Reported Leaks, Spills and Discharges at Florida Drycleaning Sites

Bill Linn, Florida Department of Environmental Protection &
Kristin Mixell, Florida State University

This paper presents data collected by the Florida Drycleaning Solvent Cleanup Program on reported spills, leaks and discharges of drycleaning solvent and solvent-contaminated wastes at 334 drycleaning facilities and 14 drycleaning wholesale supply facilities located in Florida. This information will be useful to those conducting contamination assessments and soil and groundwater remediation at contaminated drycleaning sites by helping to identify contaminant source areas. Since the bulk of the contaminant mass is generally located in close proximity to the discharge point, a better understanding of drycleaning equipment, operations and waste management practices, particularly former industry practices, will facilitate identification of contaminant source areas. This will enable investigators to focus sampling during site assessment activities to provide a more accurate picture of contaminant mass distribution in contaminant source areas that is necessary for successful site remediation. Information contained in this paper may also be useful to regulatory personnel conducting compliance inspections at drycleaning operations.

Background

The Florida Drycleaning Solvent Cleanup Program, created by the Florida Legislature in 1994, has been charged with the responsibility of rehabilitating over 1,400 contaminated drycleaning sites. As part of the application process for the Program, active drycleaning operations were required to complete a questionnaire that included questions regarding facility history, operational and waste management practices. One of these questions addressed leaks, spills, and discharges of drycleaning solvents:

> "Describe any spilling, leaking, seeping, pouring, emitting, emptying, dumping or mis-application of drycleaning solvents that has occurred at any time during the operation of the facility prior to this application."

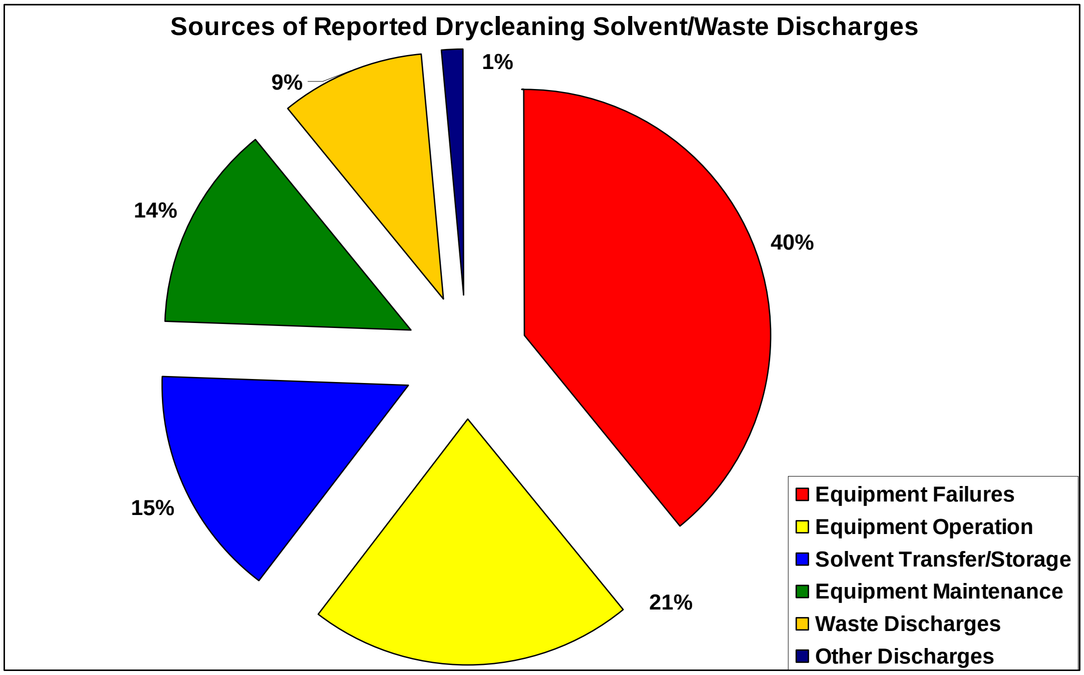
Of the 1,566 applications received by the Program, approximately 70% were from active drycleaning facilities and drycleaning wholesale supply facilities. Of the active facilities applications, 348 facilities (or 31.8% of the active facilities) indicated that there had been at least one leak, spill or discharge of drycleaning solvent or solvent-contaminated wastes at their facility. These data represent a total of 530 reported incidents. Most of the reported incidents were solvent discharges, but some were discharges of wastes – still bottoms, filters, and contact water. No data were submitted for solvent vapor emissions and therefore, solvent vapor emissions are not discussed in this paper. Utilizing these data, a spreadsheet was developed that included facility name, identification number, reported type of discharge and the amount of solvent/waste discharged, if provided. Examination of these data leads to the development of six spill/discharge scenarios:

