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Doctoral dissertation abstract

Tytuł: Analysis of the influence of lubrication conditions on resistance to friction and surface topography of deep-drawing steel sheets in the deep drawing process

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Abstract:

The paper presents an analysis of the influence of lubrication conditions on the resistance to friction and surface topography of DC03, DC04, DC05 and DC06 deep-drawing steel sheets used in the sheet metal forming process. For experimental tests reflecting the friction phenomenon occurring in the blankholder area in the sheet metal forming process, a test apparatus was developed to carry out a strip drawing test. The strip drawing tests were carried out using variable input parameters, the level of which reflected real conditions of sheet metal forming process. Deep draw lubricants were delivered directly to the contact zone under specific pressure.

The values of the coefficient of friction and roughness parameters of sheet metal obtained from the friction process were used to perform statistical analyses, which were the basis for understanding the character of the friction phenomenon, depending on the type of sheet metal used, contact pressure, lubrication pressure, kinematic viscosity of oil and initial topography of the sheet metal surface. Owing the complex interactions of the input parameters of the friction process with the value of the coefficient of friction and the roughness parameters of the sheet metal, multilayer artificial neural networks and networks with radial basis functions were used to analyse the relationship between these parameters. The developed neural networks with different architecture and different neuron activation functions allowed the generation of a network with high efficiency in predicting the value of the coefficient of friction and changes in the surface topography as a result of the friction process.

In conditions of pressure-assisted lubrication, a decrease in lubrication efficiency was observed with an increase in lubricant pressure in the range of 2-8 MPa. This conclusion can be applied to all lubricant pressure values used. Depending on the value of contact pressure, grade of sheet metal and oil viscosity, pressure-assisted lubrication reduces the coefficient of friction by approximately 47-71% compared to dry friction conditions.