Finite Element Analysis of tube drawing process with diameter expansion

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ABSTRACT

This paper presents investigations on a new tube drawing process with diameter expansion by Finite Element Method. Tube drawing methods are conventionally applied for manufacturing various tubes in order to reduce thickness, improve dimensional precision and strength [1]. Among the various tubes, thin-walled tubes contribute to reduction in size and weight of various machine components. Many drawing passes are needed in conventional methods for manufacturing thin-walled tubes from rather thick-walled raw tubes, but the production cost increases with the increase of the number of drawing passes.

The authors proposed a new tube drawing method, which utilizes diameter expansion for the effective thickness reduction. The proposed method is composed of two steps. In the first step which is tube flaring, the tube edge is expanded by pushing the plug into the tube. In second step which is the plug drawing, the tube is expanded through the whole tube length by drawing the plug while the flared portion is chucked. The tube wall is stretched in both of the axial and the hoop directions, then a negative deviatoric stress is large in the thickness direction, with compared to that of the conventional tube drawing with diameter shrinkage.

In this study, appropriate working conditions was investigated in the proposed method by FEM. The working conditions are plug angle, material properties and thickness of the tube. At first, the analysis of the tube flaring was carried out. The analytical result was almost same as the experimental result under the typical working condition, and the effects of the working conditions on the flaring limit were shown. The analysis of the plug drawing was carried out under the conditions that the tube flaring was possible. As a result, the effects of the working conditions on the dimensional precision and the thickness reduction were shown. (294 words)

REFERENCES