International J.ofMultidispl.Research&Advcs.inEngg.(IJMRAE),
ISSN 0975-7074, Vol. 3, No. IV(October 2011), pp. 131-144

EXPERIMENTAL INVESTIGATION OF CRYOGENIC COOLING IN THE TURNING OF Ti-6AL-4V ALLOY WITH MODIFIED CUTTING TOOL INSERT

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Abstract

In the present research work, the effect of liquid nitrogen as a coolant applied to heat generation zones through holes made on the rake and flank surfaces of the cutting tool insert during the turning of Ti-6Al-4V alloy with PVD TiAlN coated tungsten carbide tool. The influence of cryogenic cooling on the cutting temperature, cutting forces, surface roughness, chip thickness and chip morphology, have been compared with those of wet machining. The cutting temperature reduced by 63 – 73% and the cutting force decreased by 19 – 45 % cryogenic cooling over wet machining. It was also observed that in the cryogenic cooling method, the surface roughness reduced by 28 - 43% and the chip thickness reduced to a maximum of 24% over wet machining. Cryogenic cooling provided the substantial benefit in reducing the cutting forces, improving surface roughness and decreasing chip thickness through control of the cutting temperature and reduction in adhesion between the interacting surfaces. Application of cryogenic cooling reduced the serrated tooth formation in the chip.

Keywords: Cryogenic cooling, Ti-6Al-4V alloy, Cutting temperature, Cutting force, surface roughness, Chip morphology.