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DRAFT (for review and comment)

The Corporation of the Town of Markham
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Attention: Mr. Brian Millar
Civic Centre Coordinator

Re: Air Monitoring Survey of Potential Chemical Exposures During Styrofoam Processing Operations, December 2008; Pinchin File: 50486

On 18 December 2008, Mr. Doug Thom, CIH, of our firm conducted an air monitoring survey of potential chemical exposures during styrofoam processing operations at the Town of Markham facility located at 8100 Warden Avenue. The objectives of the survey were to measure airborne contaminant levels, evaluate the results of sampling against regulated occupational exposure limits (OELs) and evaluate health hazard potential associated with the use of the “XT-2005A EPS Recycling Machine” during styrofoam processing operations. This report summarizes the survey activities, the results of air monitoring, and our conclusions regarding compliance status and hazard potential.

SURVEY METHODS

The sampling strategy was developed by Mr. Rob Parker, CIH, of our firm following a review of EPS Recycling Machine operations that were provided to Pinchin by Mr. Brian Millar, Town of Markham Civic Centre Coordinator. The chemical agents monitored, the sources of potential exposure, the sampling and analytical methods, and the sampling strategy are summarized in Table 1.

The survey was performed during typical day shift operating and environmental conditions. A portable “Airpac 25” fan and the roof-mounted exhaust fan were in operation to supply air into and exhaust air out of the Sprinkler Room. The garage bay door was closed during the survey. Mr. Lubo Saltchev, Waste Management Employee, reported that typical, continuous styrofoam processing operations were conducted during the 165-minute monitoring period. He also reported that these operations might be conducted for the entire shift. Waste Management employees worked an 8-hour shift shift, during which 60 minutes were spent on prescribed break periods.

Table 1: Summary of the Air Monitoring Strategy			
Agent Monitored	Source of Exposure	Monitoring Method	Sample Description
Styrene	Thermal decomposition products potentially generated during styrofoam processing operations.	OSHA Method 7	2 long-term (1 personal and 1 area) samples
		Colourimetric Indicator Tubes	4 short-term area samples
Total Hydrocarbons (THC)		NIOSH Method 1550	2 long-term (1 personal and 1 area) samples
Carbon Monoxide (CO)		BIOS Direct-Reading Instruments	2 long-term (1 personal and 1 area) samples
Hydrogen Cyanide		Colourimetric Indicator Tubes	4 short-term area samples

The samples of styrene and total hydrocarbons (THC) were taken and analyzed in accordance with the procedures published in the National Institute for Occupational Safety and Health (NIOSH), *Manual of Analytical Methods*, or the Occupational Safety and Health Administration (OSHA) *Analytical Methods Manual*. A blank sample (i.e. a sorbent tube which had no workplace air drawn through it) was also submitted for quality control purposes. The samples and the blank were analyzed by Bureau Veritas North America Inc., an American Industrial Hygiene Association (AIHA) accredited laboratory. Both air sampling pumps used were calibrated before and after the survey.

Long-term samples of carbon monoxide (CO) were taken using Bios direct-reading monitors. These instruments operate on the principles outlined in NIOSH *Method 6604*. Both of these instruments were also calibrated before and after the survey.

Short-term area samples of styrene and hydrogen cyanide were taken using colourimetric indicator (short-term) tubes. Short-term air sampling of these agents was conducted as a simple screening method to determine if they were present and to determine compliance with applicable short-term and ceiling exposure values.

OCCUPATIONAL EXPOSURE LIMITS

The agents monitored during this survey and their respective OELs are presented in Table 2 and in the tables of results. These values are reported in units of *milligrams of the agent per cubic meter of air (mg/m³)* or *parts of the agent per million parts of air (ppm)*.

The results of air monitoring of the chemical agents were evaluated against the applicable OELs set for these agents in the *Ontario Regulation respecting Control of Exposure to Biological or Chemical Agents (O. Reg. 833)*. This regulation sets time-weighted average exposure values

(TWAEVs) for many chemical agents. TWAEVs are maximum allowable exposures averaged over an 8-hour workday. The TWAEVs for styrene and CO are 35 ppm and 25 ppm, respectively.

