Measurement and analysis of thrust force and torque in friction drilling of difficult-to-machine materials

ABSTRACT

Thrust force and torque applying in friction drilling contain some important information related to sufficient heat generation which can improve product quality and reduce tool wear. This concern becomes more challengeable when friction drilling is applied on difficult-to-machine materials. In the present study, temperature, thrust force, and torque for friction drilling of difficult-to-machine materials namely AISI304 and Ti-6Al-4V and Inconel718 are measured and analyzed. It contributes to provide an enhanced understanding of how friction in workpiece-tool interface increases the temperature. Subsequently, the sufficient heat generation, the effective thrust force, and torque that are needed to form a proper bushing with optimum features can be predicted. It is found that increasing in number of drilled holes reduces the quality of bushing shape. It is observed that thermal conductivity of workpiece material has significant effect on bushing formation quality. The findings indicate that better bushing formation and longer tool life are obtained from friction drilling of Inconel718. The microstructural changes of workpiece and tool wear are also analyzed and a relationship between them, temperature, thrust force, and torque, is explored. The maximum tool wear is observed on conical region where the process is in critical cycle time and temperature is on peak point.

Keyword: Friction drilling; AISI304; Ti-6Al-4V; Inconel718; Thrust force; Torque; Temperature