



Case Study: Active Dry-Cleaner Site Investigation With the Air-FROG 400 Portable GC

Background

In October 2021, Defiant partnered with ATC-Atlas Group Services in Raleigh, North Carolina, to assist in an active dry-cleaner site investigation after abnormal results from routine indoor air sampling were returned from a fixed laboratory. This site came into the North Carolina Dry-Cleaning Solvent Cleanup Act (DSCA) program after 2014 when it was discovered that PCE-based dry cleaning machines and containers of solvent had been leaking for some time before the problem was discovered. After the site was assessed, a sub-slab depressurization system was installed to mitigate the vapor intrusion problem caused by the leaked PCE under the building.

To maintain regulatory compliance, indoor air testing has been conducted at set intervals to ensure that the SSDS was performing as intended. PCE had always been present in these indoor air samples, but at concentrations that were below the commercial occupancy threshold. In a recent round of indoor air sampling however, elevated levels of TCE were detected. Additionally, these levels were higher than the North Carolina commercial indoor air threshold, which presented a compliance issue to be resolved.

Methodology & Investigation

The initial site investigation did not discover significant TCE contamination, so the sudden appearance of TCE in laboratory data was unexpected. The prevailing theory was that the TCE detections were related to recent chemical contamination from in or around the dry cleaner facility. Another investigation was conducted by Atlas-ATC with assistance from Defiant Technologies, with the goal of locating the source of the TCE that was detected. The equipment used on this investigation was a handheld PID (RAE Systems ppbRAE 3000) for total VOC measurement and a portable gas chromatograph (Defiant Technologies Air FROG-400) to speciate and quantitate VOCs of interest.

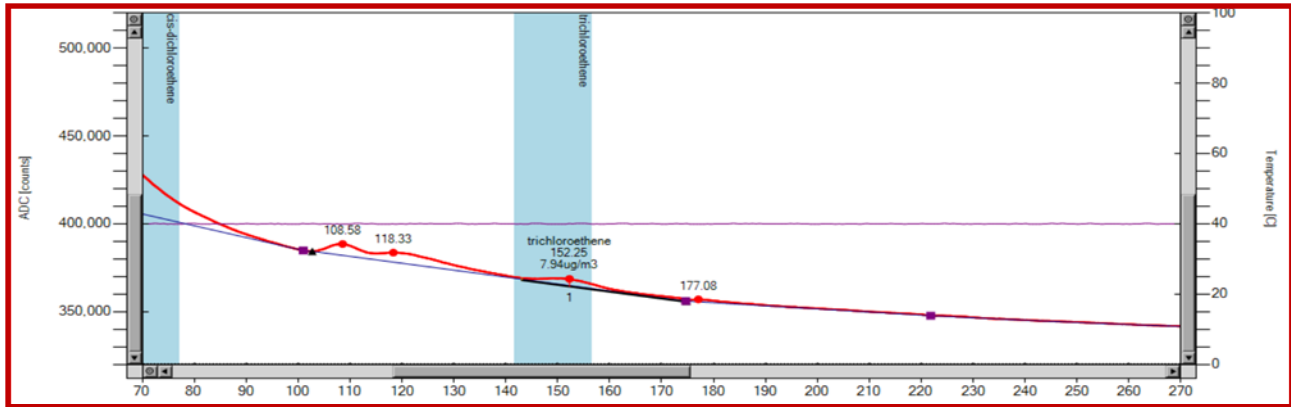
The first hour of the investigation involved a series of measurements around the facility with the handheld PID. This was done in a grid pattern to establish levels of VOC contamination at different points in the building to find areas where VOC contamination was higher than background. These areas were then flagged for further analysis with the Air FROG. The handheld PID was also used to measure the VOC concentrations in the air around any containers that held or appeared to hold cleaning chemicals. Those containers that might be emitting VOCs, as determined by the handheld PID, were also flagged for further analysis with the Air FROG.

The area of greatest interest was along an interior wall where two dry cleaning machines and a chemical storage area were located. It is important to note that these were active dry-cleaning machines using an aliphatic hydrocarbon-based solvent, so VOC detections in this area of the building wouldn't be considered unusual. However, since the handheld PID indicated the highest (1200-3800 ppbv isobutylene equivalent) VOC concentrations of any site in the building, this area was flagged for further analysis with the Air FROG.

