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Design of the laser dieless drawing process of tubes from magnesium alloy using FEM model

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Abstract

This paper is dedicated to a computer aided design of the laser dieless drawing process used for production of magnesium alloy tubes. Using laser as a heat source allows quick control of the heating and helps to regulate the temperature during sample deformation. One of important problems related to the development of this technology is a prediction of diameters of final product. The problem is caused by the character of the process in which elongation of tubes not predetermined by the tool but takes place due to pulling and free forming of the material. To design of technology a code based on finite element method (FEM) dedicated to the laser dieless drawing process and related method of design was developed.

A numerical experiment was carried out by performing calculations with varied tension and heating parameters. The calculation results (in form of technological diagrams) allow determination of the process parameters needed for reaching specific final dimensions of the tube and for explanation of limitations of this process related to low ductility of the tubes. Examples of a fracture observed in experiments were related to a neck formation during elongation of the tubes. Two reasons for the neck formation were observed in modeling. The first was related to overheating of a tube and high gradient of temperatures along a centerline of the tube. The second corresponds to a high value of deformation and material hardening.

To validation of the FEM model, measured values of temperature, load, tube diameter and fracture monitoring were used. Further, the model allowed to identify a window of permissible