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VARIABLE CONTACT PRESSURE AND VARIABLE DRAWBEAD HEIGHT INFLUENCE ON DEEP DRAWING OF Al ALLOYS SHEETS

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Abstract: *The process of deep drawing is influenced by many factors. During the forming process, only two of those factors can be controlled. They are blank holding force and drawbead height. Realisation of such control requires rather complex computerised apparatus.*
For this investigation, electro-hydraulic sheet-metal strip sliding device has been constructed. Basic capacity of realized device is obtaining contact pressure and drawbead height as functions of time or stripe displacement. Additional features consist of the ability to measure drawing force, contact pressure, drawbead displacement etc.
Presented in the paper are the first results of influencing of increasing and decreasing function of drawbead height in combination with increasing-decreasing function of contact pressure. Stripe material is aluminium alloy AlMg4,5Mn0,7 0,9 mm sheet metal. Contact condition are additionally influenced by application of mineral oil or completely dry tool and stripe surfaces. Drawbead geometry, with rounding radii of 2 and 5 mm, is also varied.
The accomplished results indicate that simultaneous effects of variable drawbead height, variable contact pressure, tool geometry and appropriate friction conditions can influence the plastic flow process in line with desired change of forming force.

Key words*: deep drawing, stripe sliding, variable drawbead height, variable contact pressure*.

1. INTRODUCTION

Deep drawing process is widely applied in modern industry, which makes it extremely important. That is the reason for ongoing tendencies to accomplish total control of forming process. In order to succeed in that, it is necessary to select, out of a large number of influential factors, the ones which can be influenced throughout the forming process, thus correcting it until it is completed successfully. There are only two such factors: contact pressure and drawbead height [1].
Process control through active complex (closed-loop) systems requires constant dynamic feedback between the given function of the objective, controlled and controlling variables [2]. The functions of the objective and controlled variable can be different: wrinkle height, thinning in critical zone, flange motion, flange thickness change, friction force, forming force, stress in work piece wall etc. The given objective functions are defined either by computer simulations or by previous experiments. Pressure on flange and drawbead height present the controlling effects. High velocity of reacting to controlled values change and robust controlling hardware and software apparatus are required, which all implies significant investments [3, 4].
There is also the alternative – a much simpler approach – used in this paper. However, first it is necessary to define optimal functions of pressure and drawbead height according to proper criterion (drawing depth, piece quality etc.). This often requires comprehensive experiments [5, 6] in order to identify the character of specified factors influence. With such information, it is possible to form the controlling apparatus for practical application whose main objective is to realise previously defined optimal functions of pressure and drawbead height. Such equipment requires considerably smaller investments regarding hardware and software and is far more accessible to a wide range of users.
Application of constant height drawbeads is still most often applied and well known [7, 8]. The same goes for application of constant blank holding force on flange. The main reasons for this are smaller forming process costs. However, due to the development of new materials of more complex formability properties, in most cases it is not possible to accomplish the satisfactory results by classical methods.
The application of blank holding force without draw beads is the subject of separate researches based on the same aforementioned principles [9].
In this paper, the emphasis is on investigation of the character of the connection between drawing force and various influences combinations. They include friction conditions (dry, application of lubricant), drawbead geometry (two rounding radii), one variable function of pressure of increasing-decreasing character, two functions of drawbead of decreasing and increasing character and