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In the current edition of Takamaz Ryugi, we will introduce the tools used in "Hard Turning Work" which is said to be a relatively difficult process, as well as a cutting method is garnering attention.

CBN※Tools for Hard Turning

※CBN/C= An acronym for Cubic, B= Boron, N= Nitride

Q What are CBN tools?

The hardness is 4× that of quenched steel, and the advent of CBN materials makes mass-production cutting possible

Although these tools were first developed for use in the cutting of heat-resistant alloys, they have come to be used in hard turning work with Sumitomo Electric Industries, Ltd having developed "CBN tools for Quenched Steel Machining" where CBN is mixed with a ceramic binder and sintered.

The cutting tool hardness needed for stable cutting is at least 3× that of the material cut. CBN has a hardness second only to diamond, and strong resistance properties even against cutting heat. Therefore it has had great expectations since it was first developed as the optimum material for machining quenched steel. The Vickers hardness of quenched steel is about 720Hv. Whereas carbide tools are about 2× this at 1500Hv, CBN tools are about 4× this at 2800Hv, and maintain full hardness in stable machining.

However, their use in mass production was put off due to their extremely high price and low reliability due to sudden breakage. In Japan, amelioration of these problems has been underway since 25 years ago, with the intent of propagation in mass production.

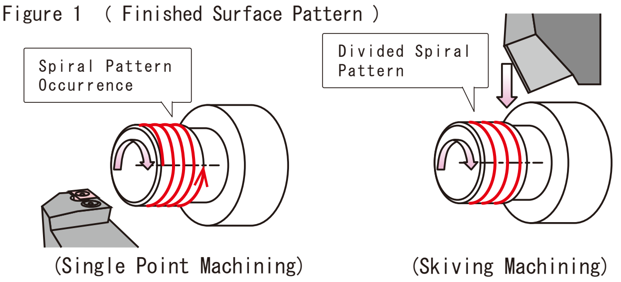
As a result, costs have today been successfully lowered to about 1/10 of what they once were. Regarding breakage, the toughness and the wear resistance have been enhanced through the improvement of tip shapes and material blends. At the same time, high-speed machining capitalizes on the "high temperature strength" that is a superior characteristic of CBN tips, thereby improving efficiency, and dramatically extending their introduction in mass production.

Q What are the Pros and Cons?

Improved Cost Performance, Reliability, Machining Precision, Suitability for a Variety of Applications

Cutting for machining straight parts such as cylinders and the like can be performed relatively simple, while for compound shapes with R, tapers, undercuts, and right angles, etc., total type grind stones are used, and it is necessary to perform the machining with pressure applied, generating restrictions, naturally. Moreover, formation into total type grindstone shapes is difficult, and there are also difficulties with uneven wear in parts. In hard turning machining, it is not only possible to machine compound shapes through NC lathe programming, but even parts machining of multiple items is possible simply by changing the program. Although workers experienced in grind setup and tracing are needed, hard turning machining using CBN tips is characterized by the ease of obtaining the demanded precision, unaffected by the skill of the worker. Although the work surface roughness using CBN tools was Rmax6.3μm 25 years ago, it has risen to Rmax1.6μm in recent years. It has become possible to obtain high-precision machining while maintaining stability. Because machining is performed using an NC lathe, there is also an additional advantage in that machining facility costs can be greatly reduced in comparison to grinding equipment.
Although hard turning machining has such outstanding characteristics, the occurrence of spiral patterns (fine thread patterns) (See Figure 1) generated oil leaks from the seals, and is restricted in terms of finishing of parts associated with oil pressure or lubrication, and future improvement of this is desired.

Figure 1 (Finished Surface Pattern)



● Topics ● Achieving seal surface machining, and making possible a great shortening of cycle time

Hard skiving machining

Hard skiving machining* refers to a machining method where a cylindrical work surface of quenched steel is scraped off so that burrs are shaved off through the up/down motion of the tool (See Figure 2, 3). The greatest advantage of this machining method is that it can even deal with oil pressure/lubrication-related parts because spiral patterns cannot be differentiated (See Figure 1).
In addition, regardless of the feedrate] multiple of a single point tool, it is possible to maintain a surface roughness on the order of Rmax1.0μm, giving the prospect of a great shortening of machining times and increased quality.

※Hard Skiving Machining/ Machining Method Patent of Sumitomo Electric Industries, Ltd

In terms of tool life, this can be extended to about 4× as the tool tip is set upon the line (generally 20mm in length) like a deburring blade.

Moreover, because it is possible to achieve a machining surface with an unchanging grinding pattern, and since it is possible to machine parts for seals, and dramatically shortens machining times, etc., it overcomes the conventional issues of hard turning machining, and is garnering much attention as a machining method promising great results.

With progressing internationalization and the trend towards small lots of multiple part types in Japan, as well as the tail winds of "improved setup" and the so-called environmental advantage of "reduced waste oil processing" due to dry machining, and future demand is expected to increase.

●CBN Straight Blade

Figure 2 (Tool for Hard Skiving Machining)

●Tool moves from top to bottom

Figure 3 (Skiving Machining State)