The results of short-term air monitoring of styrene were also evaluated against the 100 ppm short-term exposure value (STEV) set for this agent in *O. Reg. 833*. The STEV is the maximum airborne concentration of a chemical agent to which a worker may be exposed in any 15 minute period. STEVs are intended to provide protection against short-term exposures by preventing such health effects as irritation, chronic or irreversible tissue damage, or narcosis (which may lead to an increased risk of accidental injury, impair self rescue or may reduce work efficiency).

The results of air monitoring of hydrogen cyanide were evaluated against the 4.7 ppm ceiling exposure value (CEV) assigned to this agent in *O. Reg. 833*. The CEV is the maximum concentration of an agent to which a worker may be exposed at any time. The CEV is intended to protect workers from exposures to agents whose toxic effects are fast acting (i.e. irritants).

Mr. Millar reported that air sampling had been conducted at another facility during styrofoam processing operations using the “XT-2005A EPS Recycling Machine” on 28 February 2006. Review of the analytical report (EMSL Analytical file 280600300) indicated that the laboratory identified and quantified five individual compounds. These compounds included toluene, n-hexane, styrene, ethyl benzene, and xylene (3 isomers). Consequently, the results of total hydrocarbons monitoring during this survey were compared to the TWAEVs set for these compounds.

Table 2: Occupational Exposure Limits	
Agent Monitored	Occupational Exposure Limits
Styrene	35 ppm TWAEV 100 ppm STEV
Carbon Monoxide (CO)	25 ppm TWAEV
Hydrogen Cyanide	4.7 ppm CEV
Total Hydrocarbons (THC)	75 mg/m ³ TWAEV (toluene) 149 mg/m ³ TWAEV (styrene) 176 mg/m ³ TWAEV (n-hexane) 434 mg/m ³ TWAEV (ethyl benzene and xylene)

RESULTS AND CONCLUSIONS

The results are presented in Tables A1 to A5 and indicate the following:

- Personal exposures and area concentrations of styrene and carbon monoxide were below their applicable TWAEVs on both samples collected.
- Short-term area concentrations of styrene and hydrogen cyanide were undetectable and below all applicable OELs.
- The personal exposure to total hydrocarbons was below the TWAEVs for toluene, n-hexane, styrene, ethyl benzene, and xylene. The area concentration of total hydrocarbons was above the TWAEV for toluene but below the TWAEVs for n-hexane, styrene, ethyl benzene, and xylene.
- Although the 110 mg/m³ total hydrocarbons concentration of the area sample was above the 75 mg/m³ TWAEV for toluene, it is very unlikely that all of the hydrocarbons detected on this sample were toluene. The hydrocarbons present on this sample would have been the sum of several hydrocarbons and therefore toluene, if present, would have only been a fraction of the total hydrocarbons detected. It is therefore very likely that the TWAEV for toluene was not exceeded on the area sample.

Field Observations

The following field observations were made by Mr. Thom during this survey:

- Mr. Saltchev wore a 3M half-facepiece respirator equipped with chemical (including organic vapour) cartridges, and thus, his actual exposures to organic vapours would be even lower than the results measured during the survey.

RECOMMENDATIONS

The results of this survey did not indicate that additional control measures are required to further reduce employee exposures to the agents monitored. Nevertheless, the following recommendations are provided for your consideration:

1. If respirators are used in the workplace, then their use should be accompanied by a respiratory protection program (RPP) as outlined in the Canadian Standards Association (CSA) standard "*Selection, Use, and Care of Respirators*". This program includes respirator fit-testing and employee training, among other

- provisions. The Pinchin OH&S Group can provide assistance in developing and implementing an RPP for the Town of Markham if required.
2. The results of this survey are representative of the environmental, operating and production conditions of 18 December, 2008. Exposure levels will vary with changing work conditions. For this reason, periodic air monitoring should be considered (e.g. during full day production activities) to generate personal exposure histories, monitor the efficacy of control equipment and strategies, and evaluate inter-day and seasonal variations in exposure levels. With respect to the frequency of occupational hygiene surveys, there is no legislated requirement in Ontario. However, guidance is provided by the AIHA in their text "*A Strategy for Occupational Exposure Assessment*". The AIHA reports, "every workplace must undergo periodic re-evaluation (annually, unless specified otherwise). Re-evaluation is also immediately triggered by employee complaint, process change, health surveillance concerns, new toxicology data, and new regulatory action".

