Analysis of Air Quality During Ring Cutting

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Air quality measurements were recorded during the cutting of a tungsten carbide simulated finger ring. It was found that a Dremel® high speed rotary tool created airborne particulate matter concentrations in excess of accepted exposure limits. This analysis also found that the Ring Rescue® Dolphin™ Ring Cutter reduced the average air contamination by a factor of 182 when compared with a Dremel® tool.

1. Overview of Current Practice

Ring cutting is a common treatment for ring entrapment syndrome. Tungsten carbide is a popular contemporary ring material that presents unique challenges for cutting due to its hardness. The Dremel® high speed rotary tool has been described as a method for cutting hard ring materials. An often overlooked byproduct of this treatment is airborne cutting debris which can present a respiratory hazard. The goal of this investigation is to quantify the interior air contamination produced during a simulated tungsten carbide ring cut with a high speed rotary tool. A purpose-built electric ring cutter (the Ring Rescue® Dolphin™ Ring Cutter) will also be tested for comparison. Findings in each case will be presented with accepted exposure limits.

2. Methodology

An air quality meter (Dylos® DC1100 Pro with PC Interface) was setup 0.3 m (1 ft) from a rigidly mounted sample of tungsten carbide with a cross section of 6.35 x 3.18 mm. The sample was cut while the air quality meter measured inhalable particle matter (PM) suspended in the air.

In the first trial, a Dremel® model 3000 was affixed with a Dremel® EZ545 EZ Lock® diamond cutting wheel and operated at 25,000 revolutions per minute (RPM). Water was applied to the sample periodically and the sample temperature was maintained at 50±5°C. Once the cut was complete, the room was vacated and the air quality meter allowed to return to its baseline.

In the second trial, the Ring Rescue® Dolphin™ Ring Cutter was affixed with a AssureCut™ Disc. The tool was operated as specified by the manufacturer, including the application of a proprietary lubricant during use. The cutting disc spins at 350 RPM.

All trials were conducted in a closed room with an area of 8.3 m^2 (89.3 ft^2) and an interior volume of 22.4 m^3 (791.4 ft^3). A baseline air quality measurement was taken in the room six hours preceding the test. All building ventilation was shut off during the testing.

3. Results

The air quality results from both trials are summarized in Figure 1. The peak PM, 15 minute maximum average PM, and maximum recorded temperature of each trial is summarized in Table 1.

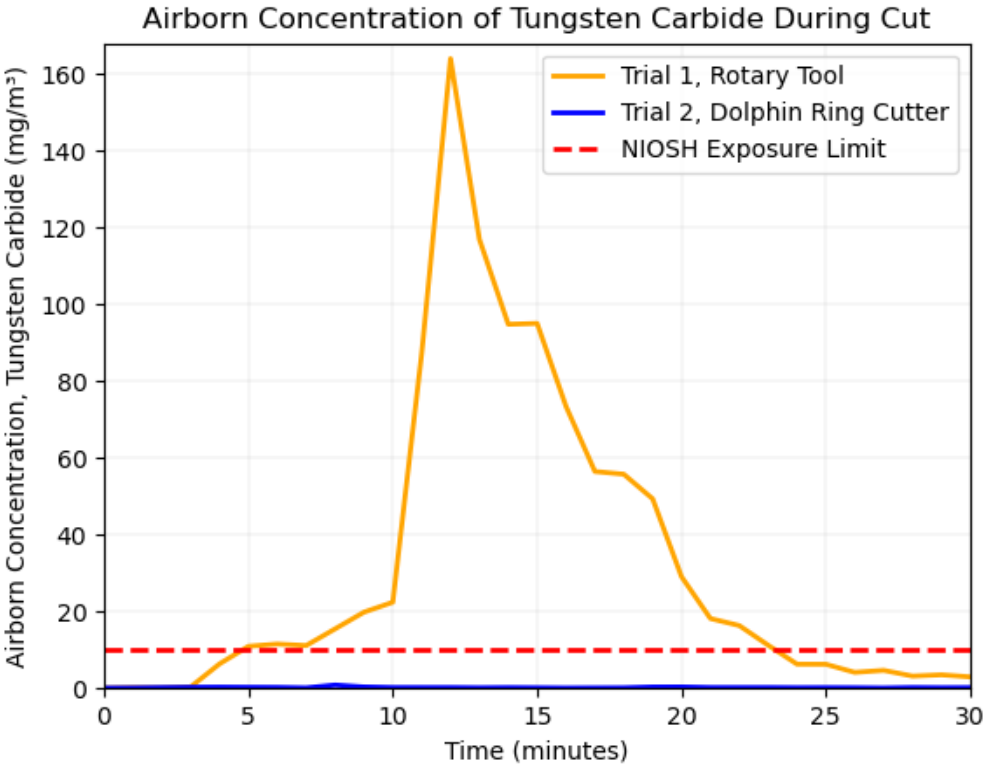

FIGURE 1. Airborne concentration of tungsten carbide measured for each cutting method.

Trial	Peak PM (mg/m^3)	15 min. Average PM (mg/m^3)	Max. Temperature (°C)
1	163.98	60.26	51.5
2	0.85	0.33	30.2

TABLE 1. Peak PM, 15 min. maximum average PM, and maximum temperature recorded during each trial

4. Discussion and Conclusion

As shown in the previous section, the high speed rotary tool creates significantly more airborne PM than the Ring Rescue® Dolphin™. Of note, the short-term exposure limit for tungsten carbide as determined by the National Institute for Occupational Health and Safety (NIOSH) is 10 mg/m^3. The high speed rotary tool exceeded this threshold.

When compared with the 15 min. maximum average of each trial, the Ring Rescue® Dolphin™ produced 182 times less airborne PM than the high speed rotary tool in this investigation. Care providers should be aware of the risk posed by airborne particulate matter when cutting rings of certain materials.

5. Acknowledgements

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