The first analyses performed on the Air FROG were from the center of the building where the handheld PID indicated the lowest airborne VOC concentrations. These analyses were non-detects for both TCE and PCE. Other samples taken toward the edge of the building where the handheld PID showed a negligible concentration of airborne VOCs also returned non-detects for TCE and PCE on the Air FROG.

The focus then turned to the area around the active dry-cleaning machines. There were two locations of interest behind the dry-cleaning machines, both being buckets that were placed to catch drips and leaks from a drain hose. Both buckets contained liquid, and the headspace was measured with the ppbRAE 3000. The total VOC concentration was measured as 496 ppbv in one bucket and 240 ppbv in the other.

The headspace of each bucket was then analyzed with the Air FROG and gave a positive, low concentration (5-10 $\mu\text{g}/\text{m}^3$) detection of TCE on both. This finding suggested that a chlorinated solvent had been used recently in the vicinity of the buckets.



Detection of TCE in bucket headspace at 8 $\mu\text{g}/\text{m}^3$

Immediately in front of the dry-cleaning machines was a chemical storage area along a wall. The handheld PID returned the highest overall total VOC concentrations here, ranging from 1200 to 3800 ppbv. The highest concentration was measured in a gap between the concrete slab and the drywall supporting the shelving upon which the chemicals were stored. All the sampling points measured with the ppbRAE 3000 were also sampled with the Air FROG.

Two samples were taken at the gap between the drywall and the concrete slab, and both produced positive detections for TCE at concentrations of 26 and 59 $\mu\text{g}/\text{m}^3$. Both samples returned non-detects for PCE. Since these detections occurred directly below the shelves containing the bottles of cleaning chemicals, the air around the bottles was then screened with the Air FROG. The Defiant Technologies Inline Diluter was installed on the Air FROG to dilute the samples to prevent overwhelming the instrument with a high concentration sample.

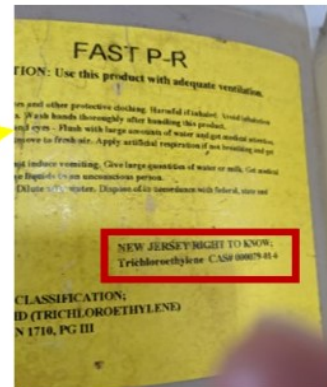
The handheld PID indicated high (1200-3800 ppbv) concentrations of VOCs in this location during the initial site screening.

Above this location are shelves where various dry-cleaning chemicals were being stored.



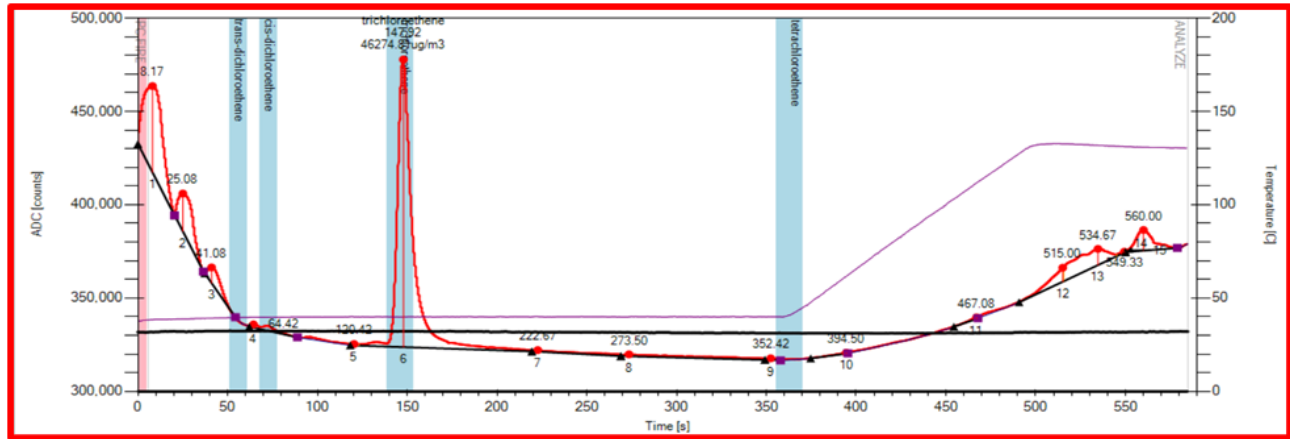
This plastic bottle was found directly next to the sampling point that produced the detection.

