Characterizing the Model 660 Low Speed Diamond Wheel Saw

1.0: Purpose

Characterizing the Model 660 Low Speed Diamond Saw will be done to provide useful information which can aid in the understanding of the operation of the saw. The information gathered in these experiments will be discussed in the manuals as well to provide the consumer with valuable data regarding the operation of the saw. Determination of parameters such as wheel diameter, load, wheel speed, and arm position and their effects on cutting time will be determined to enhance our understanding of the instrument and these parameters.

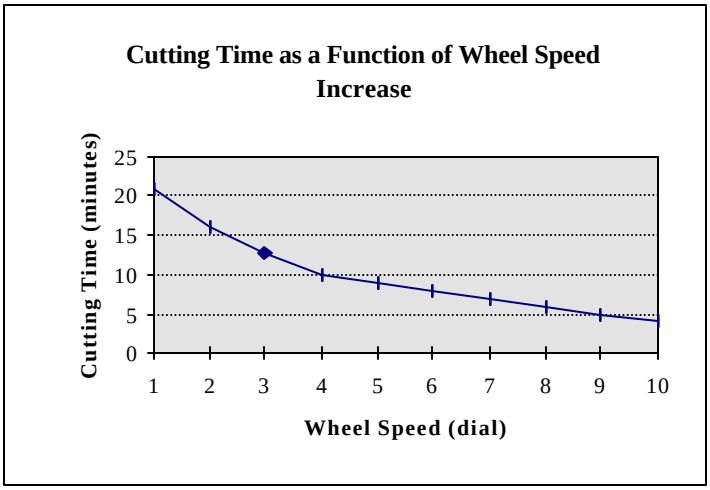
2.0: Experiments

Several tests were run on the 660 to obtain the data necessary for determining the effect certain parameters have upon cutting speed. Each test will be described individually and will be discussed in detail.

Cutting Time vs. Wheel Speed

To determine the effect that wheel speed has upon cutting time, a 25 mm quartz rod sample was cut using a 5" diamond wheel at increasing wheel speeds. Three cuts were made at each respective wheel increment indicated on the dial (e.g. 1 through 10) and the time for each cut was recorded. After compiling all of the data, the sets of cutting times were averaged and plotted in the graph below.

Graph 1: Graph showing the cutting times as a function of wheel speed increase. As can be seen from the graph, cutting time is reduced rapidly as the wheel speed is increased.



As can be seen in Graph 1, the cutting times of materials decreases as the wheel speed is increased. It can also be observed that this decrease is not linear, and begins to level off at the higher end of the speed settings. Although this was only done with one sample type, this is an indication of the manner in which the saw will act with all other samples in general. The exact times will vary, but the shape of the graph will remain constant because it is a function of the motor speed and not sample composition.

Cutting Time vs. Applied Load

To determine the effect that load has upon the cutting times of materials, cuts were made using 5" diamond wheel and a 25 mm quartz rod sample as used on the wheel speed tests. Three cuts were made and the times at each respective load were averaged and plotted on a graph in the similar manner as the wheel speed test.

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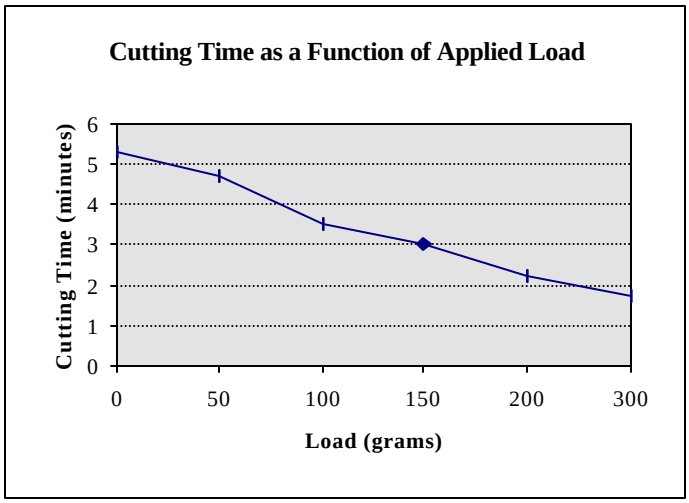


