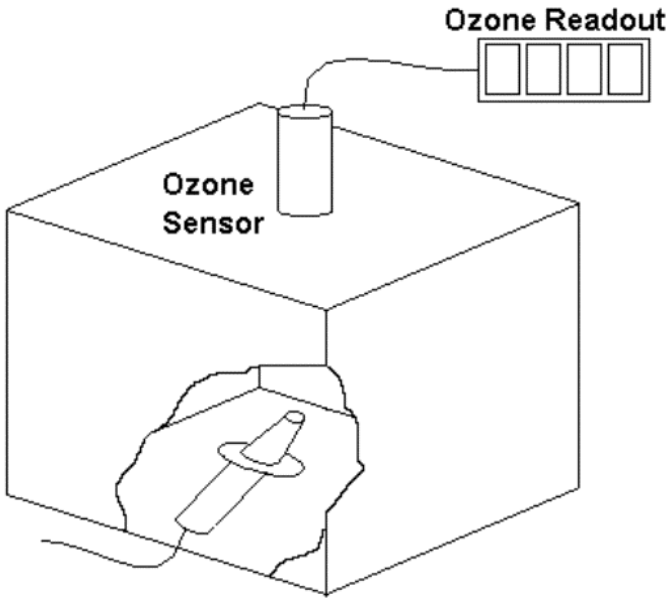
High Frequency - Ozone Production Tests

Purpose
The purpose of the tests was to determine the rate of production and dissipation of ozone as produced from the portable high frequency unit.

Procedure
The portable high frequency unit was placed into a series of cubical containers along with an ozone meter as depicted in the following sketch:



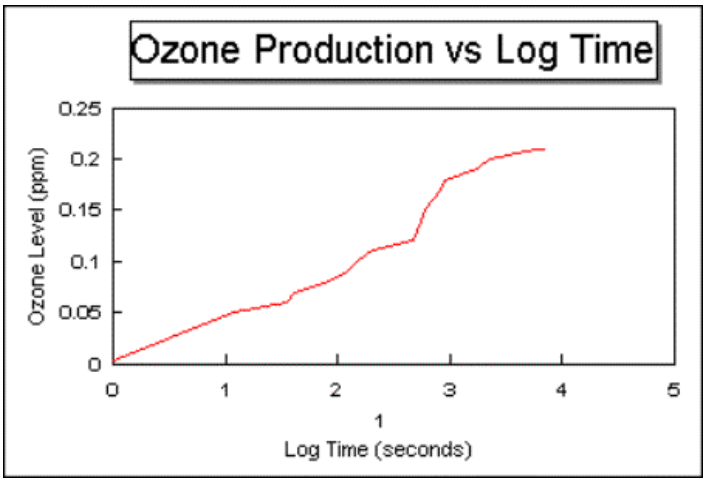
Three different sized containers were used:

1. 12" X 12" X 12"
2. 6" X 6" X 6"
3. 3" X 3" X 3"

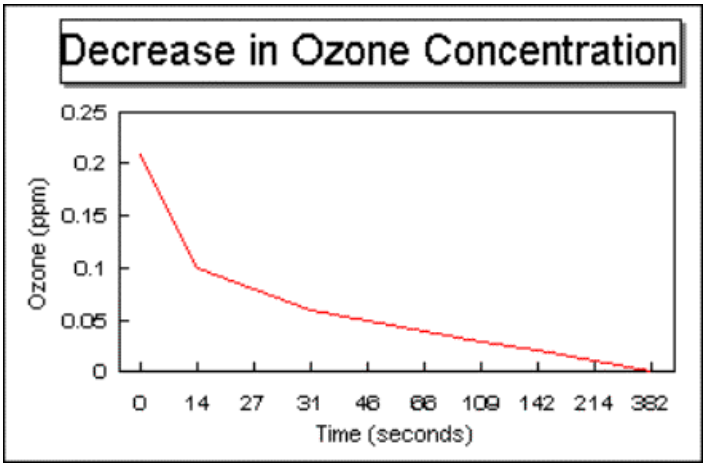
The portable high frequency unit was grounded and placed at the bottom of the container, directly below the ozone sensor.

Results
The first series of tests were run in the 12" X 12" X 12" container. In this enclosure, after 1 hour there were no readings.

Next, the 6" X 6" X 6" container was used. The results in this container are depicted below:



In the 3" X 3" X 3" container, the readings quickly (within 2 seconds) went to 0.28 ppm and remained there for over 30 minutes.



The above diagram illustrates the decrease in ozone once the portable high frequency unit was turned off:

Ozone Toxicity

Ozone is an irritant of the mucous membranes and the lungs. Effects of exposure can be wide ranging. Signs of exposure increase as follows:

- Odour Threshold .01 ppm
- Obvious Odour .05 ppm
- At 0.1 ppm 5% of people will experience eye irritation

The following scales represent the exposure time required to produce the listed toxic effects. The scale is the product of dose in ppm and time of exposure in minutes. The most severe application of the portable high frequency unit is 0.70 ppm-minutes and this would occur if the user were to inhale all of the ozone produced during a 5

minute treatment.

- 0.65 to 3 ppm-minutes
  - throat irritation
  - throat dryness
  - watering eyes

- 3 to 36 ppm-minutes
  - changes in visual acuity
  - increase in peripheral vision
  - coughing
  - choking
  - substernal pain
  - dyspnea

- 36 to 72 ppm-minutes
  - head ache
  - dizziness
  - burning eyes
  - pulmonary edema
  - broncho pneumonia

- 72 to 96 ppm-minutes
  - impaired lung function
  - ionizing radiation mimicking
  - chromosomal damage

- 6,000 ppm-minutes
  - potentially lethal

- 12,000 ppm-minutes
  - LC50 in rats

Legislated Limits
United States National Ambient Air Quality Standard - hourly average of 0.12 ppm (7.2 ppm-min)1

Maximum standard for ozone in the workplace (TLV) .05 ppm for 8 hours (24 ppm-minutes)1

1 Kehrer, in handbook on TOXICITY OF INORGANIC COMPOUNDS (Marcel Dekker, Inc.)

TLC-TWA 0.1 ppm2

ACGIH, NIOSH, MSHA 0.2 ppm2

OSHA IDLH 10 ppm2

2 Pradyot Patnaik A COMPREHENSIVE GUIDE TO THE HAZARDOUS PROPERTIES OF CHEMICAL SUBSTANCES, Van Nostrand Reinhold

Conclusion

If the portable high frequency unit is operated in an open environment there is no chance that ozone can build up to levels which would be harmful. Further, the quantity of ozone generated by the portable high frequency unit during a most severe application is lower than the lowest levels at which any sign of physical effect can be seen. This compares well with the effects of our application studies where no negative effects associated with the wand were observed.

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