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Tool Wear Studies on EN18 Material

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Abstract:

Tool wear studies have some practical significance and application. Productivity of machining is directly linked to wear of the tool. The greater the wear the lesser the productivity per unit volume of material machined per unit time. To study how these factors affect the machining, the measurement of tool wear becomes very important requirement. The challenges involved in measurement of wear in a single point cutting tool are the attrition volume in the order of cubic microns. In this paper we address the using Image processing techniques that offer superior ability to visualize and measure tool wear. In this paper we present the tool wear of a single point high speed steel during machining of EN18 material

Keywords —Tool wear, Attrition Visualization MCVV01, Image Processing techniques, Visualization, Superimpose

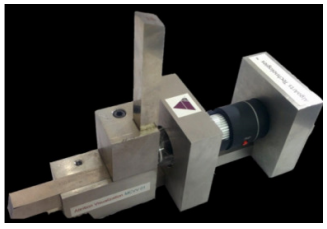
I. INTRODUCTION

Tool wear depends upon a number of factors. Factors belonging to the tool itself are:

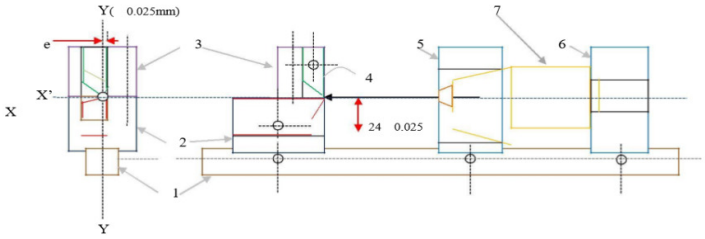
- Geometry of the tool including various angles and radius of cutting tip.
- Orientation of the cutting tool set to the Tool-Post swivel.
- Composition and structure of material of the work piece, machining conditions such as depth of cut, transverse speed of the tool, rotary speed of the work piece.

II. METHODOLOGY

Attrition Visualization MCVV01:



Tool wear Image Capture Equipment Schematic:



Nomenclature:

1: Base

2: Tool-holder (tool in horizontal-position)

3: Tool-holder (tool in vertical-position)

4: Tool shank

5: Camera-holder (front)

6: Camera-holder (rear)

7: Camera

Note: X'X is the line of sight of camera, the circle at the intersection of X'X and Y'Y is the area of tool-tip under observation. e = 0.2

Tool-Wear Attrition Measurement and Visualization

All Images of the Tool and the Calibrated Grid (0.1mm) are captured at room temperature with fixed distance between Camera and Tool (25 mm)

1. Load the camera software provided in the product box.
2. Keep the calibrated grid in a plane where we expect to see attrition, see Figure 2. Obtain Image of the Calibrated Grid using the camera software. Calibrated grid sheet is provided in the product box.

3.Place the Tool in the slot provided to obtain Top View of the Image of the Tool before machining

4.Get Top View of the Image of the Tool after machining.

5.Place the tool in the slot provided to get Front View of the Image of the Tool after machining,

6.Load Image Processing Toolbox

7. Enter the grid image and Top View image of the Tool after machining in the command window

8. Execute the above to display a superimposed image.

III. WORK PIECE AND ITS COMPOSITION:

EN18 is carbon steel with improved strength over other alloy steels.

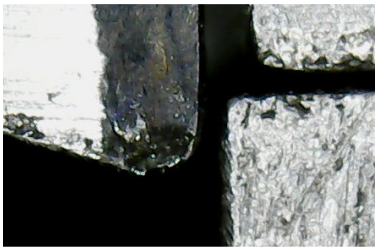
	C	Mn	Si	S	P	Cr	Ni
EN18	.35 - .45	.60 - .95	.10 - .35	.040	.040	.85 - 1.15	

EN18 Alloy Steel Round Bar Mechanical Properties:

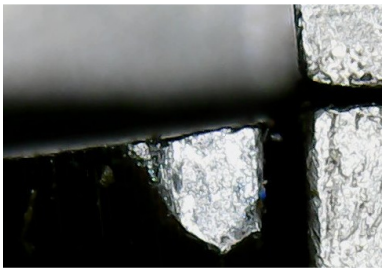
Tensile Strength (MPa)	Yield Strength (MPa)	Poissons Ratio	Modulus of Elasticity(N/mm^2)
570	295	.27 - .30	103

IV. Characterization and Estimation of Tool Wear V_W:

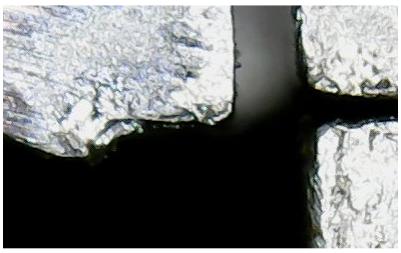
Top View of the Image of the Tool before Machining



