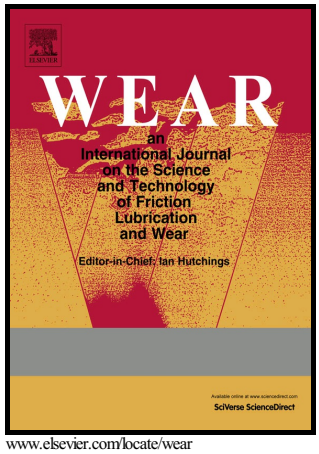

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Modeling of normal force and finishing torque considering shearing and ploughing effects in ultrasonic assisted magnetic abrasive finishing process with sintered magnetic abrasive powder

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Abstract

Ultrasonic assisted magnetic abrasive finishing process (UAMAF) is a precision manufacturing process that results nano-scale level finish in a part. Normal force on a particle helps indenting the particle in the work surface whereas horizontal force provides finishing torque that in-turn helps the particle to perform micro-machining. Better understanding of the effect of these forces on material removal and wear pattern of the work-piece necessitates mathematical modeling of normal force and finishing torque and subsequently its validation with experimental results. In the present study, single particle interaction concept is considered to develop a model which is subsequently applied for all active particles of magnetic abrasive powder (MAP). Separation point theory is applied to consider the effect of ploughing below a critical depth and shearing above that depth. Normal components of shearing and ploughing forces are considered for calculating normal force and horizontal components of shearing and ploughing forces are taken to calculate finishing torque. Johnson-Cook model is applied to calculate shearing strength of the work material during UAMAF. The impact of ultrasonic vibrations is considered while calculating strain rate. Images were taken with the help of scanned electron microscope and atomic force microscope to study the material removal and wear mechanism during UAMAF process. Predicted values of force and torque model are validated with the experimental values.

Keywords

UAMAF, shearing, ploughing, force, torque, wear