

# THE EFFECT OF CUTTING FLUID ON SURFACE ROUGHNESS OF LM6 ALUMINIUM ALLOY DURING TURNING OPERATION

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**Abstract:** The machining parameters of any machining activity highly influence the surface nature of a component. The goal of this research work is to think about the impact of cutting fluid (SERVOCUT 'S' Grade oil emulsified with water) on the surface quality of LM6 Aluminium alloy cylindrical components. The turning operation was completed with TiN coated carbide insert on the LM6 Aluminium alloy under traditionally flooded condition. The turning parameters, namely spindle speed, feed rate and depth of cut were chosen for the conduct of experiments. The surface roughness of the turned samples was examined with a surface roughness analyzer.

**Keywords:** LM6 Aluminium alloy, 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 [1-2].

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 [3-4].

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 Spindle Speed, feed rate, depth of cut and machining time [3-6]. The machining power and cutting tool wear increase almost linearly with the increase of cutting speed and feed rate [7-8]. In high-speed machining of stainless Aluminium alloy using coated carbide tool, the feed rate is found to be more significant followed by the cutting speed and the depth of cut [9-15].

The researchers [16] studied the influence of turning parameters such as speed, feed rate, depth of cut and tool nose radius on the surface roughness of Aluminium alloy based composite 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 Aluminium alloys have been investigated by many researchers. Still, there remains some difficulty in the machining of Aluminium alloy 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 LM6 Aluminium alloy under flooded machining conditions in order to study the effect of cutting fluid on surface roughness in this study.

## 2. Experimental conditions

- **Workpiece used** – LM6 (Ø30mm 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 spindle speed (rpm), feed rate (mm/rev) and depth of cut (mm) were considered while turning of LM6 Aluminium alloy under flood, near dry

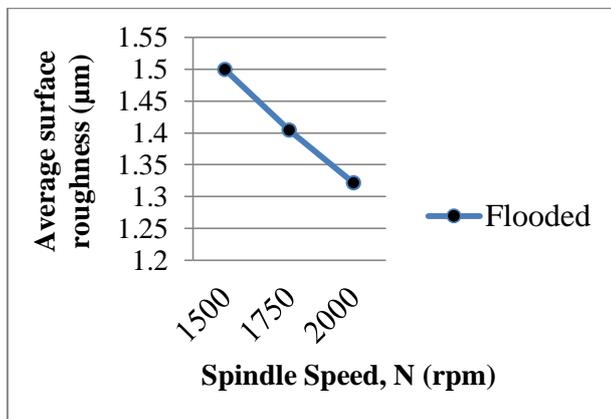
and dry machining conditions. The various levels of the parameters are given in Table 1.

**Table 1:** Parameters and their levels

Parameter	Notation	Levels		
		1	2	3
Spindle Speed (rpm)	N	1500	1750	2000
Feed rate (mm/rev)	f	0.1	0.15	0.2
Depth of Cut (mm)	d	0.3	0.6	0.9

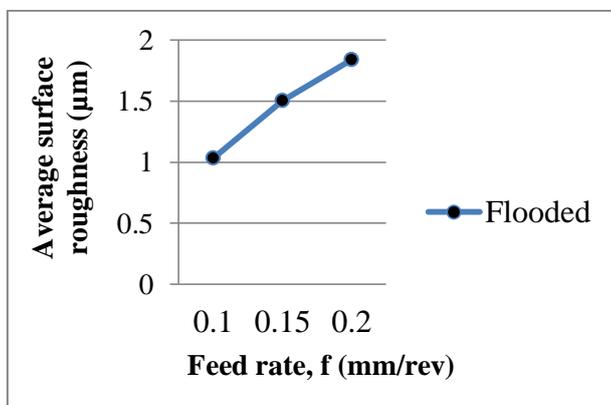
### 3.1. Effect of Parameters

The effect of Spindle Speed 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 Aluminium alloy LM6. It was observed from Figure 1, that the surface roughness value decreased with the increase of Spindle Speed.



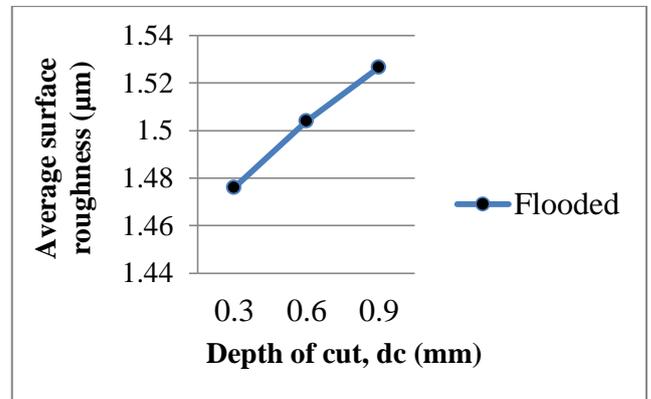
**Figure 1:** Effect of Spindle Speed on surface roughness

The effect of feed rate was observed with a constant Spindle Speed of 1750 rpm and with a constant depth of cut of 0.6 mm while machining Aluminium alloy LM6. 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

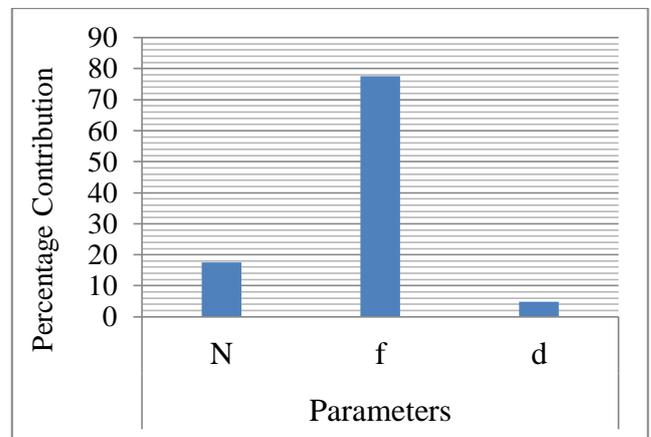
The effect of depth of cut was studied with a constant Spindle Speed of 1750 rpm and with a constant feed rate of 0.15 mm/rev when machining Aluminium alloy LM6. It was observed from Figure 3, that, the surface roughness value increased with the increase of depth of cut.



**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 LM6 Aluminium alloy 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 spindle speed, it was evident, that the surface roughness value decreased with the increase of spindle speed.

- 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 Spindle Speed and depth of cut, which is shown in the contribution chart.

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