flow field around each microchip wire in order to calculate drag force along each wire
- Calculate drag force at different temperatures and velocities
- Interface with MPI/Stress to perform graphic wire-sweep calculation to determine actual wire shape
- Interface with MPI/Stress to predict paddle shift

Results:

- Displacement (wire sweep)
- XY-displacement (wire sweep)
- Wire sweep index
- Principal stresses (wire sweep)
- Displacement (paddle shift)
- Principal stresses (paddle shift)
- Maximum pressure difference in leadframe
- Standard results from MPI/ Reactive Molding

MPI/Underfill Encapsulation

MPI/Underfill Encapsulation is an optional add-on module that extends the capabilities of MPI/Reactive Molding to simulate the pressurized underfill encapsulation process.

MPI/Underfill Encapsulation Allows You To:

- Predict the flow of the encapsu lant material in the cavity, between the chip and the substrate during the underfill encapsulation process
- Evaluate the standard results from MPI/Reactive Molding, including pressures, temperatures, and conversion (degree of cure)

Special Material Data Required for Underfill Encapsulants:

- Underfill encapsulant material properties are the same as those of encapsulation molding compounds used for standard microchip encapsulation, with these two differences:
- For underfill encapsulant rheological data, the Herschel-Bulkley-WLF model includes one additional term to describe thickness
- Underfill encapsulants include an additional data category, surface tension. In the underfill encapsulation process, when the encapsulant is dispensed, the driving force is the capillary force at the flow front. To analyze this dispensing process, surface tension data is required. The dynamic temperature-dependent surface tension model by Han is used

MPI/Injection Compression

MPI/Injection Compression interfaces with MPI/Reactive Molding to simulate filling and packing phases of the injection-compression molding process using thermoset materials. The analysis can be used for a complete evaluation of candidate materials, part design, mold esign, and process conditions. You can simulate processes where polymer injection and mold compression occur simultaneously or sequentially. You can also program the compression phase to begin before, during, or after polymer injection using timer controls built into the software.

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