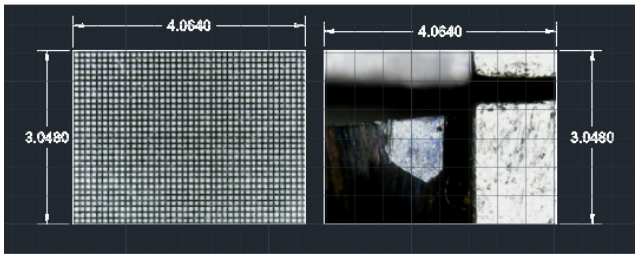
Front view of tool after machining



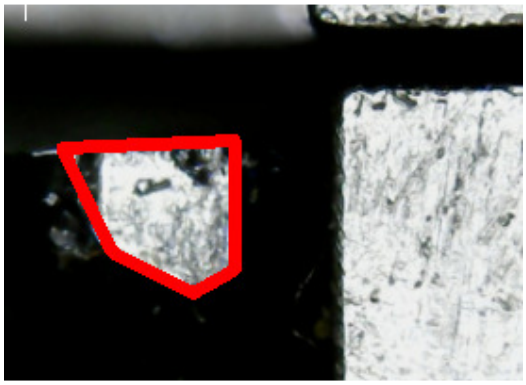
Top view of tool after machining



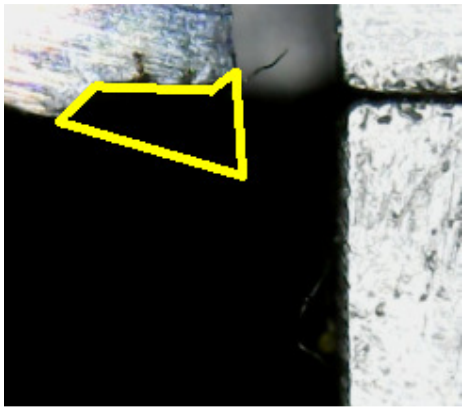
Create a calibrated grid or import grid with 0.1mm into AUTOCAD and resize the image obtained in the camera to accommodate in the calibrated grid through which volume of wear is to be derived by creating a 3D model with the help of images obtained. Volume command is used to obtain the volume of the solid model obtained.



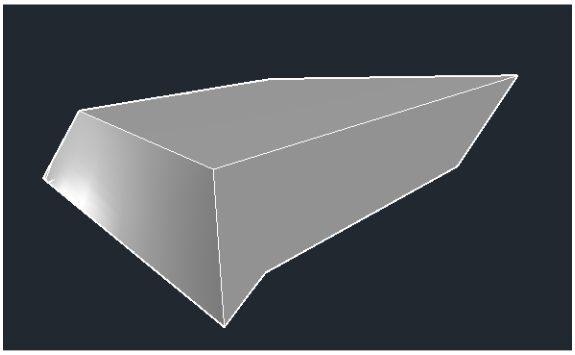
Calibrated Grid correlated to the image obtained



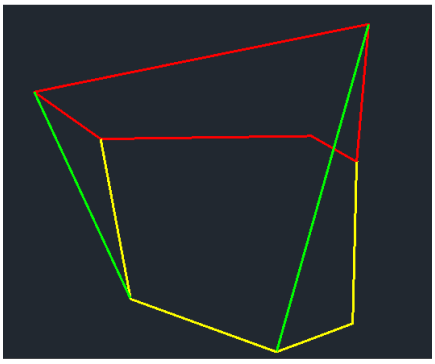
Front View of Tool wore after machining



Top View of Tool wore after machining



Solid Model Obtained by imposing Front and top view



Wireframe model obtained

V.RESULTS:

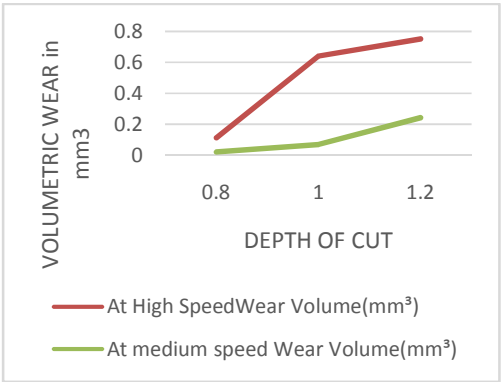
The results obtained by varying the depth of cut at High Speed and Medium Speeds are as follows

S.No	Depth of Cut(mm)	At High Speed(700 Rpm) Wear Volume(mm³)	At medium speed (460)Wear Volume(mm³)
1	0.8	0.1117	0.0217
2	1.0	0.6400	0.0707
3	1.2	0.7500	0.2427

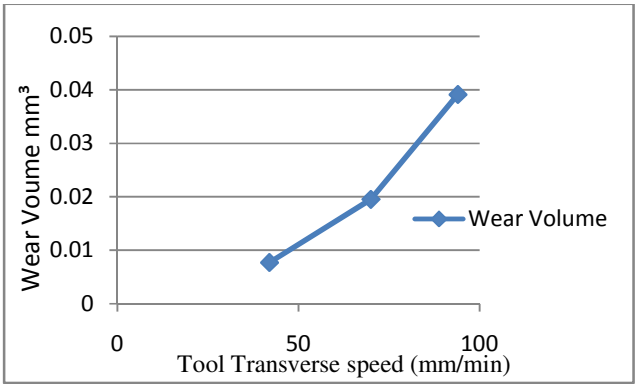
Results obtained with different Transverse speeds and the tool wear at that particular speeds are as follows.

S.No	Tool Transverse Speed(mm/min)	Wear Volume(mm³)
1	42	0.0077
2	70	0.0195
3	94	0.0391

The variation of tool wear at high(700 Rpm) and medium(460 Rpm) speed is given below.



Variation of tool wears at different transverse speeds observed is represented by the graph given below



VI.CONCLUSION:

The Variation of tool wear with respect to speed, depth of cut, tool transverse speed and Material are observed for En18 material using Image processing techniques and AUTOCAD Software. Wear was observed less initially whereas increase in tool transverse speed tool wears increased. Tool wear is observed more at high speeds compared to low speeds. We further extended our study for different materials.

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