While sampling in the chemical storage area with the Air FROG, a TCE detection was observed at a concentration of 45 ppmv.



Air FROG Sampling Dry-Cleaning Chemical Storage Area

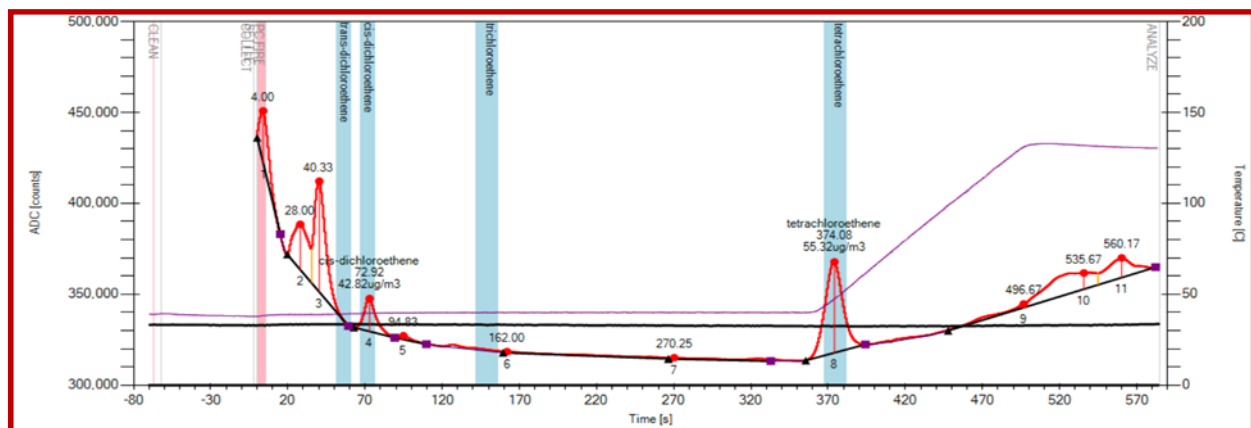
It is worth noting that most of the bottles of cleaning chemicals on these shelves were not labeled with their specific contents, so it was assumed that any or all of them could have contained the TCE that was causing the detections. A series of points along these shelves were sampled, and the sample that returned the highest concentration of TCE ($46\text{mg}/\text{m}^3$) was located next to a clear plastic jug containing a clear fluid. Upon further inspection, this bottle was labeled as containing >95% TCE.



Chromatogram Showing TCE Detection of $45\text{mg}/\text{m}^3$ in Chemical Storage Area

Since no other locations inside the building indicated the presence of TCE, this bottle of TCE was presumptively determined to be the source of the contamination detected in the off-site laboratory data, and corrective action could be taken.

One other sampling location indicated elevated total VOCs, and that was from an electrical conduit feeding a breaker box from beneath the slab. The headspace from the conduit was analyzed with the Air FROG and a detection of PCE at $55\mu\text{g}/\text{m}^3$ was returned. This conduit was acting as a pathway for the leaked PCE beneath the slab to enter the building and was likely one source of the PCE being detected in off-site laboratory data. As the concentrations of PCE in the indoor air were below North Carolina commercial occupancy thresholds, the presence of PCE was not of great concern. However, it is useful information if future sampling shows an exceedance because it would provide future investigations a place to start.



Chromatogram Showing Detection of PCE at $55\mu\text{g}/\text{m}^3$ from Electrical Conduit

Conclusion

As demonstrated in this case study, the Air FROG is a powerful tool that allows environmental professionals and industrial hygienists to quickly speciate and analyze a wide range of chemicals of concern. Combined with a handheld PID like the ppbRAE 3000, an unknown source can be located, and corrective action taken – well before a Summa canister could be sampled, sent to an off-site laboratory for analysis, and meaningful data reported. This approach not only yields fast results, saving valuable time in the field, but also prevents costly redeployments and saves the environmental professional unnecessary lab costs.

Defiant Technologies would like to sincerely thank Atlas-ATC Group Services, North Carolina Department of Environmental Quality, Larry George, Jeremy Robbins and Sue Murphy for the opportunity to participate in this investigation.



Defiant Technologies Inc.
6814A Academy Parkway W NE
Albuquerque, NM 87109
505-999-5880