Wear of Cemented Carbide tools in Copper Alloy Forging Process

- Lab Test Verification

H. Mikado[1]*, M. Kimura[1], J. Heinrichs[2], U. Wiklund[2], S. Jacobson[2], S. Kawamura[1]

[1]Technology and Innovation Center, YKK Corporation, Japan
[2]Applied Materials Science, Uppsala University, Sweden

Copper alloys are widely used in many components, such as zipper elements, due to their superior combination of strength and plasticity. The production of zipper elements includes several complicated shearing and forging process steps to arrive at the final element shape. Despite the commonly used copper alloy work material being significantly softer than the cemented carbide tool material, the tool life is often limited by wear. The mechanisms causing this wear are not well understood. Hence, an increased understanding could facilitate the development towards prolonged tool life in zipper production.

A previous investigation of a worn forging die tool from production revealed preferential removal of Co binder and transfer of copper alloy to the tool surface. More interestingly, the repeated forging contacts lead to modification of the transferred material composition, as the transferred material partly becomes rich either in Cu or Zn, compared to the work material composition. Furthermore, the Zn rich transfer shows a high presence of oxygen.

To gain deeper insights into the active wear mechanisms during the copper alloy forging process, a new tribotester was proposed and developed. This equipment comprised a cemented carbide cylinder repeatedly put in sliding contact with a rotating copper alloy cylinder in crossed cylinders configuration. The test was interrupted at selected intervals so that the cemented carbide cylinder could be repeatedly evaluated by SEM and EDS. The degradation mechanisms, including gradual wear against the copper alloy, transfer of copper alloy and gradual change of topography, are discussed and compared with those found on zipper manufacturing tools from production.

Keywords: Cemented carbide, Copper alloy, Forging die, Wear

*Corresponding author: h-mikado@ykk.com