Improved functional surfaces for aluminum punching tools

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The use of lightweight materials in the automotive industry, as a key element in fuel economy, is a growing trend to achieve the stricter vehicle emission limits in Europe. Aluminum, in the form of stamped sheet, has the potential to be used extensively in vehicle as a high-specification structural and skin parts. However, compared to steel, aluminum is more difficult to stamp, thus the optimized techniques and manufacture strategies learned in steel stamping are not adequate given the complex processability of aluminum alloys. To achieve the quality standards, it is necessary to develop specific techniques, geometries, and functional surfaces on tooling, to optimize aluminum stamping processes.

In this work, the influence of surface and geometry of tools during the punching process of 5754 aluminum sheets have been evaluated in a pilot plant under similar industrial conditions. Before the pilot test, different surface roughness qualities and commercial lubricants were evaluated at lab scale using a ball on disk test. Lubricants were screened by means of a Stribeck curve. Subsequently, performance of coatings proposed by Oerlikon were evaluated through "coated ball" on "5754 aluminum disk" tests. The best combination between lubricant and coating was used to perform the aluminum punching process in the pilot plat, where two types of geometry and roughness of tool were analyzed. Results were expressed in terms of the appearance of unwanted burrs of the stamped sample, as well as, in terms of adhesion of the material on tool surface. Polished surface before coating deposition and round punches with back taper geometry were the key factor to improve the process.

Keywords: Functional surface, aluminum punching tools, coatings for aluminum, lightweight.

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