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Performance evaluation of PCBN, coated carbide and mixed ceramic inserts in finish-turning of AISI D2 steel

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HIGHLIGHTS

- Tool life of PCBN was longer than ceramic and carbide insert.
 - Tool wear of PCBN was lower than ceramic and carbide inserts.
 - Better surface roughness (R_a) was obtained with PCBN inserts.
 - R_a for ceramic/carbide insert was below $1.6\mu\text{m}$
 - R_a was affected by the wear on the cutting tool.
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ABSTRACT

The present study compares the performance of three different cutting tools, viz., PCBN, mixed ceramic and coated carbide tool in finish turning of hardened D2 tool steel in terms of tool wear, surface roughness, and economic feasibility under dry cutting conditions. Results showed that tool life of PCBN inserts was better than mixed ceramic and coated carbide inserts. The flank wear of PCBN tools was observed to be lower than mixed ceramic and coated carbide inserts. The surface roughness achieved under all cutting conditions for mixed ceramic and coated-carbide inserts was comparable with that achieved with PCBN inserts and was below $1.6\mu\text{m}$. Experimental results showed that the wear mechanism of ceramic tool is pre-dominantly abrasive wear at lower speeds and abrasive wear followed by adhesive wear at medium and higher speeds and for PCBN tools the dominant wear mechanism is abrasive wear and cratering at lower speeds followed by adhesive wear at higher speeds. For carbide tool the dominant wear mechanism was abrasive wear and cratering at lower speeds followed by adhesion and chipping at higher speeds. Obtained results revealed that PCBN tools can outperform both ceramic and carbide tools in terms of tool life under different machinability criteria used.

Keywords:

| Hard turning | PCBN | Coated carbide | Tool life | Surface roughness | Economic analysis |