COMPARISON OF TRIBOLOGICAL PROPERTIES OF STEEL AND AL-ALLOYS SHEET METALS INTENDED FOR DEEP DRAWING

Conference Paper · June 2008

COMPARISON OF TRIBOLOGICAL PROPERTIES OF STEEL AND AL-ALLOYS SHEET METALS INTENDED FOR DEEP DRAWING

Milentije Stefanovic[1], Milan Slivic[2], Srbislav Aleksandrovic[1], Milica Samarzic[3]

Keywords: deep drawing, tribology, sheet metal, deep drawing

ABSTRACT

During the last few years, aluminium alloys are increasingly more used in production of light constructions, especially for manufacture of light car bodies of passenger cars. From the aspect of tribological factors influence, experience in application of low-carbon steel sheet metals in manufacture of car body parts by deep drawing procedures up to now differs significantly regarding the application of Al-alloys. The paper presents the results of tribological investigations of specified materials properties at sliding tests, as well as results at deep drawing with variable blank holding force. The combination of unfavourable formability parameters and sensitivity to tribological conditions at application of Al-alloys requires a particular approach to tools and technology designing in comparison with classic forming procedure /1/.

At investigation by sliding the piece between flat contact surfaces, by which sliding of sheet metal on flat die surface is modelled, the influence of pressure and contact surfaces condition on the sliding force value were observed. At investigating Al-alloy, with dry contact conditions, excessive sticking of particles from surface layer of sheet metal onto the contact pair occurred, causing a sudden increase of sliding force. Anyway, sticking of particles onto the contact pair was also noticed at application of lubricant, but at much smaller range, fig.1.

The increase of pressure leads to decrease of friction coefficient in both investigated materials. The values of friction coefficient depend on roughness properties of sheet metal surfaces, besides already specified experimental conditions. Such situation occurs at successive sliding, i.e. multi-phase deep drawing, when tribological conditions of Al-alloys become dominant and restrain formability considerably.

Figure 2 shows the influence of variable blank holding force (VBF), controlled during the forming process. Deep drawing of a cylindrical work piece in conditions of dry friction on flange, particularly typical for Al alloy sheet metals, was considered. Figure 2 presents the thinning distribution at sheet metal of Al Mg alloy type 5000 /2/. The specific influence on friction through variable normal force (blank holding force) at dry friction at steel sheet metal is manifested as smaller thinning intensity at all 4 types of VBF in comparison with usually applicable constant blank holding force Fd=const=6,16 kN. The similar effect is significantly smaller for Al sheet metal. Thinning remains unchanged except for one type of VBF (COMB) where the effect is significant. Conclusion is that it is possible to improve the results of forming process and Al sheet metals at dry friction by achieving influence through controlled VBF during the process (INC-increase, DEC-decrease, COMB-combination of previous, PULS-pulsating value).

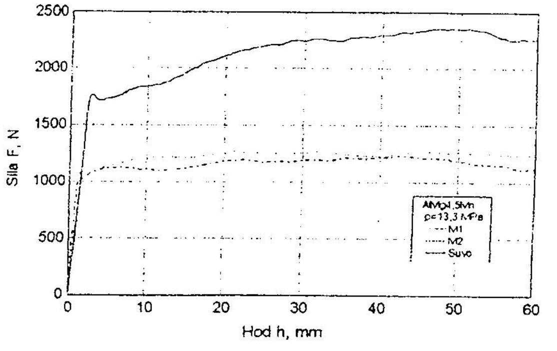

Fig.1. Change force-sliding path for alloy AlMg4,5Mn at contact pressure of 13,3 MPa

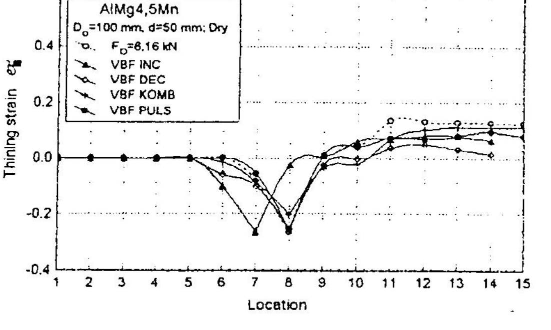

Fig. 2.Sheet metal thinning strain at various forces on blank holder

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FACULTY OF MECHANICAL ENGINEERING, 34000 Kragujevac, SERBIA
FACULTY OF MECHANICAL ENGINEERING, 78000 Banja Luka, BOSNIA and HERCEGOVINA, RS
CAR INSTITUTE ZASTAVA, Kragujevac, SERBIA