EFFECT OF MINERAL BASED CUTTING FLUID ON SURFACE ROUGHNESS OF EN24 STEEL DURING TURNING OPERATION

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Abstract: The machining parameters of any machining operation highly affect the surface quality of a component. The objective of this paper is to study the effect of mineral based cutting fluid emulsified with water on the surface quality of EN24 steel components. The turning operation was carried out with TiN coated carbide insert on the EN24 steel under traditionally flooded condition. The turning parameters, namely cutting velocity, feed rate and depth of cut were chosen for the conduct of experiments. The surface roughness of the turned specimens was measured with a surface roughness tester.

Keywords: EN24, TiN coated carbide insert, turning operation, flooded condition

1. INTRODUCTION

The surface roughness is one of the most important product quality characteristics and has the great importance of the functional behaviour of the machined parts. Manufacturing involves numerous processes to convert raw materials to finished products to be used for various purposes. The poor surface quality fails to satisfy functional requirements of the products, while extremely high surface quality causes high production costs and low overall productivity. Hence, the improved surface quality and the economics of the manufacturing operation are becoming a very important consideration to produce the finished products.

The cutting fluids are employed in machining to decrease friction, cool the job and wash away the chips. With the application of cutting fluids, the wear rate of the tool gets reduced and surface quality of machined components gets improved. In addition, the cutting fluids protect the machined surface from the occurrence of corrosion. They also minimize the cutting forces thus saving the energy. Many researchers are working in the field of cutting fluids to reduce its usage while machining for environmental and economic benefits.

The greater influence on the surface roughness is exerted by the feed rate when compared to the influence of the cutting speed and depth of cut [1-2].

Tool wear can be minimized by employing lower values of cutting velocity, feed rate, depth of cut and machining time [3-4]. The machining power and cutting tool wear increase almost linearly with the increase of cutting speed and feed rate [5-9]. In high-speed machining of stainless steel using coated carbide tool, the feed rate is found to be more significant followed by the cutting speed and the depth of cut [10-12].

The researchers [13] studied the influence of turning parameters such as speed, feed rate, depth of cut and tool nose radius on the surface roughness of medium carbon steel and suggested optimized parametric setting for obtaining better surface finish.

From the literature survey, it becomes clear that the effect of cutting fluids in the field of machining carbon steels have been investigated by many researchers. Still, there remains some difficulty in the machining of carbon steel with the application of cutting fluids, which reveals that still more research has to be carried out to find a reasonable solution. Therefore, the turning operation was carried out on the EN24 steel under flooded machining conditions in order to study the effect of cutting fluid on surface roughness in this study.

2. EXPERIMENTAL CONDITIONS

- **Workpiece used** – EN24 (Ø80mm x 150mm)
- **Cutting tool used** – TiN Coated carbide insert
- **Machine tool** – Turning centre (All Geared Conventional Lathe)
- **Cutting fluid** – Mineral based (Servocut 'S') emulsion

- **Coolant application technique** – flooded
- **Output response** – Surface roughness

3. RESULTS AND DISCUSSION

The parameters namely cutting velocity (m/min), feed rate (mm/rev) and depth of cut (mm) were considered while turning of EN24 steel under flood, near dry and dry machining conditions. The various levels of the parameters are given in Table 1.

Table 1: Parameters and their levels

Parameter	Notation	Levels		
		1	2	3
Cutting velocity (m/min)	v	325	350	375
Feed rate (mm/rev)	f	0.1	0.15	0.2
Depth of Cut (mm)	d	0.3	0.6	0.9

3.1. Effect of Parameters

The effect of cutting velocity was observed with a constant feed rate of 0.15 mm/rev and with a constant depth of cut of 0.6 mm while machining steel EN24. It was observed from Figure 1, that the surface roughness value decreased with the increase of cutting velocity.

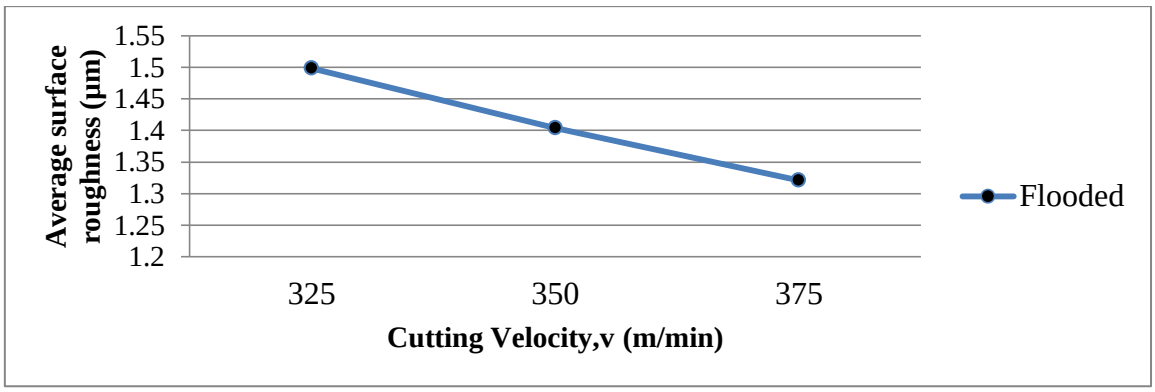

Figure 1: Effect of cutting velocity on surface roughness

The effect of feed rate was observed with a constant cutting velocity of 350 m/min and with a constant depth of cut of 0.6 mm while machining steel EN24. It was observed from Figure 2, that the surface roughness value increased with the increase of feed rate.

