HEALTH
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Industrial Hygiene Survey

Air Cycle Corporation

Osceola County Maintenance Facility

August 2004

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Executive Summary

On August 5, 2004 an industrial hygiene survey was conducted for Air Cycle Corporation at the Osceola County Maintenance Facility in Florida. This survey was conducted as a follow up to an identical survey that was conducted at an Illinois facility on July 9, 2003. The purpose of the survey was to characterize personal exposures to and area concentrations of mercury vapor while an employee crushed fluorescent bulbs that contain mercury, using a privately owned and maintained Air Cycle Corporation Bulb Eater™.

One personal air samples and one area air sample was collected during the survey. The personal air sample was collected from a representative breathing zone of the worker to measure the actual exposures during the task of relatively short duration, which is typical of most workers using a Bulb Eater™, then characterize those actual exposures as a time weighted average over the course of the work day. The area air sample was collected to characterize the air concentration of mercury from a worse case location near the source of the emissions.

Neither of the samples exceeded the American Conference of Governmental Industrial Hygienists (ACGIH) 8 Hour threshold limit value (TLV) of 0.025 milligrams per cubic meter (mg/M^3) or the (Occupational Safety and Health Administration's (OSHA) 8 Hour Permissible Exposure Limit of 0.1 mg/M^3.

The following recommendations are offered in this report to assure the control of worker exposures and for regulatory compliance:

1. Notify the evaluated employees of the results of this survey.

2 Continue advising purchasers to use the Bulb Eater™ in well-ventilated areas.

Industrial Hygiene Survey

Air Cycle Corporation

Osceola County Maintenance Facility

August 2004

Narrative Report

A. Purpose of Sampling

On August 5, 2004 an industrial hygiene survey was conducted for the Air Cycle Corporation at the Osceola County Maintenance Facility in Florida. This survey was conducted as a follow up to an identical survey that was conducted at an Illinois facility on July 9, 2003. The purpose of the survey was to characterize personal exposures to and area concentrations of mercury vapor while an employee crushed fluorescent bulbs that contain mercury, using a privately owned and maintained Air Cycle Corporation Bulb Eater™.

The Objectives of the survey were to:

1. Evaluate potential employee exposures to mercury vapor, by collecting air samples.

2. If applicable, assist the Air Cycle Corporation with their progressive administrative and personal protective equipment recommendations they provide to their customers, that have been designed to minimize the potential for employee exposures while using their privately owned and maintained Bulb Eater™.

B. Industrial Hygiene Methodology

All industrial hygiene practices, air sampling, calculations, evaluations, and interpretations were conducted in accordance with the established industrial hygiene practices set forth by the American Board of Industrial Hygiene and OSHA. All personal air samples were collected from representative breathing zones as defined by OSHA, which is within six to nine inches of the worker's nose with the media inlet facing downward. Excess tubing was positioned so as not to kink or interfere with the work of the employee.

Samples were collected using IH sampling pumps with air drawn through a method-specific media based upon the contaminant to be analyzed. Pump flow calibrations were performed before and after each day's sampling period using a factory calibrated BIOS DC_Lite primary standard flow meter. The flow rate for each pump was measured three times and then averaged, and none of the post or pre-calibrations varied by greater than five percent, which would void the sample. Of the post and pre-calibration flow rates, the lowest average flow rate was used in the air sample volume calculations in order to arrive at the highest contaminant concentration. The basis for this approach is to achieve the higher reported concentration of the chemical in order to quantify the worker's worse case personal exposure.

The pump was placed on the worker and then activated, and the employee were did not tamper with the pump and media. The pumps worked properly and were removed at the end of the sampling period.

The date of the sampling is usually our sample number. For example, sample number 08050401 represents the eighth month and fifth day of year 04; with specific sample number 01 collected that day. The specific air sample data collection sheets can be found in Appendix B. The sample number, the calculated sample volume, contaminant to be analyzed, and chain-of-custody signature were recorded onto the specific lab analysis request form. The sorbent tubes were refrigerated until being sent to the laboratory for analysis.

Employee chemical exposures were compared to the OSHA 8 hour Permissible Exposure Limits (PEls) and the American Conference of Governmental Industrial Hygienists (ACGIH) 8 hour Threshold Limit Values (TLVs). A PEL is a regulatory limit and represents the maximum allowable concentration of a contaminant to which an employee can be exposed during the workday. A PEL can be established as a full-shift time weighted average (TWA) exposure, short-term exposure level (STEL), or ceiling limit. Mercury is only regulated as an 8 hour exposure by OSHA. A TLV is a recommended exposure limit and represents the time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. Like the PEL, the TLV can be established as a full-shift time weighted average (TWA) exposure, short-term exposure level (STEL), or ceiling limit. As with OSHA, the ACGIH has only an 8 hour recommended TLV for mercury. However, when assessing agents that have only an 8 hour TLV, the ACGIH provides that a worker may be exposed to up to three times the TLV for a task of thirty minute duration, or 0.075 mg/M^3 mercury.