- Spills/Discharges associated with drycleaning equipment failure
- Spills/Discharges associated with drycleaning equipment/machine operation
- Spills/Discharges associated with solvent transfer or storage
- Spills/Discharges associated with equipment/machine maintenance
- Discharges of drycleaning wastes
- “Other” spills/discharges

Results

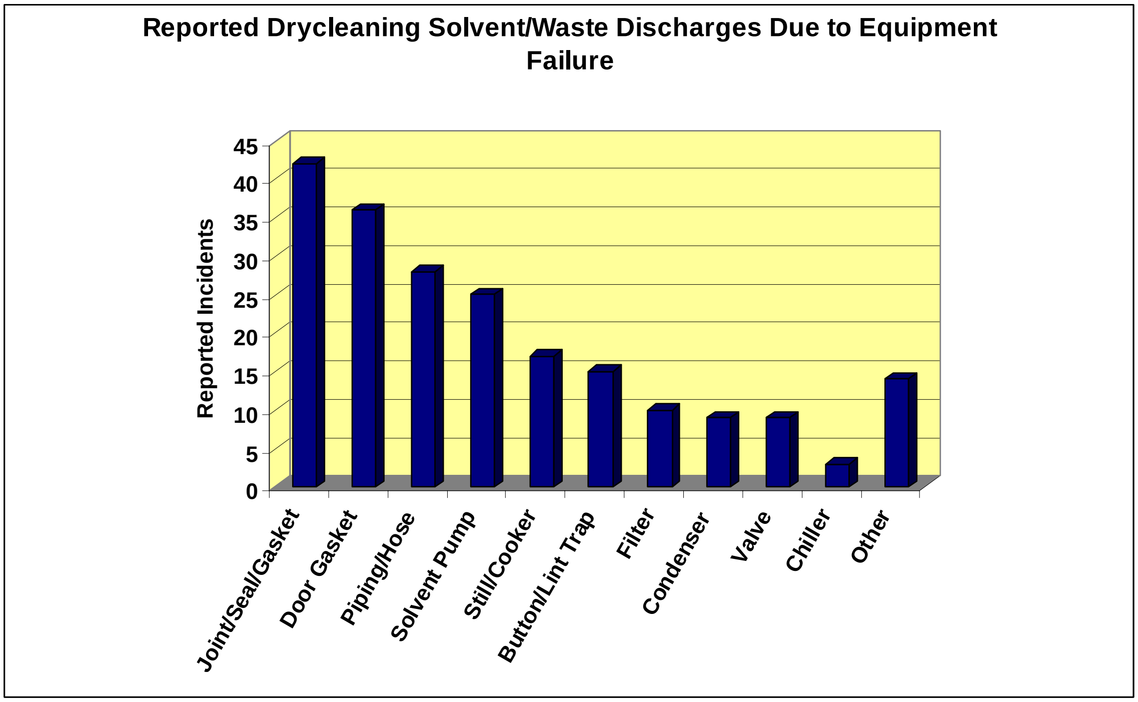
In terms of reported discharges the breakdown was as follows:

Spill/Discharge Scenario	**No. of Incidents**
Equipment Failure	208
Equipment /Machine Operation	111
Solvent Transfer & Storage	81
Equipment Maintenance	73
Waste Discharges	50
“Other Spills”	7
Totals	**530**



Discharges Due to Equipment Failure

The largest number of reported spills/discharges (39.2% of reported discharges) was associated with drycleaning equipment failure. According to an EPA study, up to 25% of solvent emissions in drycleaning operations can be attributed to equipment leaks (University of Tennessee, 1994). The types of reported equipment failures included: leaking seals, gaskets, piping, hoses, valves, etc. Equipment leaks can be the result of equipment wear and corrosion; expansion and contraction of metal from temperature changes; and vibration of equipment. In terms of what was specifically identified, leaking door gaskets were the most commonly reported source of solvent leakage. Leaks associated with piping and hoses included leaks at piping joints, coupling failures (failed hose clamps, and piping joint failures) and in some cases, ruptures of piping and hoses. Leaks associated with distillation units included failure of pressure valves and leaks associated with gaskets on the still door. Discharges from the button trap commonly were associated with failure of the button trap lid gasket. Discharges associated with filters were generally related to failed seals or leaks at the cartridge filter housings. Excessive pressure buildup in cartridge filters, caused by soil buildup can force soil through the filter causing it to rupture. Excess moisture in a filter or buildup of water repellent agents or fabric finishers can cause rapid pressure increase that can also cause filters to fail (EPA, 1994). Leaks/discharges associated with condenser coils were likely pinhole leaks in the coils caused by corrosion and pitting from acidic lint and dirt buildup. Most of the discharges associated with the solvent pump were due to seal or packing failures



