SELF-LUBRICATING TRIBOLOGICAL CHARACTERIZATION OF CU-NI/TIC/CAF_2 COMPOSITE FOR RAILWAY SWITCH SLIDE BASEPLATE

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The Cu-Ni alloys have been extensively used in the chemical and marine conditions for ship-building, the food industry, the beverage industry, power stations, the chemical industry, heat exchange equipment, air conditioning plant, brake lines, brake tubes, and oil rigs and platforms [1]. Composites of Cu-Ni with graphite/ Ag/ TiC/CaF/graphite, have already been developed through powder metallurgy [2, 3]. However, the synergetic effect of reinforcement of TiC/ CaF_2 for improving the mechanical and tribological properties of Cu-Ni alloy has not been investigated till date.

High-purity Cu and Ni micro powder were used as the matrix materials, whereas TiC powder and CaF_2 were used as reinforcements. After mixing the powders in a Planetary ball mill, compaction was done in a die to develop a green specimen discs of 35 mm diameter. The sintering process of green discs were carried out in a vacuum tube furnace.

The CU-Ni alloy and Cu-Ni composite (TiC and CaF2) had the highest and lowest density values of 8.24 gm/cm3 and 6.86 gm/cm3, respectively. Among the composites, Cu-Ni/TiC/CaF_2 composite exhibited the lowest hardness of 54.9 HV. Friction and wear experimental studies on Cu-Ni alloy and its composites against 90-UTS steel were performed on a pin-on-disk tribometer. The lowest COF (0.30) and lowest wear rate (5.36 x 10^{-5} mm^3/ N.m) were observed in the case of Cu-Ni / 5wt% TiC + 4 wt% CaF_2 among all the composites.

The worn surfaces were characterized by OM, 3D profilometer, FESEM, EDS and Raman spectroscopy. Cu_2O, NiO, TiO_2, Fe_2O_3 and Fe_3O_4 were formed, as a result of the tribo-oxidation on the wear tracks, which significantly affected the wear behaviour and wear mechanism. The main wear mechanism of the Cu-Ni matrix-based composites was a combination of adhesive wear, tribo-oxidation wear, delamination and minor abrasive wear.

References

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