ABSTRACT

This study investigates the thermal behavior of trochoidal milling on Polytetrafluoroethylene (PTFE), a polymer known for its low thermal conductivity and susceptibility to heat-induced deformation. The objective is to analyze the influence of feed rate, spindle speed, and stepover on the cutting tool temperature and to develop a predictive mathematical model for thermal generation during the milling process. Experiments were conducted using a full factorial design on a CNC milling machine, with tool temperature measured using a FLIR thermal imaging system. Data was processed and modeled using linear, polynomial, and nonlinear regression methods in Minitab18. Results show that spindle speed significantly influences tool temperature, while feed rate and stepover exhibit more complex, interaction-dependent effects. Among the models tested, the linear regression model provided the best balance of accuracy and simplicity, with an average error of 3.76%. The developed model can assist machinists in selecting optimal parameters to minimize thermal damage when machining PTFE, promoting efficient, precise, and sustainable manufacturing processes.

Keywords: Trochoidal Milling, Cutting Temperature, PTFE, Machining Parameters, Thermal Modeling, Machining.