Semi-orthogonal turning of hardmetal with CVD diamond and commercial PCD at different cutting angles

F.A. Almeida[a], A.J.S. Fernandes[b], F.J. Oliveira[a], R.F. Silva[a] (rsilva@ua.pt)

[a] CICECO- Department of Ceramics & Glass Engineering

[b] Department of Physics

University of Aveiro, 3810-193 Aveiro, Portugal

Turning of abrasive hardmetal parts by chip removal is a new challenge for cutting tools, alternatively to grinding. In such applications, polycrystalline diamond (PCD) and polycrystalline cubic boron nitride (PCBN) are the most established market options. Chemical vapour deposited (CVD) diamond can be an excellent alternative considering that the absence of any binder phase and its higher hardness should allow its use for machining a wider range of hardmetal grades.

In this work, thick CVD diamond brazed inserts and commercial PCD cutting tools were used to dry turn WC-18wt%Co bars. The cutting parameters were: speed (s) 20m/min, depth (d) 0.2-0.4mm, feed (f) 0.1mm/rev for roughing operations; and (s) 60m/min, depth (d) 0.05mm, feed (f) 0.04mm/rev for finishing purposes. Two cutting angle configurations were used, taking the combination of the tool holder and the cutting insert: i) a positive insert with a 0° (neutral) rake angle (γ) and a 11° clearance angle (α); ii) a negative insert with γ=-6° (negative) and α=6°.

For the CVD diamond tools in roughing conditions, the results showed that the use of the highest clearance angle (α=11º) diminishes the cutting forces and the adhesion of the workpiece material to the flank face. In the case of the finishing operation, no sign of wear was detected for this angle configuration, and just a very small flank wear for the negative insert. The use of neutral rake angles diminishes the crater land in rough machining and prevents this wear mode in finishing operations. On the contrary, a regular crater land was formed when the negative cutting tool was used. In the case of the PCD ones, the cutting operation had to be stopped at half the cutting length achieved by the CVD diamond tools due to the very high tool wear that increased the cutting forces.

Keywords: Cutting tools; CVD diamond; hardmetal; cutting angle

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