

Worker Overexposed to Toluene

Date of Incident: 99 08 10

Type of Incident: Fatal

SUMMARY

On 99 08 10 a worker was working in the laboratory, where a vapour phase extractor was located. A bath of hot toluene vapours was used to clean oil residue from geophysical core samples in the vapour phase extractor. When the worker opened the lid of the vapour phase extractor, he was exposed to fatal concentrations of toluene vapours. At approximately 18:35 the worker was found lying unconscious on the floor. Later, at 19:08, he was pronounced dead at the scene.

The direct cause of the incident was that the worker was exposed to fatal concentrations (toxicologist report stated exposure greater than 10,000 ppm) of toluene vapours when he opened the lid of the vapour phase extractor. A contributing factor was the cooling system was turned off allowing toluene vapours to accumulate in the headspace of the vapour phase extractor. Additionally, the worker was not protected from toluene vapours with adequate respiratory protective equipment.

The employer voluntarily stopped work after the incident and commenced an investigation. The employer developed confined space entry procedures for the vapour phase extractor room. The employer developed a locking mechanism that prevents the lid from opening if toluene vapour concentrations are elevated in the vapour phase extractor.

Workplace Health and Safety officers arrived at 20:20 on 99 08 10 and commenced an incident investigation. A stop work order was issued on the vapour phase extractor room requiring the employer to complete an incident investigation and implement corrective actions to prevent recurrence.

The employer complied with the provisions of all orders issued. Workplace Health and Safety released the stop work order on 99 08 11.

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Section 1.0	FILE NUMBER
1.1	F-193029
Section 2.0	DATE AND TIME OF INCIDENT
2.1	99 08 10, 18:35
Section 3.0	DATE AND TIME OF INVESTIGATION
3.1	99 08 10, 20:20
Section 4.0	NAME OF INVESTIGATOR(S) (INTERNAL)
4.1	Lorene Leitch, Workplace Health and Safety Officer Shantha Nandana, Workplace Health and Safety Officer Chuck Samphire, Workplace Health and Safety Officer
Section 5.0	INCIDENT REPORTED BY
5.1	City of Calgary Emergency Medical Services Department
Section 6.0	DATE AND TIME INCIDENT WAS REPORTED
6.1	99 08 10, 18:50
Section 7.0	NAME AND ADDRESS OF PRINCIPAL STAKEHOLDER(S)
7.1	Owner(s)
7.1.1	582393 Alberta Ltd 1000, 400 – 3 rd Avenue S.W. Calgary, Alberta T2P 4H2
7.2	Prime Contractor
7.2.1	Ref. 7.1

7.3 **Employer**

7.3.1 AGAT Laboratories Ltd.
3801 – 21st Street N.E.
Calgary, Alberta T2E 6T5

Section 8.0 DESCRIPTION OF PRINCIPAL OWNER(S) OR EMPLOYER(S)

8.1 The owner operates two geophysical consulting companies.

8.2 The employer operates an analytical chemical laboratory primarily for the oil and gas industry.

Section 9.0 LOCATION OF INCIDENT

9.1 The incident occurred in the vapour phase extractor room of AGAT Laboratories located at 3801 – 21st Street N. E., Calgary, Alberta (Refer Attachment A, Photograph 1 and Attachment B, Sketch).

Section 10.0 EQUIPMENT AND MATERIAL INVOLVED

10.1 The vapour phase extractor was used to extract oil from rock core samples. Approximately 10 centimetres of toluene were poured into the bottom of the vapour phase extractor. There were numerous rock core samples placed in two baskets on the top of the toluene bath. The vapour phase extractor heated the toluene, the toluene evaporated and bathed the rock core samples with hot toluene vapours. The toluene vapours cleaned the oil and water residue from the core samples. (Refer Attachment A, Photographs 1, 2, 3, 4 and 5).

10.2 The vapour phase extractor had cooling system to condense toluene vapours and prevent accumulation of vapours in the headspace. The cooling system was equipped with an on and off valve. During the incident, the cooling system was turned off. (Refer Attachment A, Photograph 6).

10.3 The vapour phase extractor also had a steam heating system to heat the toluene and create toluene vapours. The steam heating system was equipped with an on and off valve. The steam valve was turned off at the time of the incident (Refer Attachment A, Photograph 7).

