Here, we introduce the knowledge and various knowledge about the product TAKAMAZ a variety of machine tools.
I hope you will help the daily work of customers

The 14th Rotary Machining of Quenched Steel through Compound Machining

高松流 技 TAKAMAZ RYU-GI

Quenched steel is frequently used in components such as automotive parts where durability is demanded, and finishing process such as grinding is common. For this reason, currently the efficiency is poor, and there is an increasing need for more efficient machining. We would like to introduce the results of our studies about the effect of rotary machining and increased efficiency on quenched carbon steel finishing.

Trial Content

Figure 1 shows a schematic of the current rotary machining. Using a compound machine, the material to be ground is chucked on both sides. The cutting position is placed at a 10° offset relative to the Y axis in consideration of the tool shape. For this reason, the rake angle is −10°, and the draft angle is 10°. The cutting conditions are shown in Figure 1. Tool runout is less than 10μm, and the tool life is defined as the 100μm flank wear width (VB) or the loss state limit.

Trial Result (Verification of the Rotary Machining Effect)

Figure 2 shows the relationship between cutting distance and flank wear width when a tool is in a state where the rotary tool rotation has been stopped and fixed (hereafter "non-rotating tool") is used. As shown in the figure, flaking appeared in the non-rotating tool at a cutting distance of 0.2km, and the tool reached the end of its life. On the other hand, the rotary tool had a relatively small flank wear width of 32.6μm even at a cutting distance of 1.5km. This is thought to be because the tool wear is dispersed across the entire cutting circumference by the rotation of the tool. It is estimated that, in the case of the rotary tool, the power of the thrust force direction was reduced by the rotary operation of the tool, and therefore flaking did not occur.
And in reality, it was confirmed as a result of having verified the difference in thrust force to have been reduced by about 12% with the rotary tool compared to the non-rotating tool.

Tool	Material	Carbide Coating (K10+TiSiN Coating)
	Size	φ10 × 75mm
Workpiece	Material	SCM420 (HRC60)
	Size	60 × 500mm
Cutting Condition	Workpiece Rotational Speed (Vw m/min)	100
	Tool Rotational Speed (Vt m/min)	31.4
	Feed Rate (f mm/rev)	0.1, 0.3, 0.5
	Cutting depth (d mm)	0.1
	Cutting Method	Up cutting
	Cutting Environment	dry machining

Table 1 Cutting Condition

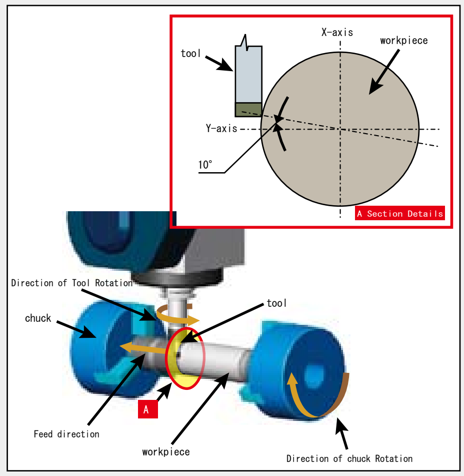


Figure1 Rotary Machining Schematic

Trial Result (Verification of the Effect of Feedrate Increase with High Efficiency)

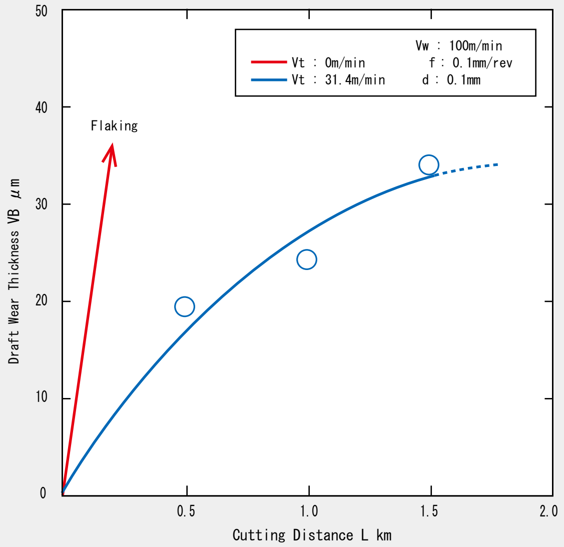
Figure 3 is a comparison of the draft wear thickness and the maximum height roughness for a cutting distance of 1.5km. As shown in the figure, the progression of the draft wear thickness tends to become faster as the feed rate increases.
In addition, the maximum height roughness of the work surface is shown to be 2.1μmRz under feed rate conditions of 0.3mm/rev, and the variance is relatively less. Furthermore, Figure 4 shows the relationship of the cutting distance and draft wear thickness under feed rate conditions of 0.3mm/rev. Even at a cutting distance of 5.0km, the wear thickness was small at around 40μm, and the progress of wear was confirmed to be gradual.

