

SEER TECHNOLOGY

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AccuSense[®] Application Brief

**Chloroform and Carbon Tetrachloride
Chemical Plant Production Process
Continuous Air Monitoring Solution**

Continuous Air Monitoring Application Chloroform & Carbon Tetrachloride Chemical Production Facility

Background

The subject chemical plant is producing a chemical product that employs chlorinated hydrocarbons in the production process. This process produces two chemical by-products, chloroform (CHCl_3) and Carbon tetrachloride (CCl_4). These are chemicals that are a potential safety hazard to plant personnel and need to be monitored and measured to corporate EH&S Accepted Exposure Limit (AEL) standards.

There are two points for monitoring, one is internal to the production facility and the other is the external transportation load/unload safety platform.

Description of Present Operations

Product from the process is moved on a conveyor belt in a solid form that is wet with CHCl_3 and CCl_4 . Five to six exhaust fans are deployed in the facility to vent fumes. Three times during the month an air sample is collected at the facility to monitor hazardous concentrations of these chemicals in the air. A sample is generated by drawing an air sample through a tube where the gases are collected on an absorbent in the tube. After 8 hours the tube is capped and sent to a laboratory for analysis. Analysis is usually available in 8 to 12 days. Labs results are accurate but the lack of sampling frequency and the extended analysis latency period result in a monitoring data gap that raises safety concerns.

The Successful CHCl_3 and CCl_4 Continuous Air Monitoring Solution

Plant safety officials have identified four required criteria for a successful solution to the need for timely analysis data to reduce the CHCl_3 and CCl_4 safety hazard for this process at the facility.

1. Clear separation of Chloroform from Carbon tetrachloride
2. Continuous Air Monitoring deployment with hi frequency sampling
3. Detect/Identify/Quantify analysis data
4. Sensitivity to 50% action level of plant AEL for CHCl_3 and CCl_4

Available Legacy Chemical Detection Technologies

There are available detection products based on established, or legacy, technologies that can be considered to support this solution. These technologies have strengths and limitations that need to be considered.

Electrochemical Detector (ED) - The ED solution will provide a very fast response to changes in concentration; however, it will have troubles differentiating between the two chemicals. ED technology is inexpensive to procure but the long term Total Cost of Ownership (TCO) accrues upward due to the need to replace degraded units.

Photo Ionization Detector (PID) - A PID is fast and easy to deploy but this technology can only provide detect/no-detect determinations. For the 9.8 and 10.6 lamps the PID does not see either chemical. It will detect both with the 11.7 lamp. PID technology is inexpensive to procure and TCO is minimal.

Ion Mobility Spectrometer (IMS) – IMS technology can detect but provides limited identification and quantification capabilities. An IMS detector will see all the CHCl_3 and CCl_4 but will likely have difficulty differentiating between them. IMS technology is moderate in cost and TCO is not excessive.

Conclusion: Review of the legacy technology option shows that none of them meet the established successful solution criteria. The common deficiency is an inability to identify and separate CHCl_3 and CCl_4 .

The AccuSense Solution

The AccuSense IH (Industrial Hygiene) instrument from SEER Technology meets the four plant criteria for the successful CHCl_3 and CCl_4 Continuous Air Monitoring Solution

1. Clear separation of Chloroform from Carbon tetrachloride: The AccuSense IH instrument uses dual hyphenated gas chromatograph technology and Hi Definition chemical signatures created by neural network technology to hyper-separate chemicals detected by the instrument. Documentation is presented in Appendix A.

2. Continuous Air Monitoring deployment with hi frequency sampling: The AccuSense IH instrument requires no consumables materials and can operated continually for 24 hours a day/ 7 days a week. The AccuSense IH unit configured to plant specifications operates with a 30 minute cycle time generating 16 samples in an 8 hour shift period.

3. Detect/Identify/Quantify analysis data: The AccuSense IH instrument generates real time chemical Detect/Identify/Quantify data in the field. The current release of AccuSense implements decoupled data collection and analysis phases that are linked for real time collection and analysis. A new release of AccuSense scheduled for 2014 will offer the choice of unlinked collection and analysis phases to support real time collection and off-line, post collection analysis. This is configuration option supports a deployment option known as "Deferred Analysis" that bypasses the need for hardwire or RF communications connectivity in the field.

4. Sensitivity to 50% action level of the plant AEL for CHCl₃ and CCl₄: The plant is presently in possession of an AccuSense IH unit with the following chemical signature database at the indicated High and Low detection sensitivity levels:

#	Chemical Name	CAS #	High PPM	Low PPM
1	Acetone	67-64-1	32.0	2.6
2	Acrolein	107-02-8	32.0	8.4
3	Acrylonitrile	107-13-1	32.0	5.5
4	Carbon Tetrachloride	56-23-5	32.0	0.3
5	Chloroform	67-66-3	32.0	0.4
6	Dimethylamine	124-40-3	32.0	1.7
7	Ethyl Chloroformate	541-41-3	10.0	2.3
8	Hexane	110-54-3	32.0	2.5
9	Methyl Bromide	74-83-9	32.0	13.1
10	Methyl Chloride	74-87-3	32.0	15.9
11	Methyl Methacrylate	80-62-6	10.0	3.6
12	Methylene Chloride	75-09-2	32.0	4.4
13	Phosegene	75-44-5	10.0	2.1

The plant's AEL's levels, action levels and AccuSense sensitivity lows for the two chemicals to be monitored are:

CHCl₃ – AEL = 10ppm, 50% action level = 5ppm / AccuSense low = 0.4ppm

CCl₄ – AEL = 10ppm, 50% action level = 5ppm / AccuSense low = 0.3ppm

Conclusion: *The AccuSense continuous air monitoring solution meets, or exceeds, all four criteria required to mitigate the CHCl₃ and CCl₄ safety hazard and protect Chloroform and Carbon Tetrachloride process workers at this chemical plant.*



Appendix A

Documentation of the separation ranges for CHCl_3 and CCl_4 . The Purple center area represents chemical concentrations that will be clearly separated and analyzed independently. The Red area represents where larger concentrations of CCl_4 will mask the presence of CHCl_3 and the Blue area represents where the larger concentrations of CHCl_3 will mask the presence of CCl_4 .

