

SAMPLING, IDENTIFICATION AND QUANTITATION OF TOLUENE

INTRODUCTION

Clandestine Laboratories (Clan Labs) pose a significant threat to public security and safety. In 2008, there were 6,783 Clan Lab incidents in the United States¹. Methamphetamine is one illicit drug manufactured in clan labs in the US. The United States Drug Enforcement Administration (DEA) maintains lists regarding both the classification of illicit drugs and the chemicals used to manufacture these controlled substances. Toluene is designated on List II and is used as a precursor in the manufacture of Methamphetamine.

Like other solvents, toluene can be used as an inhalant drug for its intoxicating properties. Toluene is a clear liquid also widely used as a solvent. It is able to dissolve materials such as paints, paint thinners, rubber, adhesives, and disinfectants. Toluene occurs naturally at low levels in crude oil and is sometimes produced during the process of making gasoline. If heated, it can give dinitrotoluene and ultimately the explosive trinitrotoluene (TNT).

Toluene can enter surface water and groundwater from spills of solvents and petroleum products as well as from leaking underground storage tanks at gasoline stations and other facilities. When toluene-containing products are placed in landfills or waste disposal sites, the toluene can enter the soil or groundwater.

This application note demonstrates the detection and identification of Toluene in ppt (part per trillion) concentrations. The experiment was completed by sampling multiple locations with an X-Sorber and performing sample analysis with the Griffin™ 450 Mobile GC/MS system.

INSTRUMENTATION

- Griffin X-Sorber sampler and thermal desorber
- Griffin 450 GC/MS system
- Griffin System Software – GSS 3.7

X-SORBER METHOD:

1. X-Sorber Desorption Temperature: 200°C
2. X-Sorber Desorption Time: 2 min
3. Precon Collection Temperature: 40°C
4. Precon Desorption Temperature: 250°C
5. Precon Desorption Time: 2 min

Gas Chromatograph Operating Conditions

Temperature Program: 40°C hold for 2 min, then increase at 10°C per minute to 70°C	
Column	Rtx-5ms, 30 m x 0.25 mm x 0.25 µm
Carrier Gas	Helium, 1 mL/minute

Mass Spectrometer Operating Conditions

Mass Scan Range	m/z 50-425
Detector Temperature	150°C

EXPERIMENTS

Prior to the field test, the X-Sorber was conditioned at 200 °C for 15 minutes utilizing the conditioning port of the Griffin 450 GC/MS system. A 100 ppt toluene gas sample was prepared by adding 0.9 mL of 10 ppm toluene gas standard (Matheson Tri Gas, part no. SG 585000-2) to 90 L of dry air in a Teflon sample bag. An X-Sorber was used to run a blank. For this test, 20 L of air was collected on the X-Sorber using a volume-based method. The X-Sorber was then docked with the Griffin 450 GC/MS system where the sample was desorbed into the GC/MS and analyzed.

Air samples were collected with an X-Sorber in four locations: a local research park, an ICx Technologies office, an ICx Technologies research laboratory, and a research laboratory within a newly constructed building in the research park.

RESULTS AND DISCUSSION

Figure 2 shows the GC/MS result of 20 L of 100 ppt toluene sample in a Teflon® bag. Toluene was detected at a retention time of 4.06 min. For comparison, the X-Sorber blank data was also shown in figure 2.

Figure 3 shows a calibration curve that was established for Toluene using the data from 0.1 ppb (part per billion) toluene gas standard to 10 ppb toluene gas standard. Air blank data were collected by sampling 20 L dry air in the sample bag. The Limit of Detection (LOD) was calculated and determined to be 0.01 ppb or 10 ppt (3 std.dev.). The LOD of toluene was determined to be 0.01 ppb or 10 ppt.

Figure 4 shows the result of the air samples collected. The samples were analyzed and the concentration of toluene in each sample was calculated using the toluene calibration curve. Table 1 is a summary of the results. As expected, the air sample from the research park has the lowest toluene level, 0.08 ppb. The ICx Technologies lab has a higher toluene level, 0.7 ppb, as compared to the toluene level in the ICx Technologies office, 0.2 ppb. The new research laboratory in the research park has a much higher toluene level, 117 ppb. The NIOSH REL (Recommended Exposure Limit) for toluene is 90 ppm (part per million).

