B_4C and Mo coatings characterization regarding stamping dies application

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Abstract

Prestigious brands of cookies usually use metallic tins as package to distribute and sell their products, trying to impress the customer through the look and avoiding cookies' break and/or damage during logistics operations. These packages are made commonly in tin coated (2.8 g/m^2) thin steel sheet (electrolytic Tin plate), which originates severe wear problems on both die and punch tool components during the stamping process. The border of the package represents a non-considerable deformation, despite their almost perpendicular orientation to the top surface, but this top is usually patterned, also implying the flow of the sheet between the top and bottom die surfaces. Due to the softness of the Tin coating, it easily adheres to the die generating premature wear and several concerns in maintaining the required final shape of the tin lid. Lubrication would be an easy way to solve the problems above referred but lubrication operations should be avoided regarding that these kind of packages are for food purposes.

This study has been developed in order to find the best coatings which avoid Tin adhesion and wear on the stamping surfaces when deforming Tin coated steel plate. Two advanced PVD

coatings (B_4C and Mo) were characterized and tested leading to improve the wear behavior of the punch and die under these work conditions. The transfer of Tin material from the metallic sheet to the punch and die was also studied, as well as the friction coefficient of this sheet against some selected coatings, also trying to minimize the Tin adherence to the tool surfaces. Tribological tests under medium loads were carried out in order to realize what kind of coating presents better wear behavior in those work conditions. Worn surfaces were studied by Scanning Electron Microscopy (SEM) and material transfer was analyzed by Energy Dispersive Spectroscopy (EDS).

Results obtained with some of the tested coatings allow to confirm that it is possible to minimize the Tin transfer from the covered steel sheet to the die and punch, ensuring a longer life of these parts, decreasing the tool maintenance operations and improving the Overall Equipment Efficiency (OEE) of that stamping process.

Keywords: Tin lid, Tin coated steel sheet, Thin films characterization, Friction coefficient, Tribological tests, Dry sliding contact, Advanced coatings, B4C coating, Mo coating

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