1. In rotary machining where the rotation shaft of the tool is forcibly driven, the tool gradually wears out, and damage such as flaking is not observed
2. In the working of quenched carbon steel by rotary machining, tool wear was markedly inhibited compared to conventional work methods.
3. In rotary machining, the thrust force is reduced compared to a non-rotating tool where the rotary tool has been stopped and fixed.
4. Even if the cutting distance is extended under feed rate conditions of 0.3mm/rev, there was no flaking on the cutting lip, wear progressed gradually, and high efficiency is possible.

Summary

Thus, it was possible to obtain the above effect through rotary machining for finishing work on quenched carbon steel when the effect and efficiency thereof was verified.

※This paper was a joint undertaking with the laboratory of Professor Hideharu Kato of the Kanazawa Institute of Technology, Department of Mechanical Engineering.



Frigure 2 Cutting Distance and Draft Wear Thickness per Various Tool Rotation Speed

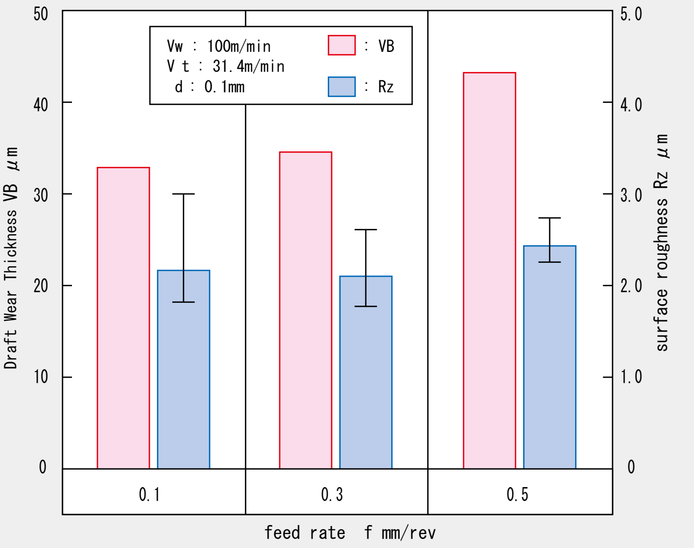


Figure 3 Comparison of the draft wear thickness and the maximum height roughness at a cutting distance of 1.5km.

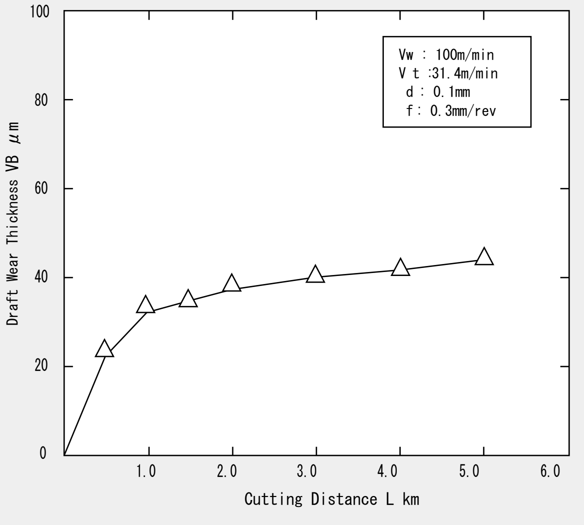


Figure 4 Relationship of the cutting distance and draft wear thickness at a feed rate of 0.3mm/rev