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THE INFLUENCE OF TOOL SURFACE CONDITION ON IRONING PROCESS EXECUTION

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Abstract: *Friction has significant influence, both on geometrical, kinematic and dynamic conditions of metals forming execution and on tool life; in that way, it influences the continuity of production.*
One of the methods for enabling the reduction of friction resistance (and in that way the influence on product quality) is the selection of properties of outer layers of the tool. Unlike machine elements, where it is possible to select a wide range of contact couples materials, in the case of ironing process one of contact couples elements – strained material – is determined in advance. The only thing that can be changed here, in certain limits, is tool material (die and punch) or various thermo-chemical forming procedures can be applied, as well as hard coatings etc., by which chemical content of surface layers is changed.
In this paper, we will present the experimental results obtained by modelling ironing process by application of proper technological lubricants, use of anti-adhesion coatings on tools (coating TiN and hard coating Cr), selection of suitable type of tool materials (tool steel, hard metal) etc. The obtained results indicate that friction resistance can be reduced to a large extent, which will also minimize tool wear.

Key words*: Ironing, Coatings, Friction, Wear, Tools*

1. INTRODUCTION

High intensity of tool wear in metal forming (MF) is the reason why tool life problem is getting the increasing attention. Together with the advancement of tool wear process, which mainly reflects the change of dimensions and form, the product quality deteriorates, and the obtained products have major dimensional deviations, worse surface quality and even visible errors in the form of notches and nodes. Tool life also influences the reliable functioning of the machines or forming systems. Frequent replacements of tools lead to unavoidable standstill of machines which also influences productivity decrease, and therefore the production costs. Tool wear process is very complex, and, and tool fracture can be caused by several reasons which act together. Tool wear process is influenced not only by friction appearance, but also by other processes, such as: fatigue (thermal and mechanical), corrosion and oxidation. Therefore, tool wear for MF will be the result of the superposition of all physical processes which act upon the tool; consequently it will be more intense than it would have been if it were influenced only by friction process course.
In tools intended for cold MF, the following types of wear are dominant:
– adhesive,
– abrasive and
– fatigue (crumbling).

However, abrasive wear is considered as the significant process which determines tool life for MF.
Intensive tool wear in ironing processes results from the fact that the entire work surface of the tool is in constant contact with the material being formed. From that reason, wear intensity is higher when compared with other tools. Wear cases for this kind of tools can be divided into following types:
– adhesive wear which manifests as the appearance of glued particles ("bulges"),
– micro and macro cracks,
– crumbling and
– the appearance of material loss in the form of ring, which is the effect of abrasive wear.

The most influential type of wear for this kind of tools is the appearance of so called annular damage on work (conic) surface for compression, which eliminates the conditions for normal forming and causes the appearance of additional friction resistance and significant increase of drawing force.
Such mechanism of tool wear is the consequence of material flow kinetics and distribution of pressures in cone for compression. The material being compressed achieves the largest straining in the entrance cone zone, which is why the highest unit pressures are created there. Furthermore, all impurities, oxides etc. remain on work edges at the entrance into the cone tool part; those impurities can act as abrasives which cause abrasive wear