We wish to express our appreciation to the employees of the Corporation of the Town of Markham who were involved with or participated in this survey. If you or the Joint Health and Safety Committee require additional information on this report, or other matters, please do not hesitate to call.

Pinchin Environmental Ltd.

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APPENDIX A
RESULTS OF AIR MONITORING
DECEMBER 2008

Table A1: Results of Long-Term Styrene Monitoring.			
Sample Number	Sample Description	Sample Duration (minutes)	Average Airborne Concentration (ppm)
1	Waste Management Employee Personal sample worn by L. Saltchev	9:00 am – 11:45 am (165)	None Detected (less than 0.26)
2	XT-2005A EPS Recycling Machine Area sample	9:00 am – 11:45 am (165)	None Detected (less than 0.26)
3	Blank Sample Taken for quality control.	---	None Detected
Exposure Limit: 35 ppm TWAEV			
Notes: TWAEV = 8-hour time-weighted average exposure value. ppm = parts of the agent per million parts of air.			

Table A2: Results of Long-Term Total Hydrocarbons Monitoring.			
Sample Number	Sample Description	Sample Duration (minutes)	Average Airborne Concentration (mg/m³)
1	Waste Management Employee Personal sample worn by L. Saltchev	9:00 am – 11:45 am (165)	69
2	XT-2005A EPS Recycling Machine Area sample	9:00 am – 11:45 am (165)	110
3	Blank Sample Taken for quality control.	---	None Detected
Exposure Limits: 75 mg/m ³ TWAEV (toluene) 149 mg/m ³ TWAEV (styrene) 176 mg/m ³ TWAEV (n-hexane) 434 mg/m ³ (ethyl benzene and xylene)			
Notes: TWAEV = 8-hour time-weighted average exposure value. mg/m ³ = milligrams of the agent per cubic meter of air.			

Table A3: Results of Long-Term Carbon Monoxide Monitoring.			
Sample Number	Sample Description	Sample Duration (minutes)	Average Airborne Concentration (ppm)
1	Waste Management Employee Personal sample worn by L. Saltchev	9:00 am – 11:45 am (165)	1
2	XT-2005A EPS Recycling Machine Area sample	9:00 am – 11:45 am (165)	1
Exposure Limit: 25 ppm TWAEV			
Notes: TWAEV = 8-hour time-weighted average exposure value. ppm = parts of the agent per million parts of air.			

Table A4: Results of Short-Term Styrene Monitoring.			
Sample Number	Sample Description	Sample Time	Airborne Concentration (ppm)
1	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	9:30 am	None Detected (less than 2)
2	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	9:45 am	None Detected (less than 2)
3	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	10:20 am	None Detected (less than 2)
4	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	11:20 am	None Detected (less than 2)
Exposure Limits: 35 ppm TWAEV 100 ppm STEV			
Notes: TWAEV = 8-hour time-weighted average exposure value. STEV = short-term exposure value. ppm = parts of the agent per million parts of air.			

Table A5: Results of Short-Term Hydrogen Cyanide Monitoring.			
Sample Number	Sample Description	Sample Time	Airborne Concentration (ppm)
1	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	9:30 am	None Detected (less than 0.2)
2	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	9:45 am	None Detected (less than 0.2)
3	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	10:20 am	None Detected (less than 0.2)
4	Between XT-2005A EPS Recycling Machine and Extrusion Pile Area sample	11:20 am	None Detected (less than 0.2)
Exposure Limit: 4.7 ppm CEV			
Notes: CEV = ceiling exposure value. ppm = parts of the agent per million parts of air.			