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INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

Investigative Strategies for Dry-Cleaner Sites

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Notice

The Technology Evaluation Group (TEG) developed this guidance of *Investigative Strategies for Dry-Cleaner Sites* as an aid in the development of a conceptual site model (CSM) for sites that used or are using dry-cleaning solvents. This guidance may also have useful information to address chlorinated solvent releases from sources other than dry cleaning facilities.

The TEG does not approve any technology nor does it verify any technology's effectiveness in conditions not identified here. Mention of trade names or commercial products does not constitute endorsement or recommendation by the IDEM for use.

Introduction

A good working knowledge of the past and present operations assists in the investigation of a dry-cleaning site. Several key pieces of information are useful in conducting investigation work:

- A determination of the age of the facility and periods of operation. This information will help develop a sampling plan and can provide information on potential types of contamination.
- Location of the waste handling areas (this should include the location of the trash dumpster). A well-developed sampling plan will include these areas.
- Types of equipment used and how they are tied into site infrastructure (special attention should be given to sewer lines).
- Proximity to other structures (needed when conducting a vapor intrusion study).

Much of this document is based on research that includes references (intended for further reading) compiled by the State Coalition for Remediation of Dry-cleaners in two documents published by that organization. These documents are:

- Chemicals Used In Dry Cleaning Operations, State Coalition for Remediation of Drycleaners, January 2002 (Revised July 2009).
- Conducting Contamination Assessment Work at Dry Cleaning Sites, State Coalition for Remediation of Drycleaners, Revised October 2010.

History of Dry-Cleaning Processes

Over the past 130 years (the first reported dry-cleaning facility in the US was 1879); several different chemicals were utilized as dry-cleaning solvents. These included: camphor oil, turpentine spirits, benzene, kerosene, white gasoline, petroleum solvents (mainly petroleum naphtha), chloroform, carbon tetrachloride, perchloroethylene (PCE), trichloroethylene (TCE), 1,1,2-trichlorotrifluoroethane, glycol ethers, 1,1,1-trichloroethane (TCA), decemethylcyclopentasiloxane, n-propyl bromide, and liquid carbon dioxide. If the dates of operation are available, a detailed list of contaminants of concern (COCs) can be developed. The next section provides a brief history of dry-cleaning operations and date ranges for when certain solvents were used. Chemistry Services has developed a Technical Guidance Document that provides additional information and can be found at:
https://www.in.gov/idem/cleanups/files/chem_guidance_contaminants_drycleaners.pdf

Early dry-cleaning solvents were petroleum-based. In 1924 (due in part to fire risk) the petroleum-based solvents were replaced with the less flammable Stoddard solvent. This solvent was the primary chemical used from the late 1920s to the late 1950s. In the early 1990s new petroleum-based solvents were developed. These include:

- Dry Cleaning Fluid-2000 or DF-2000
- EcoSolv®,
- Hydroclene, and
- Shell Sol 140 HT.

In the 1930s TCE was introduced as a replacement but was never widely used as a primary dry-cleaning solvent. TCE is still used as a pre-cleaning or spotting agent and is used in some water repellent agents.

Carbon tetrachloride was used for dry-cleaning in the 1940s and 1950s. Because of its high toxicity and tendency to contribute to machinery corrosion, carbon tetrachloride is no longer used. It was phased out in the late 1950s and replaced with PCE.

1,1,2-trichlorotrifluoroethane (Freon 113) was used for a short period in the 1960s. This chemical was later found to be an ozone depleter and is no longer used.

1,1,1-trichloroethane (TCA) was introduced in the 1980s but was never widely used. One of its main uses was for leather cleaning. It has also been used as a spotting agent and in waterproofing agents and stain repellents, such as:

- Glycol ethers
- Decamethylcylcopentasiloxane (GreenEarth™),
- n-Propyl Bromide,
- PureDry™, and
- Liquid Carbon Dioxide.

Perchloroethylene (PCE) is currently the dry-cleaning solvent used in most dry-cleaning operations. USEPA has scheduled PCE to be phased out of use by 2030.

