TOOL WEAR OPTIMISATION OF ALUMINIUM OXIDE COATED CUTTING TOOL

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Abstract:*Cutting tools that have been used in the manufacturing industries for many years for producing machine elements which encounters numerous problems such as reduced tool life, failure of tool, higher wear and tear etc. The coating includes one or several refractory layers of which at least one layer is a dense, fine-grained layer of* α*-*Al_2 O_3*. The coated tool exhibits excellent surface finish and toughness and shows much improved wear properties compared to prior art objects when used for machining steel, cast iron and, particularly when machining nodular cast iron*

Field of the Invention:
The present invention relates to the field of cutting tools and particularly to coatings for ceramic coated hard metal cutting tool inserts used for cutting, milling

Introduction:
Surfaces of cemented carbide cutting tools need to be abrasion resistant, hard and chemically inert to prevent the tool and the work material from interacting chemically with each other during machining. Cutting tools with regards to tool life travel path, the required power for machining, and the surface quality of the generated workpieces improves remarkably using coated cemented carbide cutting tools .Layers of titanium carbide (TiC), titanium nitride (TiN), titanium carbonitride (TiCN), titanium aluminum nitride (TiAlN), and aluminum oxide (Al2O3) are most commonly used when machining metals.

The cutting speed significantly affects the machined surface roughness values. With increasing cutting speed, the surface roughness values decreased. Higher values of feed rates are necessary to minimize the specific cutting force. The machining power and cutting tool wear increases almost linearly with increase in cutting speed and feed rate.

ToolMaterial:
In Metal cutting, Carbide tools have gradually taken over HSS tools in many of the tool applications; but still HSS is widely in use in some specific segments of tools like drills, reamers, taps, form turning tools, gear hobbing and gear shaping cutters, side and face mills, end mills, slab milling and straddle milling cutters, slitting saws, form milling cutters and broaches.

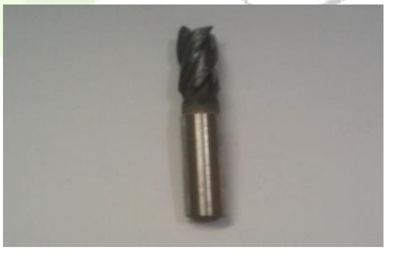

Fig 1

Reasons ForAluminium Oxide Coatings:

Moderate to extremely high mechanical strength (300 to 630 MPa)
High hardness (15 to 19 GPa)
Very high compressive strength (2,000 to 4,000 MPa)
Moderate thermal conductivity (20 to 30 W/mK)
High corrosion and wear resistance

Depth of cut (mm)	Tool rear (mm)	
	Uncoated	Coated
0.25	0.19	0.12
0.5	0.33	0.21
0.75	0.43	0.27

Table 1

Machining Method:
The HSS (High Speed Steel) Flat End Milling Cutter is used for the machining process and of two types one is Coated and the other Non Coated ordinary tool. The Cutters are then fixed to the Vertical Milling Centre for the machining process. The tools are used under similar conditions and then the wear on each tool is found with the help of the Tool Makers Microscope.

Tool Makers Microscope:
The tool maker's microscope is aversatile instrument that measure by optical means with no pressure being involved, thus very useful for measurement on small and delicate parts. The optical head can be moved up or down the vertical column and can be clamped at any height by means of clamping screw. The table which is mounted on the base of the instrument can be moved in two mutually perpendicular horizontal directions by means of accurate micrometer screw having thimble scale and venires.
A ray of light from a light source fig. b is reflected by a mirror through 90' It then passes through a transparent glass plate. A shadow image of the outline or counter of the workspaces passes through the objective of the optical head and is projected by a system of three prisms to a ground glass screen. Observations are made through an eyepiece. Measurements are made by means of cross lines engraved on the ground glass screen. The screen can be rotated through 360'; the angle of rotation is read through an auxiliary eyepiece.

Process Parameters for Trial 1:

Process Parameters	
Feed	5mm/sec
Depth of cut 1	0.25 mm
Depth of cut 2	0.5 mm
Depth of cut 3	0.75 mm
Spindle RPM	3500
Tool Diameter	10 mm
Number of Passes	20

