International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 09 | Sept - 2021 ISSN: 2582-3930

Benefits of Edge Preparation of Carbide Cutting Tools.

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Abstract -

As many as 55,000 holes are generally required to be drilled as in a complete single unit production of the Airbus A350 aircraft. Every efforts are made to increase tool performance. Edge honing is major key factor that influences performance. The systemic and controlled application of the cutting edge preparation process has several main purposes to add strength to the cutting edge, minimizes the edge chipping, eliminate previous defects of the cutting edge, increases tool life, prepares the tool surfaces for coating deposition, improves part quality (accuracy, surface finish). To retain in cost sensitive market, we need to treat tool in more organized & sophisticated way and that's the need of cutting edge preparation of carbide tools. This paper deals with aim and advantages of cutting tool preparation, solutions for cutting tool preparation, Benefits of polishing carbide cutting tools , Advantages of droplet removal from a coated surface.

Key Words: holes,drilling,aircraft,edge honing,cutting edge preparation etc

1.INTRODUCTION

Microgeometry of the cutting edge is a most often discussed term. It is an art and still the best educated guess of an operator experimenting with process parameters to achieved desired results. Modifying microgeometry of tool, tool life is often significantly prolonged.

These benefits are on the basis of good adhesion of the layer to the substrate or achieving the defined parameters of the cutting edge. To achieve this condition it is necessary to ensure reliable measurement and evaluation of the parameters of the cutting edge. Today, we have wide range of measuring instruments and lot more companies can be found which deal with this issue. Once we are through with the permutation and combinations for exact value of edge rounding requirement for specific application,we can assure better tool life with enhanced process parameters reducing cycle time.

1.1 Aim of Cutting edge preparation

1. Removal of micro defects – Less micro chipping, less jaggedness, removal of burs, surface structure improvements aesthetically and ergonomically.
2. Modification of the cutting edge in terms of micro geometry Stabilization of the cutting edge, improvement of coefficient of friction resulting in smooth gliding of chips, heat dissipation during cutting resulting in healthy cutting.
3. Quality characteristics for subsequent processes – Gives better bonding for coating
4. Surface treatment (Droplets removal formed during coating process)
5. Advantages for the tool-user
6. Better surfaces of the work piece
7. Higher processing parameters (Speed, feed rates, better material removal volume)

2.METHODOLOGY

2.1 Polishing a tool

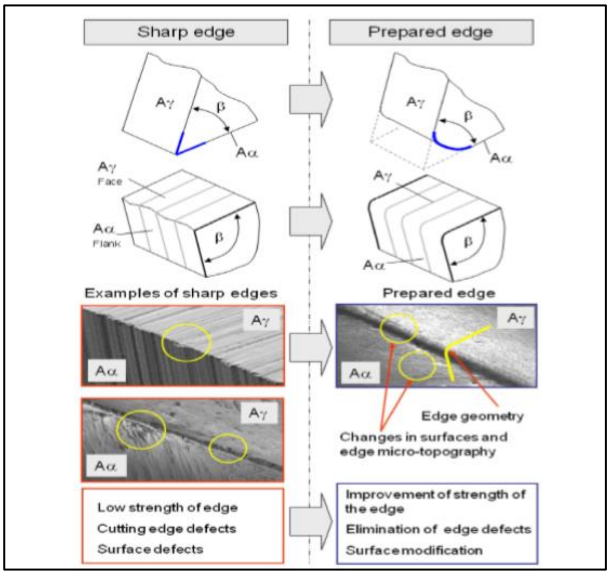

Fig -1: Polished edge

1. Improved surface quality due to reduced surface roughness
2. Faster chip flow with optimal heat dissipation
3. Improve bonding for coatings
4. Reduced cutting forces needed
5. Reduced tendency to cold welding
6. Extended tool life

A. Influence of the cutting-edge preparation on the machining process

1. Considerable increase in the service life of carbide tools (proven by numerous studies and research projects)
2. Carbide end mills: rounding of 8 – 25 µm -> increasing tool life by a factor of 2 – 3 (e.g. when machining C 45)
3. Increase in tool life by factors as high as 4 – 5 in the case of high alloy steels

Therefore: A rounding of 12 – 25 µm at the cutting edges can solve 90% of all tool life problems. At the same time, a much better bonding is achieved for PVD coating

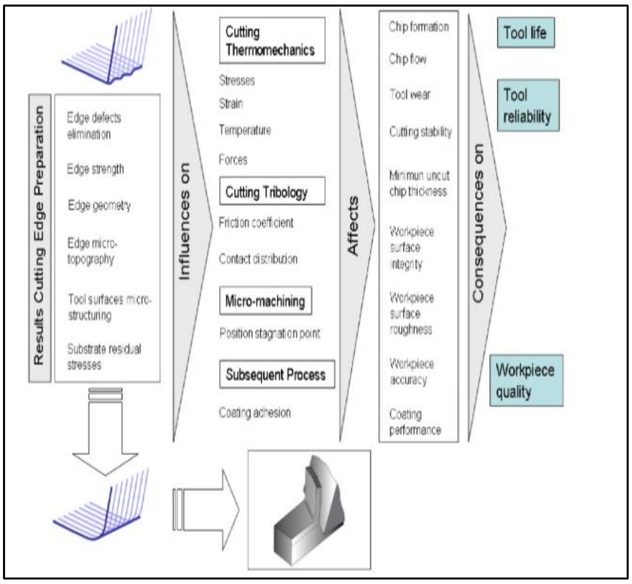

Fig -2: cutting edge preparation on machining

For steel alloys, the rule of thumb is: – 4 µm x diameter of the drill –

For a carbide drill with a diameter of 10 mm, this means an edge rounding of approx. 40 µm

For steel casting alloys, the rule of thumb is : – 5 µm x diameter of the drill – For aluminum alloys, the following value can be assumed: – 2 µm x diameter

For the edge rounding of carbide drills, it is important to ensure that the cutting edge corner is not rounded significantly more than the cutting edge.