The results were reported both as an actual concentration found plus as a time-weighted average. The basis for reporting results as an actual exposure is to characterize the employee's actual exposure during the time period the pump was worn by the employee. The basis for time weighting the data in this specific survey is because bulb crushing is performed only a few times per year after enough bulbs have been amassed that the storage space becomes filled; then, the task of crushing bulbs is typically one of short duration, usually less than two hours. Thus, it is appropriate to time weight the data in this case in order to characterize potential exposures over the course of the entire work shift.

C. Analytical Methodology

An independent lab accredited by the American Industrial Hygiene Association performed analysis of the air sample collection media. Laboratory staff, based upon the air sample volume reported on the lab analytical request form, performed calculations converting the detected analyte to milligrams per cubic meter. The specific analytical method used to evaluate potential employee exposures was OSHA ID 140, with the air drawn through an SKC 226-17-1A sorbent tube, Anasorb C300, 6 X 70 mm size, 1-section, 200 mg sorbent, with GS ends, WW separators, A tube cover.

The laboratory report is contained in Appendix C and the lab request is in Appendix D.

D. Monitoring Rationale

Most fluorescent tubes contain elemental mercury, phosphorus powder and an inert gas, typically argon, kept under very low pressure. Mercury is an essential ingredient for most energy efficient lamps. Fluorescent lamps and high intensity discharge (HID) lamps are the two most common types of lamps that utilize mercury. Because of this, the disposal of most fluorescent tubes is regulated. (Manufacturers have responded by designing green tipped "environmentally friendly" tubes that do not contain as much mercury. However, none of the tubes crushed during this survey were of that design.)

OSHA regulates worker exposures to airborne mercury vapor. According to actual worker interviews from a similar survey conducted for Air Cycle in 2003 and those interviewed during this survey, bulbs are typically crushed for a time-period of approximately one hour or less. In this case, the facility was asked to amass enough bulbs to allow for a sampling period of at least one hour. The rationale for crushing for such a short time period is due to how quickly the bulbs can be crushed. In other words, it takes roughly one second to crush a 4' fluorescent lamp and a fraction of a second longer for 8' lamps. The amount of storage space that would be needed to store enough bulbs for crushing over an eight-hour work shift would be prohibitive in most cases, and could create safety hazards from the accidental breakage of stored bulbs. In general, the typical employee will crush bulbs when enough have been collected to fill their dedicated storage area.

Tube nomenclature is as follows: for an F32T8TL735 for example, the F stands for fluorescent; the 32 indicates the wattage, and the T number represents that it is tubular with a diameter in eights of an inch (T12 =12/8ths=1½ inches, T8=8/8ths=1 inch).

The Bulb Eater™ is a machine that processes, or crushes, spent fluorescent lamps into small fragments. The crushed glass is compacted into a 55-gallon container by the workers who feed the bulbs into a bulb-specific tube on top of the machine that has a diameter only slightly greater than that of the tube being crushed. The Model 55 VRS crushes over 1350 T8 4' lamps into one 55-gallon drum. The Model 55 VRS-U crushes straight fluorescent lamps of any length and u-shaped fluorescent lamps as well. As tubes enter the drum, air is emitted from the machine's vent. This air has been filtered through a High Efficiency Particulate Air filter to capture dust, then through a carbon filter designed to neutralize the mercury vapor.

At the Osceola County Maintenance Facility in Kissimmee, Florida, the approximate breakdown of bulbs crushed over a 70 minute time period was as follows:

- 7 Sylvannia F32T8TL735
- 13 Sylvannia F32T12TL735
- 17 Phillips F32T8
- 14 Sylvannia FB031835 narrow diameter U Tubes
- 15 GE F32T8SPX35-U-6 large diameter U-Tubes
- Approximately 10 Broken inside the storage container, open to atmosphere

E. Air Sample Results

- Both the area sample and the personal sample were less than the laboratory detection limit of 0.0034 mg/M^3, well below the OSHA PEL of 0.1 mg/M^3 and the ACGIH TLV of 0.025 mg/M^3. Calculated as an 8-hour exposure, both results were less than 0.0005 mg/M^3.

F. Conclusions

The sample results indicate that employee exposures to mercury vapor at the Osceola Maintenance Facility were controlled at the time of the survey. This can most likely be attributed to the engineering controls utilized by Air Cycle Corporation on their Bulb Eater™ Machine. While Air Cycle recommends using the machine in well-ventilated areas with a floor fan positioned to move air away from the worker's breathing zone, it should be noted that during this survey, the floor fan was turned off in order to characterize *worse case* exposures.

G. Recommendations

The following recommendations are offered in this report to assure the control of worker exposures and for regulatory compliance:

1. Notify the employee of the results of this survey.

2. Continue advising purchasers to use the Bulb Eater™ in well-ventilated areas.

H. Confidentiality

All aspects of this study were and will be treated by HSE Solutions, Inc., as strictly confidential. No information, recommendations, or results have been released to outside parties, including federal agencies or other government bodies.

Results of this assessment are based on conditions observed while on location performing the industrial hygiene survey. Any operational or equipment changes which are not "in kind" may change conditions and air concentrations identified in this industrial hygiene survey. If you have any questions concerning this survey, please feel free to contact me at (217) 345-2725.

Respectfully submitted,

Bob Borman, CIH
HSE Solutions, Inc.