10.4 Half mask organic cartridge respirators were available at the site.

Section 11.0 NAMES OF OTHER INVESTIGATORS (EXTERNAL)

11.1 Calgary Police Services

11.2 AGAT Laboratories Ltd.

Section 12.0 NARRATIVE DESCRIPTION OF INCIDENT

12.1 Rock core samples from the oil and gas industry were delivered to the employer to determine concentrations of oil and gas in the core samples.

12.2 Two baskets were filled with core samples and placed in the vapour phase extractor on 99 08 05. The vapour phase extractor was left running to bathe the rock core samples in toluene vapours for approximately 4-6 days.

12.3 On 99 08 10 at 08:42, the worker began his shift. He worked throughout the day performing maintenance work at the facility. At approximately 16:30 he spoke to a co-worker and mentioned he had the flu.

12.4 Between 16:30 and 17:00 the worker was overheard having a conversation on the telephone. No one observed the worker after 17:00.

12.5 At 18:32 the lab coordinator and the lab technician were performing a security check of the building and noticed the worker's van parked outside. The lab coordinator and lab technician went to investigate the worker's whereabouts as his shift normally ends around 17:00.

12.6 At 18:35 the lab coordinator reached the vapour phase extractor room and looked through the window of the door and saw the worker lying unconscious on the floor.

12.7 The lab coordinator instructed the lab technician to call EMS. The lab coordinator then pulled the worker out of the vapour phase extractor room and began CPR (Refer Attachment A, Photograph 8).

12.8 At 18:45 Emergency Medical Services (EMS) arrived and continued CPR.

12.9 At 18:54 the Fire Department and the Hazardous Materials unit (Haz Mat) arrived at the scene. The Haz Mat unit noticed a strong odour of toluene and evacuated the building.

- 12.10 EMS moved the worker to the parking lot outside of the facility and continued CPR.
- 12.11 At 19:08 EMS contacted a physician at Foothills Hospital who pronounced the worker dead at the scene.
- 12.12 The Haz Mat unit had all utilities to the building disconnected, performed air testing and later determined there wasn't a toluene leak or elevated levels of toluene remaining in the facility.
- 12.13 At 20:05 the Medical Examiner arrived at the scene and the deceased worker was transported to the Medical Examiner's office.
- 12.14 At 20:20 Workplace Health and Safety officers arrived at the scene.
- 12.15 At 23:00 Haz Mat declared the building safe to enter and the investigation was commenced.

Section 13.0 CONCLUSIONS

13.1 Direct cause:

The worker opened the lid of the vapour phase extractor and was exposed to fatal concentrations of toluene vapours.

13.2 Indirect cause:

The valve that operated the cooling system was shut off. The cooling system was not operating which allowed high concentrations of toluene to accumulate in the headspace of the vapour phase extractor. The high concentration of toluene vapours was released when the worker opened the lid.

The worker was not wearing any respiratory protective equipment, as required by the employer's safe operating procedure, when he was working inside the vapour phase extractor room.

- 13.3 The incident could have been prevented if the cooling system of the vapour phase extractor was turned on to prevent an accumulation of toluene vapours in the headspace. If the worker was wearing appropriate respiratory protective equipment he may have had time to escape from the vapour phase extractor room.

Section 14.0 FOLLOW-UP/ACTION TAKEN

14.1 Industry

14.1.1 The employer stopped work and commenced an incident investigation to determine the cause to prevent a recurrence. The employer checked the vapour phase extractor for defects. There were no abnormalities found. The employer removed the cooling valve handle to ensure the cooling system could not be turned off and the system was left constantly running to prevent a build up of toluene vapours in the vapour phase extractor.

14.1.2 The employer reviewed safe operating procedures for the vapour phase extractor room. The room was treated as a confined space. The employer reinforced their safe operating procedure for the vapour phase extractor. Workers are required to wear respiratory protective equipment at all times in the vapour phase extractor room. The procedures included that during entry to the room another worker be stationed at the entrance to facilitate a rescue.

14.1.3 The vapour phase extractor was redesigned. An additional cooling coil was installed to improve the condensation of the toluene vapours. A safeguard locking mechanism was installed to prevent the lid from being opened when there is a high concentration of toluene vapours in the headspace. Temperature sensors operate the locking mechanism. The temperature read out is installed outside the room to warn workers of elevated vapour concentrations (Refer Attachment A, Photographs 9, 10, 11 and 12).