Table 2

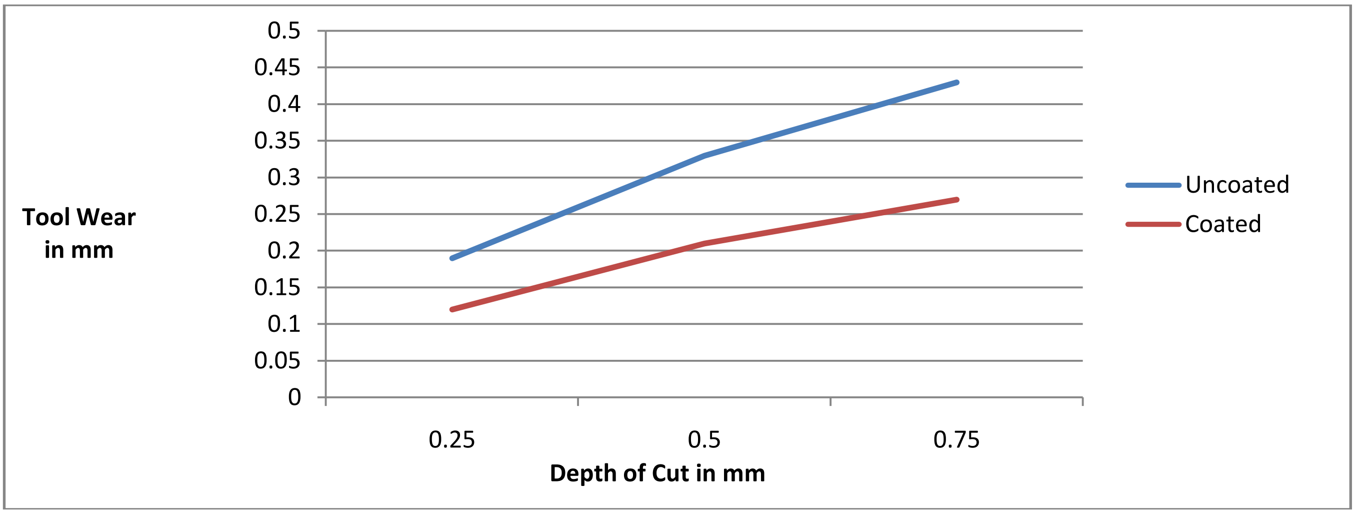

Fig 2

Process Parameters	
Feed	5mm/sec
Depth of cut	0.5 mm
Spindle Speed 1	1000 RPM
Spindle Speed 2	2000 RPM
Spindle Speed 3	3000 RPM
Tool Diameter	10 mm
Number of Passes	20

Table 3

Spindle Speed (RPM)	Tool rear (mm)	
	Uncoated	Coated
1000	0.14	0.09
2000	0.29	0.17
3000	0.47	0.29

Table 4

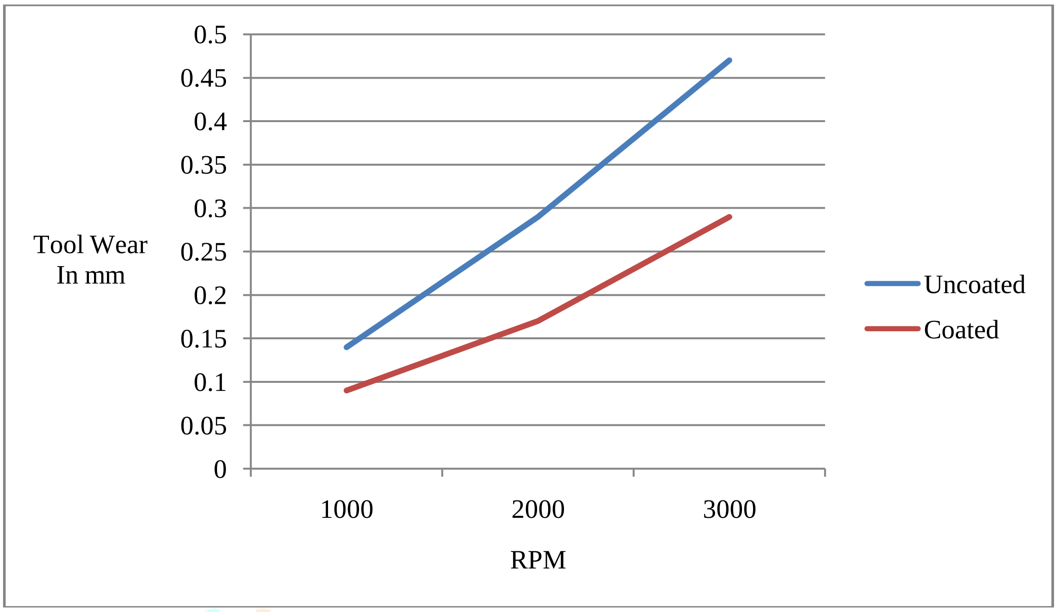

Fig 3

Conclusion

From the experiment we are able to infer that tool with coating has wear lesser than that of tool without coating for a set number of cycles. This proves our aim of the experiment that milling tool with Al_2O_3 coating extends the life of the tool to a greater number of cycles.

References

- Multilayer coated hard alloy cutting tool by Yoshimura.
- Method of making a pvd al2o3 coated cutting tool by Seigfried Schiller, Fred Fietzke , Bjorn Lujenberg.
- Multilayerdpvd coated cutting tool by ChristianStrondel , TorbjornSelinder and Mats Sjostrand.
- Refractory coating for cutting tools by Kennametal incorporated.