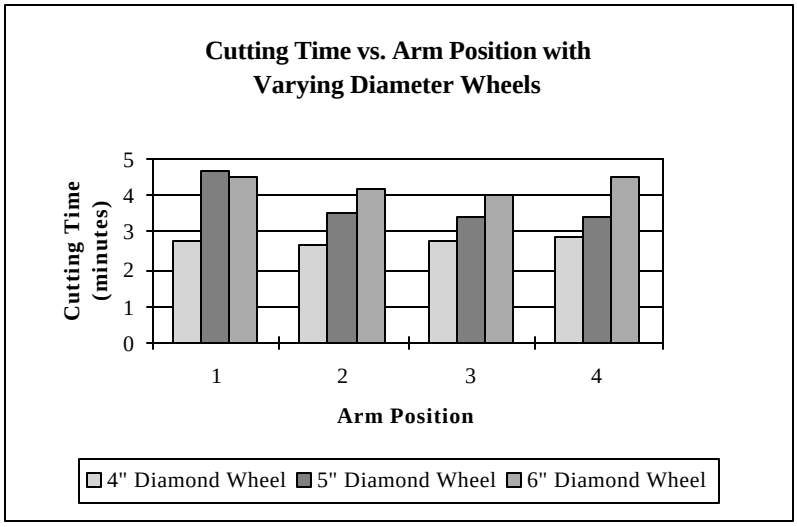
Graph 2: Graph showing cutting time as a function of load increase on the specimen arm. As load is increased, the cutting time decreases linearly.

As indicated by Graph 2, load has direct relationship to the cutting times. The greater the amount of load applied to the specimen, the faster the cutting time will be of any particular sample type. However, caution must be used when cutting materials that are very soft and ductile (e.g. copper) because an overload on the sample may cause the diamond wheel to clog or become loaded with copper particles, which will decrease the cutting time. Frequent dressing of the diamond cutting wheel using a SiC dressing stick is necessary to minimize this effect.

Cutting Time vs. Arm Position

This test was done to determine if any relationship between cutting time and arm position with respect to the diamond cutting wheel. There are four different positions which can be adjusted on the 660 to change the location of the specimen on the cutting wheel and are designed to optimize the location for various diameter cutting wheels. By changing these positions and keeping the speed of the wheel constant, one can determine if there is a relationship existing between cutting time and arm position. Three cuts were made at each arm position and then averaged and plotted on the graph. This was done for three different wheel diameters, all of the same type and composition (e.g. medium diamond particle size, high concentration). The arm positions used were as follows:

Position 1: Fully extended away from the micrometer shaft
Position 2: One retraction of the arm from position 1.
Position 3: Two retractions of the arm from position 1.
Position 4: Fully retracted to the base of the arm assembly.



Graph 3: Graph showing cutting time as a function of arm position for varying diameter cutting wheels. No significant relationship exists between these two parameters.

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From these graphs produced and the data collected, it can be said that no apparent relationship exists between the position of the arm and the cutting time. Therefore arm position is used solely for the positioning of the sample when changing wheel diameters or when trying to optimize the position of the specimen with respect to the cutting wheel surface.

3.0: Conclusions

The Model 660 performs much like the Model 650 Saw, both using the same principles in design for achieving the desired cutting actions. The relationships between the cutting time and variables such as load, arm position, wheel diameter, and wheel speed are found to comply with the expected results and are summarized below:

1. Cutting times will decrease with an increase in load applied to the specimen. Some highly ductile materials may show a slight increase at higher loads due to the nature of their composition and cutting type. Frequent dressing should be done to minimize this problem.

2. Cutting times decrease with an increase in wheel speed, but this is not a directly linear relationship. The effect levels off at the higher wheel speeds, limited by the motor capacity.

3. Positioning of the arm with respect to the cutting wheel has no definite relationship to cutting time. The position of the sample does not affect cutting time to any significant degree.

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