14.1.4 The employer completed their incident investigation report and complied with all orders issued by Workplace Health Safety.

14.2 Alberta Human Resources & Employment

14.2.1 Following the incident, Workplace Health Safety issued a stop work order on the vapour phase extractor room until the investigation was completed. Photographs and measurements were taken of the scene. Witness statements were obtained from workers who work in the vapour phase extractor room and workers who were in the building at the time of the incident. The drawings of the vapour phase extractor room and operating procedures were obtained.

14.2.2 On 99 08 11 another order was issued quoting sections 82 and 190 of the Alberta Regulation 448/83, General Safety Regulation, requiring the employer to treat the vapour phase extractor as a confined space. The employer was required to install a safeguard mechanism on the vapour phase extractor.

- 14.2.3 On 99 09 13 Workplace Health and Safety issued other orders quoting section 13 of the Occupational Health and Safety Act, and sections 2, 3, 10, 17, and 25 of the Alberta Regulation 393/88, Chemical Hazards Regulation. Sections 14, 99, 189 and 191 of the Alberta Regulation 448/83, General Safety Regulation, were also quoted. The order requested an incident investigation report from the employer. The report was received on 99 11 24.
- 14.2.4 The employer was requested to conduct a hazard assessment to minimize workers' exposure to harmful substances and provide training regarding their new safe operating procedures.
- 14.2.5 The employer was requested to establish a code of practice for respiratory protective equipment.
- 14.2.6 A general inspection was performed at AGAT Laboratories' other facilities on 99 08 25 to ensure compliance with the legislation.

Section 15.0 INJURY SEVERITY

- 15.1 From the toxicologist's report, the worker was exposed to a fatal concentration of greater than 10,000 parts per million toluene. This concentration resulted in severe central nervous system depression.

Section 16.0 SIGNATURES

[original signed]

Section 17.0 ATTACHMENTS

Attachment A	Photographs
Attachment B	Sketch



Photograph 1

Vapour phase extractor room. Vapour phase extractor shown with lid open.

Position worker was found. Looking southerly



Photograph 2 Vapour phase extractor with lid closed. Looking southerly.



Photograph 3 Basket #1



Photograph 4 Basket #2

Rock core samples that were in vapour phase extractor at time of incident.

Stopper found here



Photograph 5 Fresh toluene used to fill vapour phase extractor. Looking easterly.

Note: Toluene barrel was open at the time of the incident with stopper placed on top of barrel.

Cooling value



Photograph 6

Cooling value that was shut off on vapour phase extractor.
Looking westerly.



Photograph 7 Shows the insulated steam valve of the extractor in the shut off position. Looking southerly.