Recommended rounding values for end mills

For end mills, the following edge rounding values are recommended: –

Wood processing: 6-8 µm – Aluminum alloys: 8-10 µm – Steel, high alloyed steels, heavy finishing: 12-25 µm – Titanium nickel alloys: 30-40 µm

As a rule, we can say: – If the cutting edge of an end mill is rounded by 10-25 µm an increase in tool life of 3-4 times can be achieved.

In the process, best described as drill polishing, a spindle-mounted diamond filament brush is rotating. As this wheel is rotating Material removal along the cutting edge results from the interaction of the motion of the abrasive grain embedded in the flexible plastic filament and pressure build up manually to the tool (drill).

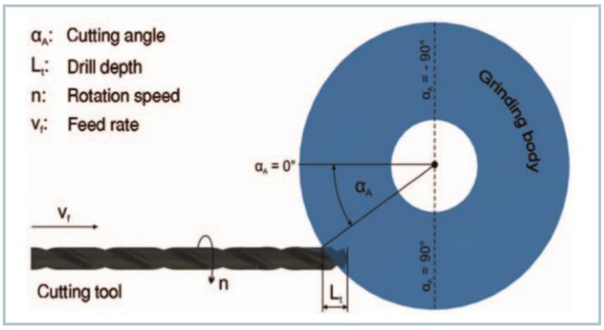

Fig -2: Schematic of the process parameters of the edge preparation process Drill Polishing

Influence of the process on the cutting edge Produced: Figure shows the effects of this new process on the shape of the cutting edge of a solid carbide twist drill, diameter 8,5 mm, with all process parameters remaining constant.

A diamond filament brush wheel from the renowned German manufacturer Pferd was used as the grinding body. The semifinished drill shown in Figure displays along the cutting edges the micro-defects resulting from the first grinding operation. Based on the process parameters, these defects are easily removed.

The contact time of t = 15 secs between the grinding body and the cutting tool is sufficient to achieve this. The main cutting edges are in contact with the brush, the brush's flexibility means that it handles cutting edges with care.

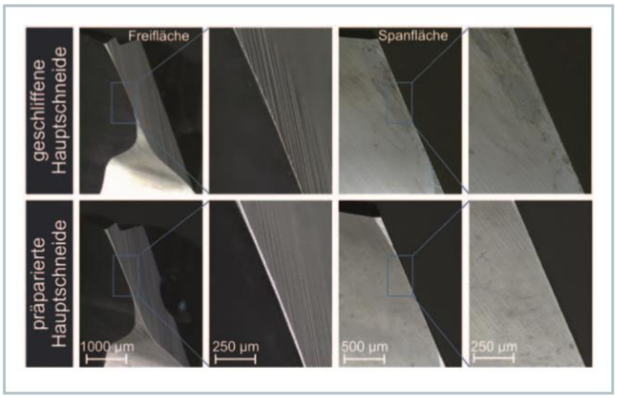

Fig -3: Optical micrographs of a ground and a polished solid carbide twist drill Abrasive Tool & Pfred diamond filament brush.Process parameters: Speed = 1,650 rpm, feed rate

Vf =6mm/min, drill depth Lt = 1,5 mm, Drill angle αa = 30°

Source: Artifex Dr. Lohmann GmbH & Co KG

One of the important tasks in honing operation is that selection of honing materials because different tool material requires different abrasive materials also the honing is depend on size of abrasives.

Abrasive generally rely upon a difference in hardness between the abrasive and the material being worked upon, the abrasive being the harder of the two substances. However, this is not necessary as any two solid materials that repeatedly run against each other will tend to wear each other away (such as softer shoe soles wearing away wooden or stone steps over decades or centuries or glaciers abrading stone valleys).

Some factors which will affect how quickly a substance is abraded include Difference in Hardness between the two substances: A much harder abrasive will cut faster and deeper.

Grain size (grit size): Larger grains will cut faster as they also cut deeper Adhesion between grains and backing, between grains and matrix: determines how quickly grains are lost from the abrasive and how soon fresh grains, if present, are exposed. Contact force: More force will cause faster abrasion. Loading: Worn abrasive and cast off work material tends to fill spaces between abrasive grains so reducing cutting efficiency while increasing friction.

Selection of abrasives for honing applications is dependent on many factors. Bore configuration, material being honed, coolant used, stock removal requirements, incoming surface finish, final surface finish surface finish requirements, cycle time, and quantities of parts to be processed all play a part in the abrasive selection. While there is no easy way to assure the abrasive selected will meet all of your requirements, understanding the basics of abrasive selection will greatly enhance the potential for success.

3.CONCLUSION

This article shows the importance of edge preparation of carbide cutting tools (Drill and End Mill). It has a great influence on the cutting process - mainly tool life, Parameters, resultant forces on machine, material removal rate and temperature load. Development of tools is a state of art process, so norms and evaluation methods of tool wear must evolve along with it, so that the description is complex and informative. In this paper two case studies are presented one for drilling and other for milling. Based on these trial data we would like to find a more complete and more informative method for evaluation of the cutting edge and tool wear which will be usable for a wider spectrum of cutting tool manufacturers.

ACKNOWLEDGEMENT

I would like to thanks Prof. A.A.Katkar,Prof.G.C.Koli and our Head of department for giving me valuable guidance.

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