Serbian Tribology Society

SERBIATRIB '13

13th International Conference on Tribology

Faculty of Engineering in Kragujevac

Kragujevac, Serbia, 15 – 17 May 2013

ANALYSIS OF TRIBOLOGICAL PROCESS DURING IRONING OF SHEET METAL MADE OF AlMg3

Dragan Adamović[1], Milentije Stefanović[1], Srbislav Aleksandrović[1], Miroslav Živković[1], Fatima Živić[1], Marko Topalović[1]

[1] Fakultet inženjerskih nauka u Kragujevcu, S. Janjić 6, 34000 Kragujevac, adam@kg.ac.rs, stefan@kg.ac.rs, srba@kg.ac.rs, zile@kg.ac.rs, zivic@kg.ac.rs,

Abstract: *The paper gives detailed analysis of tribological processes which occur in ironing, their influence on tool and formed material by means of specially developed physical model of drawing process. The typical property of such cold forming procedures is multiple repetitions of operations, i.e. several thinnings in one operation, which leads to gradual increase of thickness of glued material layer on contact surfaces of the tool. At sufficiently large thickness of glued layers, plastic forming of created glued particles occurs, i.e. their tear-off, disruption of forming process stability and increase of surface roughness of work piece. The obtained results indicate the basic influence of tribo-conditions on ironing process, tool durability and quality of obtained parts.*

Key words: *Ironing, tribo-modeling, tribological processes*

1. INTRODUCTION

Friction accompanies all physical processes that involve movement. It is also very important in metal forming, during which only external friction is considered. External friction occurs between material which is being plastically deformed and material of tool.

External friction shows significant influence on the course of plastic deformation, and thus the useful properties of the final product as well as the tool lifetime. The friction force, i.e. its contact components, show a significant influence on the stress field in a deformed metal, especially in its outer layers that came in contact with work surface of tool. Stress field has influence on the course of metal forming, and thus the movement of deformed metal surface on the acting surface of tool, and this movement have influence on the friction force. During this process, certain types of reverse elastic releases occur as well.

This type of resulted external friction between the plastically deformed metals and tool (technically dry friction with distinct adhesion effect between contact surfaces, coupled with boundary friction), significantly influences the quality of the product. If the adhesions (compounds formed by friction due to the "cold welding") are formed on surface of the tool they can be causes of scratch and allowances on the surface of the product that deteriorates its quality.

As a result of the friction notable changes in characteristic of outer layers occur, with different character of the changes that happens on the products surface layers in comparison to changes on tool surface.

The most of the work piece surface is in contact with the working surface of the tool and will have share in the friction process only once, while tool surface takes part in this process multiple times.

The characteristics of tool deformation and the work piece deformation are also different. The outer layer of the work piece (as well as the entire volume), has lower yield stress than tool, resulting in plastic deformations, while, at the same time, tool generally remains in the zone of elastic deformation. Given the fact that surface layer has the highest stress gradient, properties of outer layers, for both product and tools, will be different from properties of other parts of product and tools. As a result of the friction, tool wear occurs. Mechanism and the intensity of tool wear are functions of friction force magnitude and type of the friction [1].