Effect of Spacing between Layers and Shape of Segment on the Performance of Pattern Saw Blade

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Abstract

Diamond tools with several layers of diamond grits through thickness direction were tested by sawing. The saw blades with evenly distributed grits showed better cutting performance compared to the random distributed saw. At a given concentration of grits, as the spacing between layers was increased, the cutting performance was improved, and as decreased, it showed more tool life

Keywords : Diamond, Diamond tool, Array, Powder1

1. Introduction

A diamond tool is used for cutting and drilling concrete or stone. A cutting segment is comprised of diamond particles and metal powders for holding the abrasive particles. Diamond particles are randomly dispersed in metal matrix. This leads to variation of performance as well as a low cutting rate. To resolve the problem, there has been an attempt to arrange the diamond particles evenly in the segment for decades(thereafter, we call it patterned saw). Recently the effort has been realized and that kind of tools came out in the market[1].

The correct design of the diamond type and used metal powder was important in the tool which having randomly dispersed diamond particles. But how to arrange the grits can become a primary parameter in patterned saw blades.

Fig. 1 shows cutting surface of segment. The diamond particles are evenly spaced but different configurations between Fig.1(a) and (b). It seems probable that they will show the same performance. However they would have the different characteristics in performance due to different configurations. Because saw blade just rotates around only one axle, each diamond particle also rotates along the same line, which can cause different performances between segment in Fig.1(a) and (b). Especially, spacing of diamond layers in cutting surface has considerably influence on cutting rate and tool life.

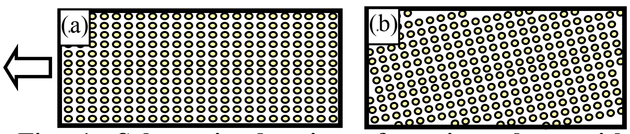


Fig. 1. Schematic drawing of cutting plane with different angles

In this article, the relation between the spacing of layers in the cutting surface and the performance of tool is investigated. Also we examine the relation between wear characteristics of cutting segment and chip groove according to change of the spacing of diamond layers.

2. Experimental and Results

Table 1 shows the segments specification those were used for sawing. One random segment and 4 different types patterned segment were used. All four patterned segment have different spacings between diamond layers.

The blades used were 14 inch diameter and consisted of 24 abrasive segments with segment dimension of 40mm length and 3.2mm thickness. The segments were joined to the steel core by brazing.

We used G.I's MBS 955k 40/50mesh with 0.8cts/cc concentration and 50Co-50Fe(wt%) metal matrix segment.

According to the patterning technology (instead of mixing the metal powders and the diamond particles) repeated layers of metal powders and diamond particles in a predetermined, non-random pattern are prepared, and then sintered the layered product, thereby producing the segment.

Fig. 2 shows typical side view of patterned diamond segment, (a) straight (b) serrated respectively. In Fig.2(b), some regions of diamonds were shifted 0.2mm in thickness direction of segment(called serrated). With this technique,

Table 1. The specification of sawing test blades

	Segment type	# of layer	Spacing
1	Random	-	
2	Arrayed(straight)	6	0.56
3	〃	7	0.47
4	〃	8	0.4
5	Arrayed (Serrated)	5	0.2~0.7mm

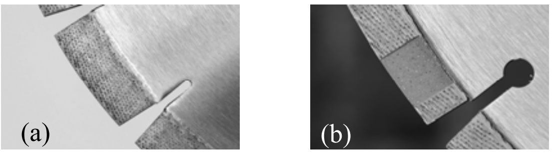


Fig. 2. Photograph of straight & serrated segment.

Table 2. Experimental conditions

Spindle speed (rpm)	1800
Blade peripheral speed (m/s)	32
Traverse speed (m/min)	4
Cutting mode	Down - cutting
Depth of cut (mm)	30
Workpiece	Granite(class Ⅳ)

the diamond layers become closer without additional diamond layers.

The sawing test was conducted in bridge type PEDRINI automation-sawing machine and sawing parameters were seen in table 2.

After the test, diamond grits and chip groove on the segment wear surface were investigated under microscope. The amount of drain power and worn away segment height were also checked for cutting rate and tool life respectively.

Fig. 3 shows surface of the segment which was observed. In patterned diamond blade, it was observed diamond layer and cutting groove linearly except randomly distributed diamond blade. In case of the patterned diamond segment, chip groove was formed between the layers, which were worn away faster than diamond layers.

[random]
[6 layered]
[7 layered]
[(8 layered)
[5 layered Serrated]

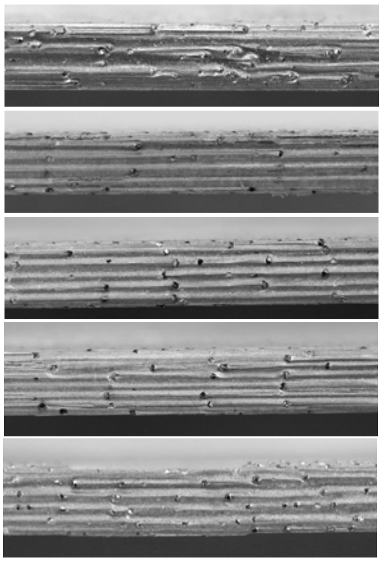
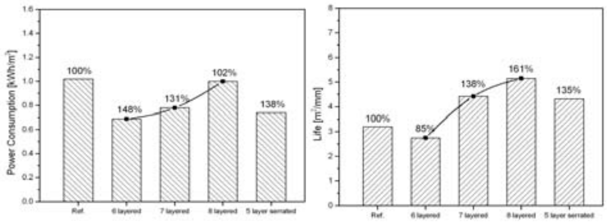


Fig. 3. Surface of pattern saw blade with number of layer & segment shape.

As the layer was increased, spacing between layers became narrow. So, we can change blade performance and wear mechanism by controlling the spacing between layers[2]. Besides, the spacing can be changed by slightly shifting the diamond layers such as serrated type segment, and the width and depth of chip groove could be controlled.



(a) (b)

Fig. 4. Power consumption and tool life with the number of layer & segment shape

Fig 4 shows the sawing test result of diamond blades. In the Fig 4(a), power consumption of arrayed diamond blade was very lower than randomly distributed diamond blade. We think that this is attributed to decreasing cutting load for evenly arrayed diamond blade. More increasing the spacing, the width of chip groove became deeper, and H_{max} value was increased[3], which gave rise to the lower power consumption.

Fig 4(b) shows graph of tool life. All the patterned diamond blades show longer life than randomly distributed diamond blade except 6-layered blade. This result would be due to decreased cutting load by evenly distributed diamond particles in patterned blade. Especially, although serrated blade of 5 layers had fewer layer, it was possible to increase tool life considerably without sacrificing cutting speed. In serrated blades, the spacing between layers became narrower which affected on wear mechanism.

3. Summary

The distance between diamond layers has been shown to have a critical effect on blade performance. In patterned diamond tools, it has been possible to increase both cutting rate and tool life.

4. References

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