OP-11-655

Tuesday, May 10, 2011, 03:15-03:35 pm
Room: Karam 2

APPLICATION OF HIGH POROSITY METAL FOAMS IN A HEATING/COOLING SYSTEM FOR RAPID HEAT CYCLE INJECTION MOLDING PROCESS

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Rapid heating cycle molding (RHCM) is a novel polymer injection molding technology developed in recent years. This paper proposes an innovative heating and cooling system based on the use of metallic foams to increase the efficiency of the conventional RHCM technique. An open-cell foam is a kind of porous medium that is emerging as an effective method of heat transfer enhancement, due to its large surface area to volume ratio and high thermal conductivity. Open-cell metal foams also present high specific stiffness and strength. To evaluate the feasibility of the new heating and cooling system, a mold insert with two aluminum foams for a double gated tensile specimen was manufactured. Water was forced to flow through the metal foams. A numerical simulation method was developed to analyze the structural deflection of the metallic foam and the thermal response of the mold cavity surface during the heating and cooling phases. A 3D fully transient numerical simulation was carried out to simulate the thermal behavior of the mold. This methodology entailed modeling an idealized open cell metal foam based on a fundamental periodic unit cells and solving the flow through the three-dimensional cellular unit. A good agreement was obtained between the numerical and experimental results. Both the simulation and test production results indicate that the proposed innovative heating and cooling system can realize high-temperature injection molding reducing the molding cycle time with respect to traditional RHCM technique. The use of metallic foam allows a temperature control medium very close to the surface, extremely fast temperature drop and uniform temperature distribution. The surface appearance of the specimen was improved and the surface marks were eliminated completely. Keywords: Rapid heat cycle molding, Injection molding, Numerical analysis, Metallic foam