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REACTIVE ROTATIONAL MOLDING OF POLYURETHANE: UNDERSTANDING OF CURING PROCESS AND SPH SIMULATION OF THE FLOW

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Reactive rotational molding allows the use of a wider range of material and decreases the process cycle time compare to rotational molding of thermoplastics. However due to chemical transformations, the fast increase of material viscosity leads to a complex implementation. This process requires a good understanding of physicochemical phenomena to manage the process and to determine the best parameters. Moreover a simulation of the flow could be a tool of great interest to optimize the process conditions. In this study we used Polyurethane as reactive material. Physical and chemical transformations of Polyurethane are studied by thermal analysis. Thanks to the Differential Scanning Calorimetric results of curing process, the vitrification and gel point of Polyurethane were identified. Then Time-Temperature-Transformation diagram was established based on these results. The material flow occurring during reactive rotational molding can be compare to a free surface flow of a Newtonian fluid. Mainly two forces are in competition: the gravity and the viscosity forces. Smoothed Particle Hydrodynamics which is a lagrangian meshless method was chosen to simulate this flow. This 2D simulation model the Polyurethane flow in a mold rotating around its main axis. This model can predict the material behavior during the first time of reactive rotational molding where viscosity is still low before the gel point.