Cutting Performance of Turning Insert with Three-arcs-shaped Finishing Edge

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The machined surface is an important index of the quality and functional performance of a machined component [1]. In turning operations, ideal surface roughness is the best possible finish that may be obtained for a given tool shape and feed rate and can only be approached if built-up edge, chatter, inaccuracies in the machine-tool movement, etc., are eliminated [2]. Surface roughness is dependent on both the tool geometry and the feed rate "S." For example, in turning by an offset tool with the side cutting edge angle 0 degrees and the corner radius "r," the theory value of surface roughness (the maximum height roughness "Rz") is similar in $S^2/(8r)$ in the case of the feed rate "S" being lower than "2r." Thus, using a larger corner radius or a lower feed rate is effective for obtaining a good machined surface. However, turning at lower feed rates decreases productivity and it has a negative influence on the turning operation because of continuous chipping. On the other hand, turning at a larger corner radius increases both the productivity and good machined surface because of the higher feed turning.

Incidentally, in the turning of a shaft with a step of specified corner "R," it is important whether the corner radius of the turning insert is the same as the specified corner "R" or lower than it. A turning tool with a large corner radius cannot adapt to cutting a shaft with a step of the specified corner "R." Therefore, a finishing blade is formed at the point of the intersection between the corner radius and the straight cutting edge. This finishing blade is called a wiper edge [3, 4].

In this study, the surface roughness, cutting force, and tool wear were experimentally investigated in order to clarify the cutting performance of the turning insert with a three-arcs-shaped finishing edge. Work piece material ASTM D2 (JIS SKD11) was turned with two types of turning inserts that had different radii of the arc-shaped finishing edge.

The main results obtained are as follows.

(1) The machined surface of the insert with a three-arcs-shaped finishing edge was better than that of the normal insert.
(2) The wear progress of the insert with an arc-shaped finishing edge was slightly slower than that of the normal insert.
(3) The cutting force of the insert with an arc-shaped finishing edge was almost the same as that of the normal insert.

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