Door to Vapour
Phase Extractor Room

Shows window that lab
coordinator looked through
to see worker

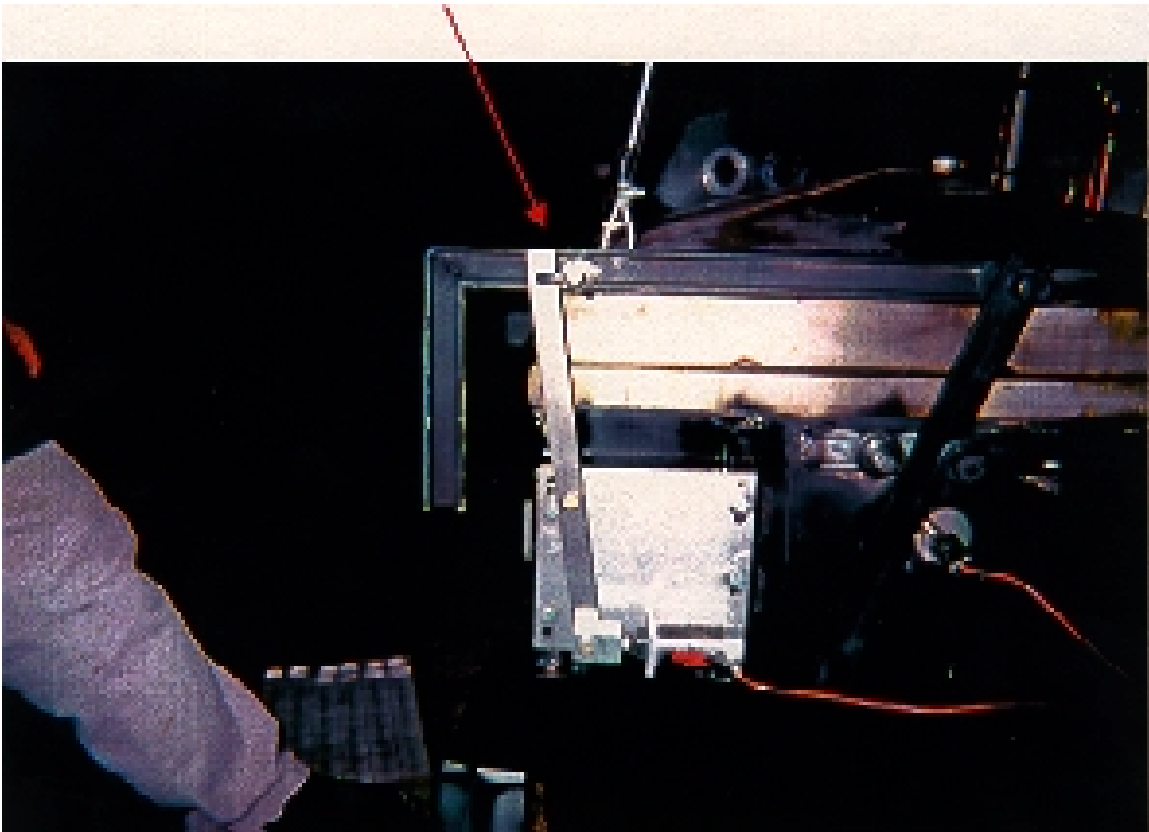


Photograph 8

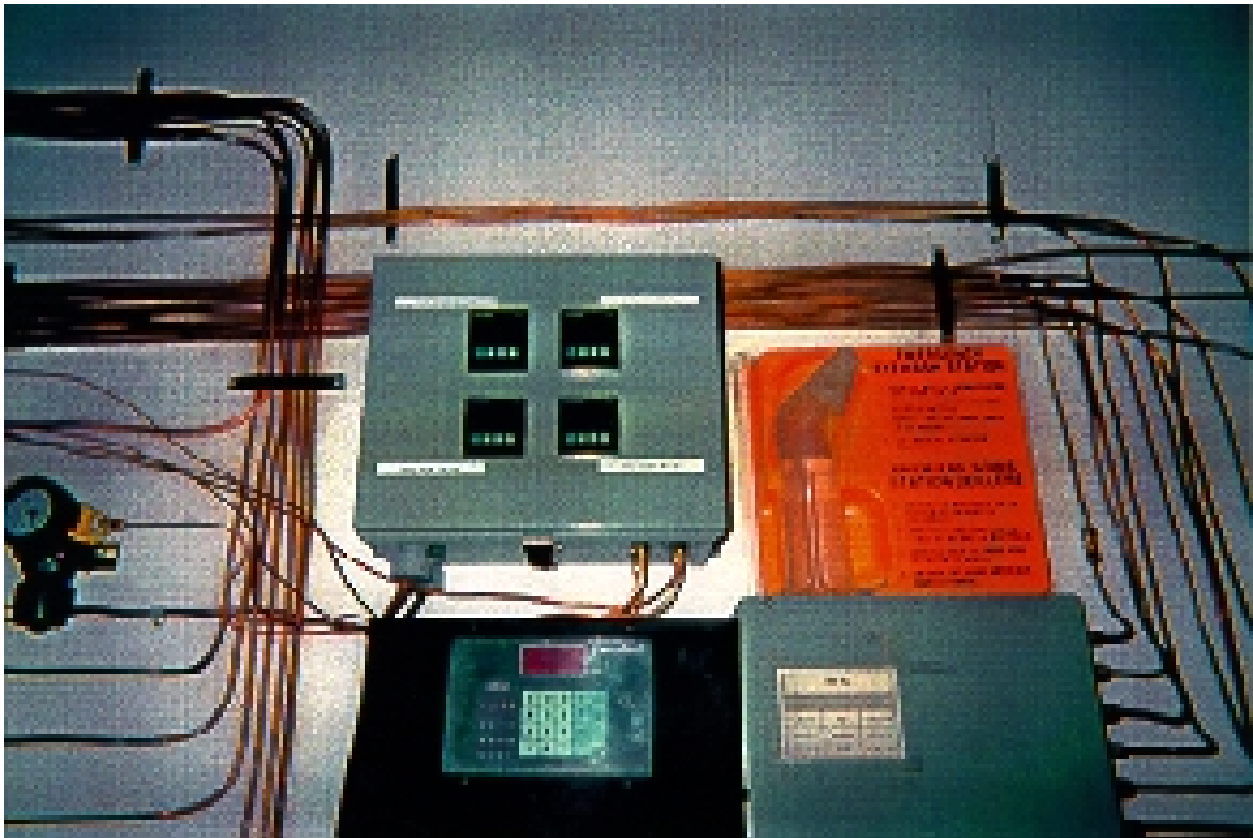
Worker was pulled from Vapour Phase Extractor Room into the main core lab area by Lab Coordinator. Looking westerly.