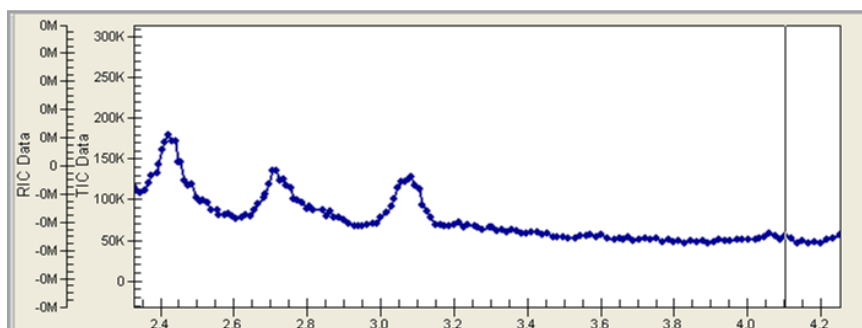


Figure 1: X-Sorber blank

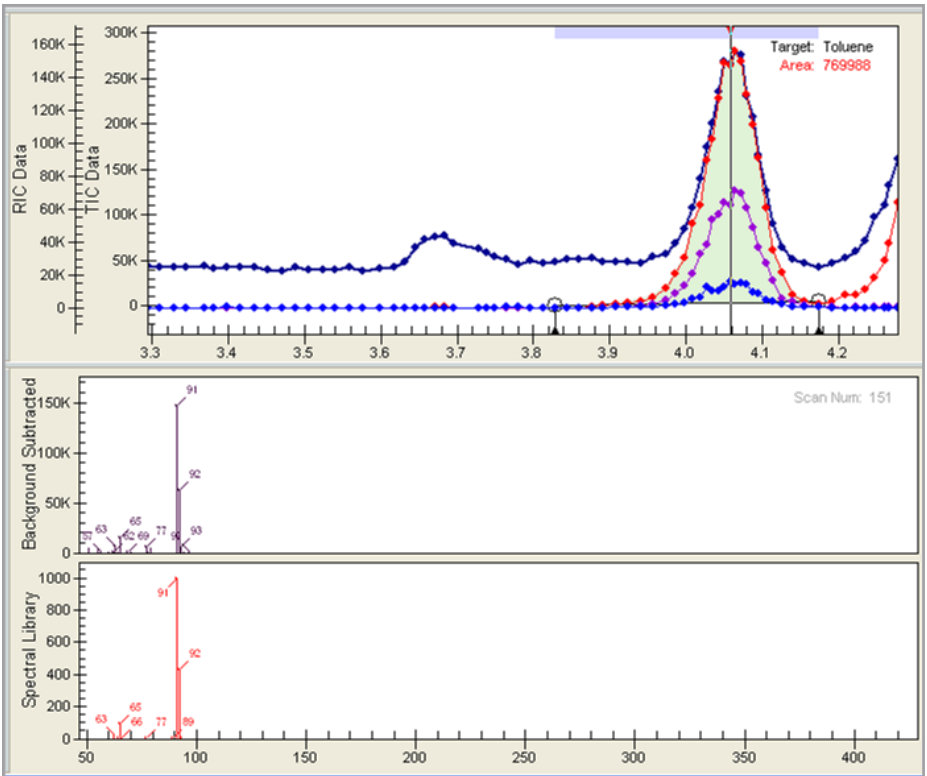


Figure 2: Detection of 100 ppt toluene (20 L collected by X-Sorber)