Discharges During Equipment/Machine Operation

Discharges of solvents and solvent-contaminated wastes during drycleaning machinery operation accounted for 20.9 % of reported discharges. Many of these discharges were the result of operator error. Types of spills and discharges associated with machinery operations include boilovers of solvent/distillation residues from distillation units (most commonly due to overfilling the distillation units, but in some cases due to excessive operating temperatures); Machine door not closed (due to clothing caught in door; door not closed before starting machine, or door opened while machine was still operating); loose cartridge filter housing; water separator overflowing (due to plugging of the air vent, or solvent or water outlets with lint or dirt); and valves left open.

Discharges Associated With Solvent Transfer & Storage

Approximately 15.3% of the reported spills/discharges in the data set were associated with solvent transfer and solvent storage - the most frequently reported type of discharge. By far, most of these spills were related to solvent transfer (over 85% of the reported incidents), which involved either the delivery of the solvent to the facility – most commonly by tanker truck - or filling the drycleaning machine with solvent.

Drycleaners used substantially more perc in their operations in the past. The Textile Care Allied Trades Association has documented a 73 percent reduction in perc useage by U.S. drycleaners in the past ten years. Perc useage by U.S. drycleaners has declined from a high of 360 million gallons in the late 1970s to 59 million gallons in 2000 (National Clothesline, 2000). This declining perc useage is due largely to the transition from transfer machines to dry-to-dry machines utilizing closed-loop technology. In the past, solvent deliveries to the drycleaning facility were larger and more frequent than today's fourth and fifth generation machines require. Methods of solvent delivery and storage have also changed. Today most drycleaning solvent is delivered in drums and pumped into the drycleaning machine where it is stored in tanks located in the base of the machine. In the mid 1990s, closed-loop delivery systems were developed and many wholesale suppliers utilize these systems.

In the past, solvent was commonly delivered to the drycleaning facility by a tanker truck. The solvent was pumped from the truck to the drycleaning machine, or more commonly, to an above-ground storage tank (AST). Some facilities have stored petroleum drycleaning solvent in underground storage tanks (USTs). The ASTs were located either inside the facility or outside the facility near the service entrance. There were leaks and spills associated with the filling of the ASTs and the drycleaning machines. There are reported incidents of overfilling of both the machine and tanks. There are also reported incidents of solvent leaking from the tanks truck's delivery hose as it was reeled back to the tank truck. Solvent is also delivered to drycleaning facilities in drums. There are reports of solvent releases from drums during delivery.

Solvent was transferred from the AST to the drycleaning machine by one of two methods. Sometimes piping, regulated by valves, ran from the AST to the machine. Some ASTs had valves located at the base of the tank. Solvent was transferred from the tank by filling a bucket or container and carrying the container from the tank to the machine. Solvent was discharged through leaking valves, spillage from buckets or containers and spillage when filling and overfilling the drycleaning machine. Drycleaning solvent delivered in drums was pumped by hand into the drycleaning machine or into a bucket or container which was used to fill the drycleaning machine.

Until the advent of closed-loop solvent delivery systems and machines equipped with solvent filling ports, solvent was introduced into most drycleaning machines either through the machine door into the drum or through the button trap lid, located at the rear of the machine.

A number of the wholesale drycleaning supply facilities received solvent deliveries via railroad tank cars. Solvent was pumped from the tank cars to large ASTs. There were solvent discharges associated with these operations. Solvent was either transferred from the ASTs to tank trucks or transferred to drums for delivery to the facility. There were solvent releases associated with transferring the solvent from rail cars to storage tanks, and filling the delivery tank trucks and drums. There have also been reported releases at wholesale drycleaning supply facilities associated with spills from drums that were dropped or fell while being transported.

