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A study on EDM debris particle size and flushing mechanism for efficient debris removal in EDM-drilling of Inconel 718

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Abstract

Electrical discharge machining (EDM) is a non-contact machining process that removes material through spark erosion and is often used for drilling holes in difficult-to-cut materials such as Nickel-based super alloys. However, this process becomes slower with the increase of the hole depth. This is because the flushing pressure becomes inefficient for the effective evacuation of process debris leading to secondary discharges and resulting in increased machining time. This study presents an innovative simultaneous flushing and vacuum-assisted debris removal system, which facilitates better debris removal for deep-hole EDM drilling. Improvement in the drilling time and better surface roughness have been achieved using the developed setup. To evaluate the performance of the vacuum-assisted debris removal system, a novel computational fluid dynamics model is also proposed in this study. Experimentally measured particle size data of full length scale act as a reference for the proposed numerical model.The analysis presented in this study provides significant insight into sizes of the debris particles in different machining conditions, in full length scale using an automated image processing technique. The presented numerical model can be used to investigate the various factors influencing the removal of debris from the machining zone. The experimental and numerical components of this research complement each other in the design of the presented vacuum-assisted debris removal system.

Keywords: EDM, Particle size, Suction, Flushing, Particles trajectory, Simulation.