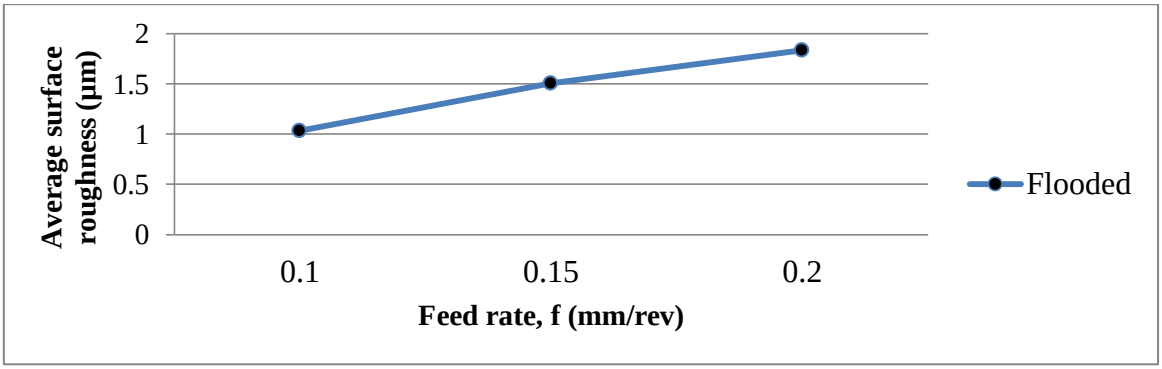

Figure 2: Effect of cutting feed on surface roughness

The effect of depth of cut was studied with a constant cutting velocity of 350 m/min and with a constant feed rate of 0.15 mm/rev when machining steel EN24. It was observed from Figure 3, that, the surface roughness value increased with the increase of depth of cut.

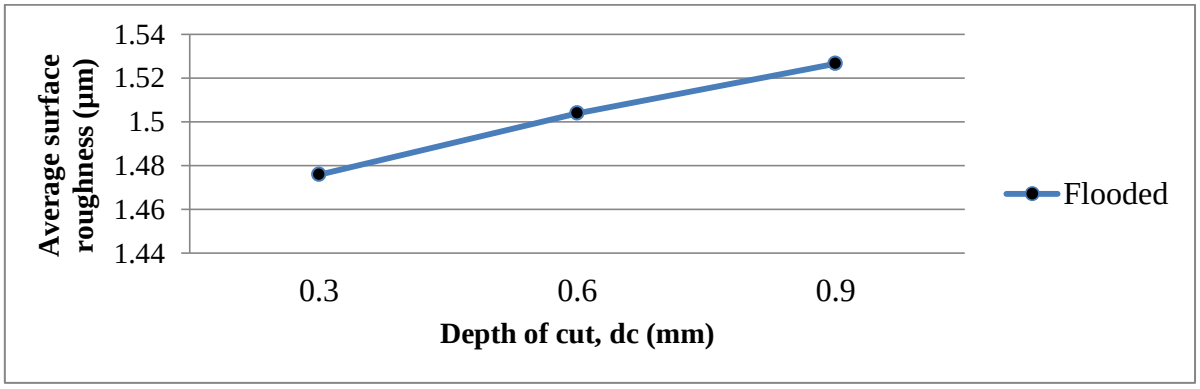

Figure 3: Effect of depth of cut on surface roughness

3.2. Contribution of Parameters

The machining parameters were ranked based on the variation of their effect on the surface roughness. The percentage contribution of machining parameters is shown in Figure 4.

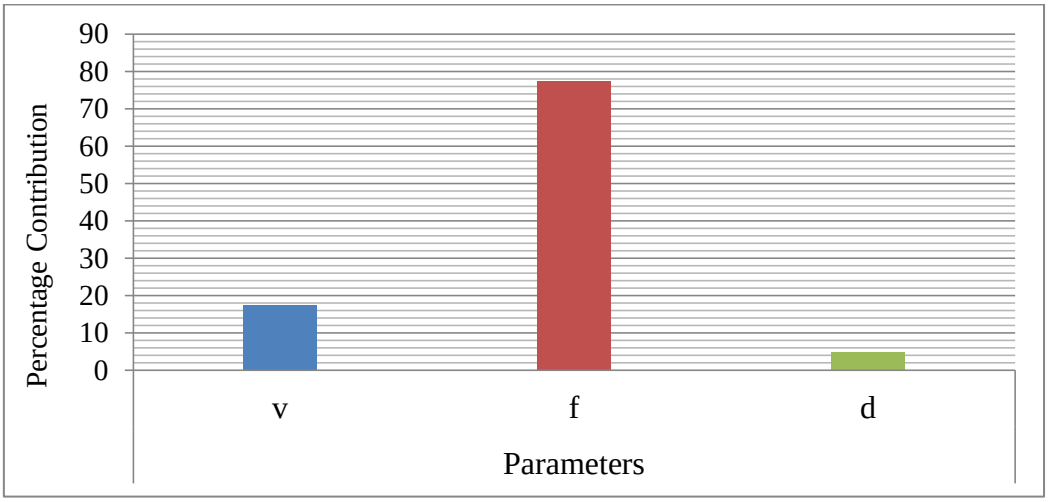

Figure 4: Percentage contribution

4. CONCLUSION

Based on the surface roughness test conducted on EN24 steel during turning operation with titanium nitride coated carbide insert under flooded machining condition, this research work is concluded with the following key points:

i. From the effect curve plotted for cutting velocity, it was evident, that the surface roughness value decreased with the increase of cutting velocity.

ii. From the effect curve plotted for feed rate, it was evident, that the surface roughness value increased with the increase of feed rate.

iii. From the effect curve plotted for depth of cut, it was evident, that the surface roughness value increased with the increase of depth of cut.

iv. From the experimentation, it could be concluded that feed rate has a greater effect on the surface roughness followed by cutting velocity and depth of cut, which is shown in the contribution chart.

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