Pre-Cleaning / Spotting Agents
Numerous chemicals are used for pre-cleaning and spot cleaning. Prior to placement in the dry-cleaning machine, heavily stained garments are pre-cleaned. Most pre-cleaning solvents are also used in the primary dry-cleaning cycle. There are three main categories of pre-cleaners:

- Wet-side Spotting Agents,
- Dry-side Spotting Agents, and
- Bleaches

Garment Treatment Chemicals
There are a variety of chemicals that are used to treat garments for various reasons. There are four main categories of garment treating chemicals:

- Waterproofing chemicals,
- Flame retardant chemicals,
- Fabric conditioning chemicals, and
- Stain repellent chemicals.

POTENTIAL SOURCE AREAS
When evaluating a dry-cleaning facility for potential source areas, most investigators assume that releases occur near the dry-cleaning equipment. While this is true, other potential sources need to be investigated as well. These potential source areas include:

- Solvent recovery systems (distillation units, filters, traps),
- Areas around service doors,
- The sanitary sewer / septic tank and leach field,
- ASTs and USTs,
- Storm sewers,
- Dumpsters and trash cans,
- Spotting Board area(s),
- Blind drains or sumps,
- Air handling equipment (especially areas where these devices discharge to the outside),
- Storage buildings, and
- Unique treatment units (for example discharging separator water to the outside through a mister unit).

HOW TO INVESTIGATE
Like all investigations, planning can make the difference between collecting the information needed to develop a meaningful conceptual site model (CSM) and having to remobilize to collect additional information. Planning should start with conducting a thorough Phase I Site Assessment. Although similar, this list is not intended to include all requirements for conducting Phase I Environmental Site Assessments per 40 CFR 312.21 (AAI) and ASTM Standard E1527-05.

A Phase I Site Assessment for a dry-cleaner has the following elements:

- Historical documentation, including but not limited to:
  - City directory searches (this can include crisscross, phone books, and city directories);
  - Review of historical aerial photographs (These photos could be from several different sources);
  - Review of topographical maps;
  - Historical fire insurance maps (like the Sanborn and Baist maps); and
  - Full title search back to when the property was first developed.

- Review of other remediation projects that are currently active or are complete. This information could be useful if a contributing off-site source is present.

- Review any facility as-built drawings and/or emergency plans. These will provide information about locations of processes and waste handling areas.

- Obtain utility records. Check with the city or town for maps of the underground utilities (man-made preferential pathways) that may be affected by contamination from the site. Identify any current or historical septic systems.

Once the historical information is compiled, assess the on-site and near site features. A site reconnaissance should include:

- Identification of sensitive receptors that may be affected by a release from the site. Sensitive receptors can include:
  - Residences,
  - Day care centers,
  - Hospitals,
  - Nursing homes,
  - Schools,
  - Water supply wells, and
  - Natural features (like rivers, lakes, karst, habitat of endangered species)

- Review any operation records stored on-site. These records could give clues where to conduct sampling.

- Canvas the businesses around the area to determine if other sources are present that may account for contamination found in unlikely locations.

- Review locations of the dry-cleaning equipment as well as other areas where solvents may have been used, stored, treated, or disposed of. This should include:
  - The dry-cleaning machine,
  - The distillation unit,
  - Solvent storage tanks,
  - Waste storage areas,

  - Spotting boards,
  - Vacuum units,
  - ASTs,
  - USTs,
  - Floor drains,
  - Sump pits,
  - Mop buckets, and
  - Dumpsters and trash cans.

- Evaluate historical waste management practices. This should include a list of wastes generated by the dry-cleaning process.

- Determine how solvents were delivered to the facility and how spent solvents were managed.

- Determine how the dry-cleaning machine was filled. The methods used to load and un-load a dry-cleaning machine account for most of the contamination detected at a dry-cleaning facility.

- Review wastewater management. This should include a detailed description on the use of drain lines and floor maintenance (floor cleaning).

- Determine the locations of air handling system vents to the outside.

- Follow all piping to the terminus and account for all discharges from them.

