Engineering Failure Analysis 18 (2011) 1689–1697

Contents lists available at ScienceDirect

Engineering Failure Analysis

journal homepage: www.elsevier.com/locate/engfailanal

Surface fatigue and wear of PVD coated punches during fine blanking operation

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ARTICLE INFO

Article history:
Available online 12 February 2011

Keywords:
Surface fatigue
Wear
PVD coating
Fine blanking

ABSTRACT

Performance of two different physical vapour deposited (PVD) TiCN and Alcrona® (AlCrN) coatings systems is under investigation. Coatings were deposited on the punches produced from the Böhler S390 Microclean steel. Two different surface preparation techniques were used – wet polishing (high surface roughness) and dry polishing (low surface roughness).

Industrial trials of PVD coated punches in fine blanking operation were performed and studied. Wear of punches was analysed in regard to the punch geometry, position in the die and surface roughness, and measured after maximum 100,000 cycles at high loads.

Punches with higher surface roughness seem to withstand numerous loading cycles with some traces of coating delamination and wear. On the other hand performance of PVD coatings with smaller surface roughness in a striking way was much worse.

Comparative trials of the coatings surface fatigue wear and indentation surface fatigue testing were performed in the laboratory as well. In surface fatigue wear testing coatings were dynamically indented by ball (spherical) indenters made from conventional hardmetal (WC-6 wt.%). Testing parameters were identical to those of industrial trials. The Vickers diamond pyramid indenter was cyclically pressed with 500 N load at single point during indentation surface fatigue testing. Results are in agreement with surface fatigue wear tests results.

Finally the microstructural investigations using SEM and XRD techniques were performed for better understanding of the surface fatigue and wear mechanisms during fine blanking process.

Results of both trials are in good agreement and allow predicting performance of coatings.

1. Introduction

Recent challenges in products developments lead to extensive need for more durable tooling. The use of high strength steels instead of tool steels brought out a new aims for material scientists – increase endurance of the tool materials in cyclic loading (cold forging, stamping and blanking). To solve the fatigue damage problems of high-speed steels (HSS) the powder metallurgy (PM) routes are used. As a result of the finer and more uniform microstructure that PM-HSSs exhibit, as compared to their conventionally produced counterparts, they also present enhanced cross-sectional hardness uniformity (wear resistance), fracture toughness and fatigue strength [1].

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doi:10.1016/j.engfailanal.2011.02.011