ABSTRACT

KEYWORDS*:* Tungsten carbide; Cutting tool; Solid lubricant; Friction; Wear; Temperature.

In manufacturing industries, major attention has been given to the dry machining due to the harmful effect and difficult handling of cutting fluids. This thesis intends to develop a solid lubricant cutting tool for carrying out dry machining. Tungsten carbide (WC) is considered for cutting tool material and calcium fluoride (CaF_2) is considered for solid lubricant and powder metallurgy as a method for developing cutting tool material. The various amount of CaF_2 (0-10 wt.%) were milled with tungsten carbide along with 10 wt.% of cobalt binder. Superior relative density (94 %) is achieved at 40 h of milling time and 400 MPa pressure. Compacted materials were subsequently sintered up to 1450 °C under nitrogen atmosphere in a tube furnace. The fractured surface of the considered materials confirmed that material with 5 and 7 wt.% of CaF_2 exhibited superior bonding between carbide particles. Considered material with 5 wt.% CaF_2 exhibited superior hardness (85 HRA) and transverse rupture strength (1500 MPa) while compressed at 400 MPa. Developed materials were made to slide over the silicon carbon abrasive sheet and sintered disc with various normal loads and at a sliding speed. Under both abrasive and adhesive conditions, material with 5 wt.% CaF_2 exhibited superior wear resistance and the lowest friction coefficient. The measured net surface temperature of the test specimen also confirmed this fact. The worn out test surface and the counter material surface revealed, traces of calcium and fluoride. Plain WC and WC with 5 wt.% CaF_2 materials were considered to understand the cutting tool performance. WC-Co-5 wt.% CaF_2 cutting tool generated 20-40 % lesser cutting force and 15-18 % lesser flank wear. Curlier and the smaller saw tooth of chip generated from WC-Co-5 wt. % CaF_2 cutting tool confirmed the lesser heat generation in cutting and improved surface finish of the machined surface.