Mechanical Engineering Master's Defense

FE Simulation Based Friction Coefficient Factors for Metal Forming

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abstract

Friction condition is an important factor in the control of compressing process. Friction calibration map (FCM), which is also called friction calibration curves (FCCs), is widely used in detecting friction factors between workpiece and die in compression process. The FCM is generated by compressing a standard ring sample in ring compression test, and it is affected by material properties. The FCM is established with constant friction factors (m), however, in Finite Element Analysis (FEA) the friction is defined by friction coefficient factor (μ). This research is to construct such a method so μ factor can be found for selected material and *m* factor.

The research is carried out with FEA and Design of Experiment (DOE). FEA is used to simulate the ring compression test. 2D quarter model is adopted as geometry model; bilinear material model is for the plastic material; no-linear solver is used to solve the model. After the model is established, validation tests are conducted. The material folding phenomenon is determined to be considered, as it will bring in new contact surface. DOE technique is used to find relations between material properties and deformation. FEA experiments are conducted for the DOE analysis. By using Design of Experts, a series of equations is obtained, which represents relation between material properties and deformation in each selected compression stage on each FCC from μ factor.

Through systematically study on relation between deformation, material properties and friction conditions, a method is established to select μ factor for particular m factor and material. It is observed that the slopes of the deformation curves are dependent on the material properties. Then, a series of equations between material properties, friction conditions, and deformation is generated, and how the ring expends would be predicted. A list of suggested μ would be gained by substituting the material properties in the series of equations for required deformation curves and these μ are used to describe the friction condition under *m* factor. When several measurements along the compression are recorded, the suggested series of friction conditions corresponding to measurements would be reliable for friction condition control.
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