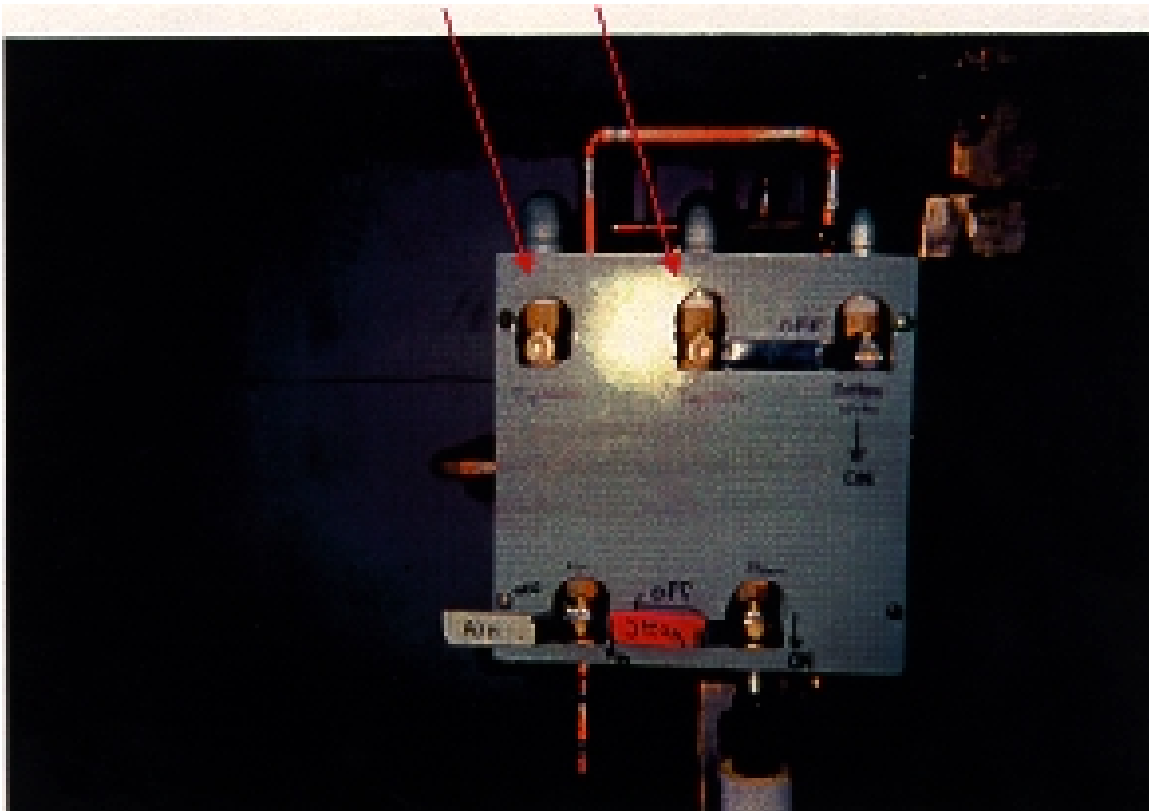
Photograph 9 Shows additional cooling coil installed to increase condensation of toluene vapours. Looking westerly.



Photograph 10 Shows locking mechanism that prevents lid from being opened when toluene vapour concentrations are elevated. Looking easterly.



Photograph 11 Shows digital temperature read-out, outside of vapour phase extractor room. Looking northerly.



Photograph 12 Shows values of the vapour phase extractor.

Note: The two top cooling coil valves are removed to ensure cooling system is constantly running. Looking easterly.

VAPOUR PHASE EXTRACTION