Discharges During Equipment/Machine Maintenance

Discharged solvent and solvent wastes during drycleaning machine/equipment maintenance accounted for 13.8% of all reported spills/releases. Types of discharges associated with equipment maintenance include:

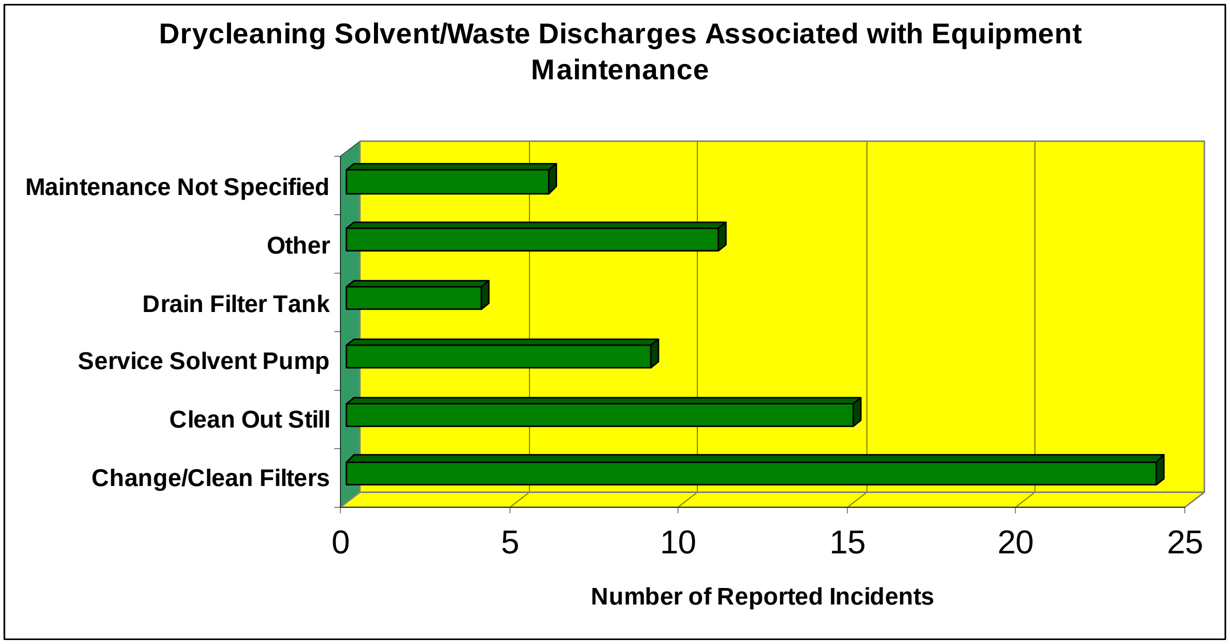
- Spills during filter changes are common. As much as one gallon of solvent can be contained in spent cartridge filters (University of Tennessee, 1994). Good operational practice is to allow the filters to drain at least overnight before changing. This practice is not always followed and solvent is commonly spilled when undrained spent cartridge filters are removed from the filter housings. Historically spent cartridge filters have often been collected and stored outside the service door of drycleaning facilities where solvent has drained from the filters and been discharged to the ground or pavement.

  Solvent discharges can also occur if the gaskets or felt washers that are placed between cartridge filters are not properly seated or if the proper size gaskets are not used (EPA 1994).

- Spills of still bottoms or cooked powder residues during cleanout of distillation units or muck cookers after the completion of the distillation process have been common occurrences at drycleaning facilities. The amount of residual solvent in still bottoms or cooked powder residue depends on the efficiency of the distillation operation. Analysis of still bottoms and cooked powder residues from PCE drycleaning operations have found that still bottoms can contain up to 75% PCE, % by weight, and cooked powder residues can contain up to 56% PCE, % by weight (Beak Consultants, 1990).

- Solvent discharges have occurred during the servicing of the solvent pump – replacing failed seals or packing or cleaning out the pump strainer.

- Solvent discharges have occurred during button trap cleanout.



Discharges Associated With Waste Management

Although most of the discharges reported in the Program applications were solvent discharges or releases, approximately 9.4% of the reported discharges were related to solvent contaminated wastes. These include contact water (separator water, vacuum water and mop water), still bottoms and cooked powder residues, filters, lint, and spotting residues. Documented discharge points for contact water include: sanitary sewers, storm sewers, soakage pits, pavement and the ground, particularly the area just outside the service door. Identified disposal locations for still bottoms include storm sewer, lint trap (sanitary sewer), ground, and dumpsters or trash containers. Spent filters were reported as being disposed to the trash or dumpsters.