- Inspect the condition of flooring throughout the facility.

It may not be possible to determine much of this information if the dry-cleaner is no longer operating. At this point historical records and employee interviews (if possible) are vital.

By identifying data gaps in the CSM the investigation and drilling plan can be developed. This model will be used to guide the Phase II Site Assessment. Data gaps in the CSM could included:

- Geological setting (this should include information on unsaturated soils, saturated soils, groundwater and bedrock);

- Surface and likely groundwater flow directions, including local conditions that alter the flow direction (i.e. water wells);

- Identification of preferential pathways for contaminant migration (this should include natural and man-made features);

- Identification of potential receptors (the more information provided the better the assessment will be); and

- A list of the contaminants of concern and all their physical and chemical properties.

CONDUCTING THE SITE ASSESSMENT (Phase II Investigation)
In general, chlorinated solvent contamination plumes are larger (deeper and of greater areal extent) than contaminant plumes associated with petroleum contamination. Dry-cleaning solvents are denser than water (so they will sink to a confining unit) and less viscous than water (so they will spread easily). The plumes can be thinner than petroleum plumes and have a center of mass well below the water table. Most of the time, contamination associated with dry-cleaning solvents will extend off-site.

To be successful in assessing chlorinated solvent contamination, the site stratigraphy needs to be defined. Information gathered from site stratigraphy can provide information on preferential flow paths and the nature and extent of confining layers.

CONTAMINATED MEDIA

Dense Non-aqueous Phase Liquids (DNAPLs)
Chlorinated solvents (except for vinyl chloride) have a density greater than water; therefore, chlorinated solvents are considered DNAPLs. When developing a sampling strategy for investigation of a dry-cleaning facility the existence of DNAPLs are a possibility and stratified samples would be helpful.

Soils
Soil sampling provides information that could be data gaps in the CSM:
- Provides information about the contaminant mass in soil (needed to properly design remedial measures);
- Provides information about the presence of free DNAPL in groundwater;
- Provides information needed to assess vapor intrusion; and
- Provides information needed to assess the presence of DNAPL

The investigator should be aware that soil source zones can be small and may appear disconnected from surface sources because chlorinated volatile organic compounds (CVOCs) are less viscous than water and tend to follow soil fractures.

To determine if areas require further testing (soil, groundwater, and vapor intrusion), there are several locations within a dry-cleaning facility where soil sampling should occur:
- Beneath the dry-cleaning machine,
- Outside any service doors,
- The locations of any USTs or ASTs,
- Sanitary sewers (include all inlets and laterals),

- Septic tanks and associated leachfields,
- Storm sewers,
- Floor drains,
- Dumpsters and trash cans,
- Areas around the spotting board(s),
- Areas where mop buckets are stored, and
- Other source areas.

Groundwater
A good CSM is needed to determine not only where to place monitoring wells but depth(s) where screens are needed to adequately monitor chlorinated solvent releases. Monitoring well screens for chlorinated solvents should be designed to straddle contaminated intervals rather than fluctuations of the water table. Standard 10-foot screens are often inappropriate for these plumes and may miss not only the core of the contaminant plume, but potential DNAPL.

Vapors
Vapor migration involving chlorinated compounds that are not aerobically biodegradable is significantly different than vapor migration involving petroleum-based contamination. Since chlorinated vapors do not aerobically biodegrade, there is generally less attenuation of chlorinated compounds in the vadose zone.

Summary and Conclusions
This document provides a basic outline for investigating dry-cleaning sites. More in-depth evaluations should be discussed on a site by site basis. An understanding of the past and present operations and the nature of the materials associated with those operations is needed to develop an accurate CSM. In addition, working knowledge of how groundwater interacts with those materials is also needed to develop an accurate CSM.

Further Information
If you have any additional information regarding this subject or any questions about this evaluation, please contact the Office of Land Quality, Science Services Branch at (317) 233-6593. IDEM TEG will updated this technical guidance document periodically or on receipt of new information.

ADDITIONAL READING AND REFERENCES

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