INFLUENCE ON THE QUALITY OF THE PROCESS LIQUID SURFACE IN TURNING

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Abstract

This article deals with issues related to the optimization criteria in the selection of process liquid from the viewpoint of surface roughness. Surface roughness is one of the values in the evaluation of the surface quality. With the development of new eco-type of process fluids, there is the need to test not only their impact on the environment, but also the influence of these newly developed process fluids in the cutting process itself. Requirements for the quality of machined surfaces are in many cases difficult to fulfill without the appropriate application of the process liquid.

A new trend in machining is machining without process fluids.

Key words: roughness, process liquid, coated indexable inserts, turning, sintered karbid

INTRODUCTION

The working environment can be modified to favourably acted on a tool, its durability, on the quality of the workpiece, on the dimensional and shape accuracy, on the surface roughness and qualities of the surface layer. The main regulator of the work environment are process fluids and their correct choice.

Cutting fluid acts on the machining process especially for its cooling, lubricating and cleaning effect. The Department of machining and assembly of TUL performed durability tests widely used in turning steel 16MnCr5.

When choosing a process liquid it is always necessary to consider which are the predominant requirements and choose the liquid that best meets both the technical as well as economic and ecotoxi cological workplace conditions. Operational testing of process fluids is performed during machining. The results of these tests demonstrate how the testing process fluid affects:

- Roughness of machined surfaces
- Cutting forces
- Cutting Temperature
- Worn Tool

Research in achieved roughness of the machined surface is an important part in testing of the influence of process fluids to the final quality of finished parts. Requirements for the quality of machined surfaces are in many cases difficult to fulfill without the appropriate application of the process liquid.

SELECTION PROCESS FLUID ACCORDING TO THE TYPE OF WORK

When choosing a process fluid in terms of material, the following statements are applied. By increasing the strength of the workpiece material, there is greater stress on the tool cutting edge and it is therefore necessary to choose a process liquid that has a higher concentration or additives, which ensures higher strength of the lubricating layer. When selecting the process liquid by the method of machining it is necessary to consider the requirements of tool life and machined surface quality.

At the turning it is important to keep the durability of tools and that is the reason for using the emulsion. In the shape turning it is necessary to have the perfect quality of machined surfaces, therefore it is advisable to choose the process fluid with good lubricating effects (neat oil or emulsion with higher concentration).

SYNTHETIC AND SEMI-SYNTHETIC FLUIDS

This type of cutting fluid is characterized by high operational stability. Most are soluble in water and have good cooling, lubricating and protective effects. Synthetic cutting fluids do not contain mineral oils, but are composed of solvents - glycols, which emulsify in water, or dissolve. Glycols are translucent, so you can track the course of the machining process.

Application of synthetic cutting fluids has economic benefits opposite the oil-based liquids and also ensures rapid heat dissipation, a good cleaning effect and simple preparation. The synthetic cutting fluids can also disperse the oil, resulting in semi-synthetic cutting fluids, which have more favourable lubricating abilities. Oil particles are much smaller in the semi-synthetic fluids than in emulsions.

EXPERIMENTAL DATA

Experimental measurements were carried out in the laboratories of the Department of machining and assembly at TU in
Liberec. Turning conducted on a sample of structural steel 16MnCr5.

Mn-Cr steels for hardening. Steel is well hot forming after soft annealing and cold, with a guaranteed range of hardenability. It is well machinable – it is recommended tempered steel for strength from 690 to 880 MPa for smooth machining. It is suitable for machine components for processing up to Ø 35 mm, the cementation of very hard cemented layer with a great core strength (shafts, gears, camshafts, valve lifters, piston pins, gear couplings) for the mass production of machine parts, provided compliance with the same heat treatment technology for the customer, good weldability.

The lathe S1-250 /1000 with the turning knife CTAPR 2020 K16 834 KT staffed indexable inserts TPUN 16 0304 S30 carbide was used for the test. The cutting plate is coated. For each test new edge inserts were always used. All the measurements were always repeated 5 times and measured values were statistically evaluated.

A workpiece material was selected from a cement-alloy steel 16MnCr5. For experiments different types of process fluids from Paramo Pardubice, Inc. were used.

The following liquid process media were used:

- PARAMO EOPS UNI - Universal semisynthetic cutting fluid
- PARAMO EOPS AW - semisynthetic cutting fluid with a high content of active ingredients
- PARAMO ERO SB - coolant for a well-defined tool geometry
- PARAMO SK 220 - synthetic machining fluid

The process and the measurement procedure that followed during the experiment are shown in Tab.1.

Concentration of liquids was controlled by a special apparatus – refractometer Brix 0-18% ATC, with an accuracy ± 0.15%, the concentration of the measurements was maintained at 4.5% limit.

Roughness parameters were measured by using the laboratory profilometer Mitutoyo Surftest SV-2000N2.

Tab.1 Cutting conditions

<table>
<thead>
<tr>
<th>Machined material</th>
<th>low-alloyed stainless steel, chrome-manganese hardening 16MnCr5</th>
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<tr>
<td>Stock size [mm]</td>
<td>080 x 800</td>
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Effect of process fluids to the surface roughness

The considered values of the average arithmetic profile deviation Ra, which were determined for samples with turning feed 0.15 mm / rev. scope and depth of 0.5 mm are reported in Figure 1.

![Fig. 1 Influence of the process liquid to the surface roughness](image)

Parameter values for Ra longitudinally machined steel were in the range from 4.39 to 5.28 micron. From the measured values it is evident that the use of process fluid had a significant impact on the resulting surface roughness of the workpiece. The lowest roughness Ra showed the process fluid SK 220 Paramo. The highest roughness Ra was measured in contrast with the process liquid EOPS AW.
CONCLUSION

Each required property should be verified by testing in conditions which will be able to expose to the process liquid during operation. Tests can be performed both short and long term. More advantageous tests are long time tests in which we can compare the process fluids among themselves, or compare the tests with cooling and without cooling.

From Figure 1 It is seen that there has been very good results roughness Ra of fluid SK 220.

The comparison of properties and the results achieved in the application of various types of cutting environment is important in their development and in selection of appropriate technological solutions to machining.

The tendency of continuous increasing quality of working conditions in industrial plants and reducing operating costs of production leads to such methods of using process fluids in engineering, where their positive influence on the machining process is utilized.

REFERENCES


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