Evaluation of Ozone Exposure from use of Electrostatic Detection Apparatus

By

Mark Cameron, MS, CIH
California Department of Justice
Mission Support Branch
4949 Broadway
Sacramento, CA 95820

Abstract

Use of Electrostatic Detection Apparatus in evaluating documents for hidden indentations creates ozone. Ozone can cause respiratory irritation and breathing difficulty. Ozone discharge was measured for an hour during continuous operation at two different locations. Results indicated that continuos use can generate ozone concentrations that will exceed the permissible exposure limit mandated by the Occupational Safety and Health Administration. Ozone levels can be controlled by shutting the corona off after creating static on the document and by using local exhaust ventilation.

INTRODUCTION

Electrostatic Detection Apparatus (ESDA) is used by forensic document examiners to visualize indented impressions in paper evidence, which may provide additional information in criminal cases. When using an ESDA, the document is first placed on the work surface and then covered with an imaging film (much like plastic wrap). The machine is turned on which seals the plastic wrap on the document. The corona wand is turned on and passed over the document surface. Toner beads are spread over the surface which fill in any indentations. The document can then be photographed.

When the corona wand is used, the electric filament generates ozone gas. Ozone occurs naturally, being generated by ultraviolet light in the upper atmosphere and during lightning. Ozone is generated by electrical equipment and by automotive exhaust. Ozone generation during ESDA operation has been noted as potentially hazards to forensic document examiners (1).

Human exposure to ozone can produce cough, soreness on deep inspiration, shortness of breath, chest tightness, dryness of mucous membranes. Non-respiratory effects include headache, nausea, weakness and dizziness (2). The US Environmental Protection Agency designates outdoor ozone levels of 0.12 ppm over an eight hour period in the National Ambient Air Quality Standards (3). The Occupational Safety and Health Administration (OSHA) sets an eight hour permissible exposure limit (PEL) for workers of 0.1 ppm. (4). The California OSHA also allows a 15 minute Short Term Exposure Limit (STEL) of 0.3 ppm (5).

As part of a health hazard evaluation required by the California Department of Justice's Injury, Illness and Prevention Program, the two ESDA machines used by the Questioned Document Sections were measured for ozone generation in order to determine whether hazardous ozone levels were being produced.

MATERIALS and METHODS

The ESDA machine was activated according to the manufacturer's procedures. The Corona Wand was turned on and left on top of the ESDA. Ozone measurements were made with Colorimetric Indicator Tubes (Draeger #6733181, batch ARNH-5020) with an ozone detection level of 0.05 ppm (Figure 1). Ten pump strokes were required which took approximately three minutes per sample. Tubes were read immediately after the measurement was taken. Measurements were made without local ventilation and with local ventilation on.

Figure 1

RESULTS

Table #1 and 2 provide the results. The tables give a range of values because Colorimetric Indicator tubes are generally considered to be accurate to plus/minus 25% (5).

In two separate locations, continuous operation of the Corona Wand for over 30 minutes without local ventilation produced levels of ozone exceeding the PEL and potentially above the STEL.

The Sacramento ESDA built-up levels exceeding the PEL within 5 minutes of continuous use. However, those levels dropped over time to one-half of the PEL after an hour. With the ventilation system on, the exposure was never above the detection limit of the tube.

The Riverside ESDA remained below the PEL until the 60-minute reading was taken. More specifically, after 15 minutes the ozone levels started to increase with a high level (0.26-0.42 ppm) reached after 60 minutes. This exceeded not only the PEL, but the STEL as well. When the exhaust hood was turned on, the levels dropped below detection.

Table 1: Ozone Air Monitoring			
Sacramento Office			
Sample: no ventilation	Ozone (ppm)	Sample: ventilation on	Ozone (ppm)
Background	<0.05	Background	<0.05
After 1 minute	<0.05		
After 5 minutes	0.16-0.24	After 5 minutes	0.04-0.06
After 15 minutes	0.14-0.22	After 15 minutes	0.04-0.06
After 30 minutes	0.08-0.12	After 30 minutes	0.04-0.06
After 45 minutes	0.08-0.12	After 45 minutes	0.04-0.06
After 60 minutes	0.04-0.06	After 60 minutes	0.04-0.06

Table 2: Ozone Air Monitoring			
Riverside Lab			
Sample: no ventilation	Ozone (ppm)	Sample: ventilation on	Ozone (ppm)
Background	<0.05	Background	<0.05
After 1 minute	0.04-0.06		
After 5 minutes	0.02-0.04	After 5 minutes	<0.05
After 15 minutes	0.02-0.04		
After 30 minutes	0.05-0.07		
After 60 minutes	0.26-0.44	After 60 minutes	<0.05

DISCUSSION

The results varied by office due to the local ambient ventilation conditions. The Sacramento ESDA was located in a small room with limited ventilation; the Riverside ESDA was located in a former hallway which provided a larger area for air mixing.

The Sacramento ESDA built up ozone levels for 30 minutes, but then the levels decreased. The probable reason was that the small room had a ceiling HVAC register. The HVAC system may have been activated, thereby supplying fresh air to dilute the ozone levels. However, the dilution levels were still at or above the PEL for ozone.

The possible reason for the build-up in the Riverside ESDA was probably due to the larger area that the ESDA occupies. The larger area would allow accumulation of ozone to take longer before it would be detectable. The area did not have any air registers since it was a hall/entry way. This means that there was no dilution ventilation available to limit the build-up of ozone if the machine was left on for a long time.

It should be noted that a Questioned Document Examiner will not normally continuously run the Corona Wand. The Corona Wand would be turned on to statically charge a document and then be turned off. The 1 minute samples measured at both locations indicate that the ozone levels are well below the PEL, even without ventilation. However, by keeping the corona on for this evaluation, a true “worst case” scenario was measured.

If many documents were being examined and the Corona Wand turned off in-between each use, it could be assumed that the exposure would be less.

CONCLUSIONS

Short uses of the ESDA machine will not likely result in ozone exposures exceeding the PEL. However, due to the variable build up of ozone possible in different locations, the use of local exhaust ventilation at all times is recommended.

REFERENCES

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