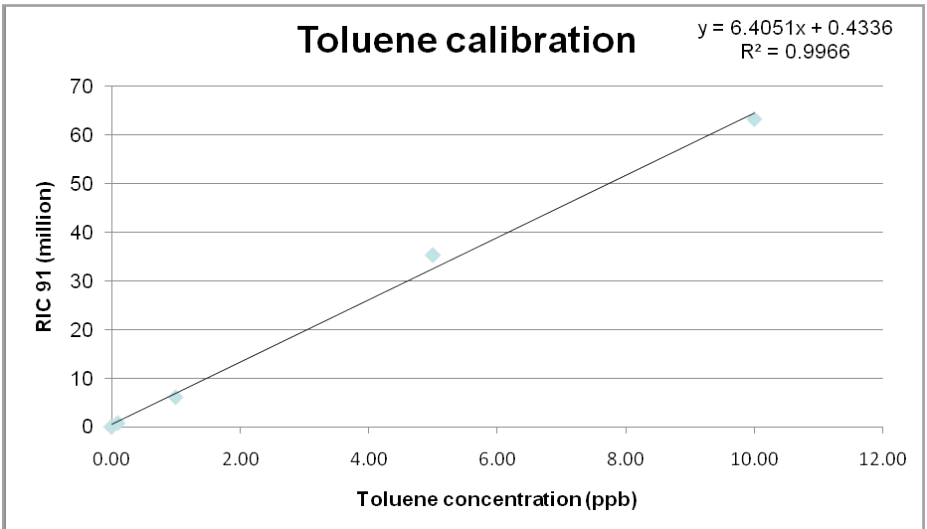


Figure 3: Calibration curve of toluene

Location	Toluene (ppb)
Outside Air	0.8
Office	0.22
Laboratory	0.69
New Building	117

Table 1: Toluene concentration at different locations

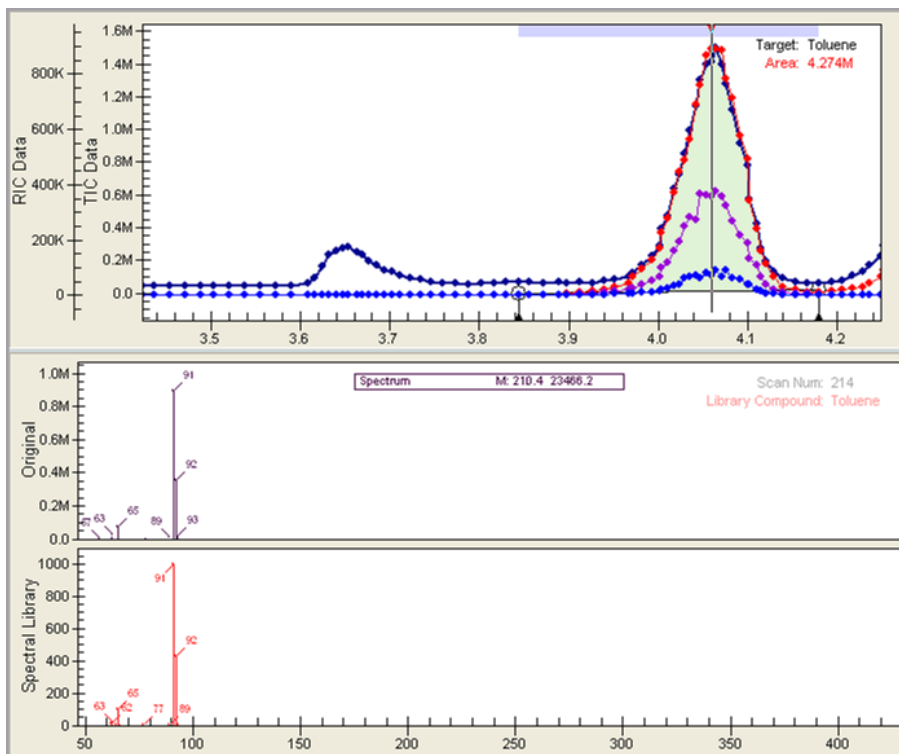


Figure 4: Detection of toluene in room air in ICx lab (20 L collected by X-Sorber)

CONCLUSION

The LOD of toluene was determined to be 10 ppt utilizing the X-Sorber and Griffin 450. These tests were based on the collection of 100 ppt toluene using an X-Sorber. Subsequent analysis was performed by the Griffin 450 GC/MS system and toluene was detected at a retention time of 4.06 min. Air samples were collected by the X-Sorber at 4 different field locations. Analyses via the Griffin 450 GC/MS identified Toluene in all 4 locations. Through this field test, it was determined that the X-Sorber is an adequate tool for the collection of air samples containing Toluene. When docked with the Griffin 450 mobile GC/MS system, the chemical threat can be both identified and quantified, providing actionable information for field response.



Figure 5: X-Sorber docked with Griffin 450 GC/MS in a mobile laboratory

3000 Kent Avenue
West Lafayette, IN
47906
T +1.888.775.1701

www.icxt.com

References

- (1) National Clandestine Laboratory Database
- (2) Wells, J.M.; Badman, E.R.; Cooks, R.G. Anal. Chem. 1998, 70, 438-444.
- (3) Patterson, G.E.; Guymon, A.J.; Riter, L.S.; Everly, M.; Griep-Raming, J.; Laughlin, B.C.; Ouyang, Z.; Cooks, R.G. Anal. Chem. 2002, 74, 6145-6153.