Wear of cemented carbide against Cu/Zn alloys: an experimental and thermodynamic investigation

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Recent studies on cemented carbide (WC/Co) tools in continuous sliding contact with significantly softer Cu alloys have revealed peculiar phenomena attributed to chemical wear, which are not yet understood. Not only are the Cu alloys able to wear down the much harder WC, but moreover both WC and Co are worn down to an almost equal level. Additionally, higher Zn content in the Cu alloys has shown to drastically decrease the wear rate. The present investigation involves tribological testing accompanied by thermodynamic calculations to develop further understanding of the mechanisms behind the wear of cemented carbide against Cu alloys. The acquired knowledge will add to the general understanding of chemical wear and can be applied in industrial fields where chemical wear of this type reduces tool life and productivity.

Unlubricated continuous sliding tests between cemented carbide and Cu/Zn alloys with different amounts of Zn were performed using a crossed cylinder set up. Each test was intermittently interrupted at defined accumulated sliding lengths to document the wear propagation in pre-defined areas of the cemented carbide using SEM, EDX and optical surface profilometry. The software ThermoCalc was used to perform thermodynamic calculations of relevant material systems to gain understanding of chemical- pathways, phases and driving forces, which were used to support the observations in the tribological tests.

The cemented carbide cylinders were analyzed and compared with respect to wear depth, material transfer and wear propagation to analyze the wear mechanisms and how Zn content in the Cu/Zn alloys affected the wear behavior. Correlations between data from the ThermoCalc calculations and wear observations were analyzed and discussed to highlight the proposed mechanisms behind the chemical wear of the cemented carbide.

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