Characterizing Low and High Concentration Diamond Wheels for Cutting Materials

1.0: Purpose

A comparison of the cutting times using different concentration diamond wheels was done to determine if there is a significant difference between the diamond wheel types. Using two different materials, cutting times were recorded on each wheel type and the results were plotted onto a graph to show the relationship between cutting time and diamond concentration.

2.0: Materials and Methods

The following parameters describe the procedure and materials which were used for the experiment.

Samples

1. Brass rod (25 mm diameter)
2. Quartz rod (25 mm diameter)

Diamond Wheel Types

1. 4" diam; .012" thick; DWL 4121
2. 4" diam; .012" thick; DWH 4121

Cutting Parameters

Load: 80 grams
Wheel Speed: 7
Blade Dressing: Prior to each cut
Coolant Density: 30:1 Standard dilution

Each sample was mounted onto a sample block using Quickstick 135 and each sample was cut on the Model 650. The samples were cut and the times for each cut were recorded. Five cuts were made for each wheel type and the times were then averaged. A graph of the results can be seen on the following page.

3.0: Results and Conclusions

It was found that diamond concentration has a great effect on the cutting times of materials. As a function of diamond concentration, cutting time increases as diamond concentration increases. This has been explained by a loading principle. As diamond concentration decreases, there is an increase in the amount of load which is applied to each individual diamond, and therefore the removal of material is more efficient. In the case of higher concentration diamond wheels, because the diamonds are closer together the load per diamond particle is reduced because of the increase in diamond concentration. This reduces the overall cutting efficiency and shows as an increase in the cutting time as recorded in the graph. Another contributing factor may also be an increase in blade loading, where the material from the specimen begins to clog the diamonds and further hinder cutting efficiency. As a result of the tests, diamond concentration also has an effect on ductile material cutting. This may be due to the actual cutting mechanisms involved rather than the diamond concentration. With ductile materials, material is removed primarily by shearing, as with a lathe. With brittle materials, material is removed by chip formation which is typically much more efficient when using diamond. The increase in cutting times for the brass may also be explained by an increase in the blade loading effect.

In any case it can be determined from the experiment that the diamond wheel concentration is inversely proportional to cutting time. Higher concentration diamond wheels take longer to cut samples as compared to those of lower concentration diamond wheels. With ductile materials the effect seems to be greater than with more brittle materials but should be investigated further to confirm this finding.

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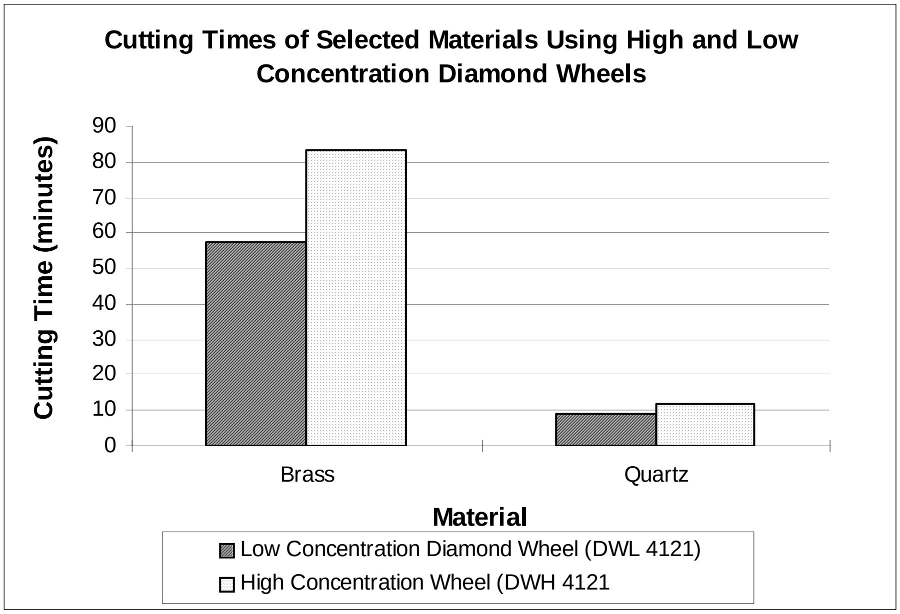

Figure 1: Chart illustrating the variation in cutting time as a function of diamond wheel concentration. As can be seen in the graph above, the cutting time is much lower for low concentration diamond wheels as compared with high concentration wheels. The effect is greatest when cutting ductile, metallic materials as compared to ceramic materials.

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