"Other" Discharges

"Other" spills accounted for only 7 of the reported incidents and included spillage of solvent and solvent contaminated wastes during the dismantling of a decommissioned drycleaning machine; spills during the removal of decommissioned drycleaning machines; solvent and waste releases from a fire at a drycleaning facility; and solvent discharged from a vandalized solvent AST.

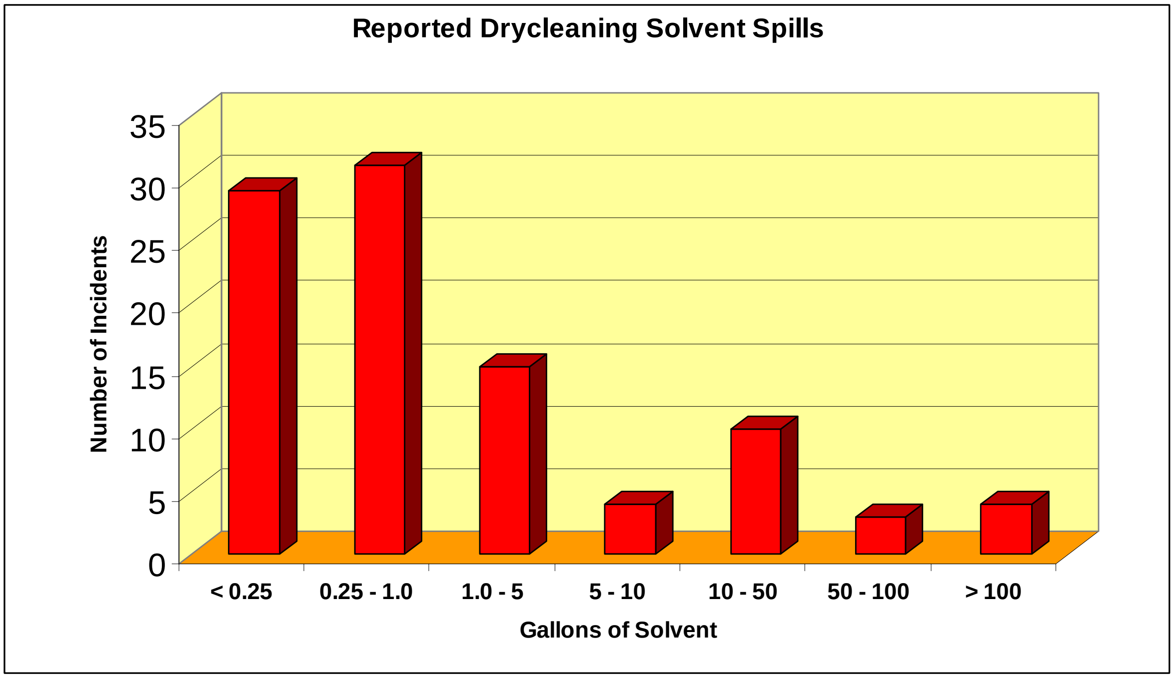
Solvent Spill/Discharge Volumes

Estimated spilled/discharged solvent volumes were reported in 96 of the 530 reported spill/discharge incidents. Although, statistically, this is a small data set, it is worthwhile to examine the reported spill amounts and the associated discharge scenarios. Reported volumes ranged from a few ounces to over 500 gallons. In terms of discharge scenarios, the spills/discharges were reported as follows:

Reported Solvent Spills (gallons)

Discharge Scenario	Incidents	Range	Mean	Median
Equipment Maintenance	33	0.023-25	2.6	0.75
Equipment Failure	22	0.031-150	15.3	1.75
Equipment Operation	20	0.023-20	1.5	0.25
Solvent Storage/Transfer	18	1-275	26.8	3.5
"Other" Spills	3	20- >500	210	110
Totals	**96**	**0.023- >500**	**16.3**	**1**

Discounting the "Other" spills category (spill volumes reported for 3 incidents), spills associated with solvent transfer/storage and equipment failures account for the largest reported total amounts of solvent spilled or discharged.



These two scenarios also account for the largest average spill volumes. Although equipment maintenance and equipment operations account for the greatest number of reported discharges – 54, or over 56.2% of all discharges – the reported volumes of discharged solvent associated with these discharge scenarios are much smaller than those associated with failures of equipment or solvent storage/transfers.

Reported spills of solvent of 10 gallons or more, and their origin follow:

Solvent Storage/Transfer

- 10 gallons – delivery truck spill
- 62 gallons – spill near machine
- 55 gallons – drum of solvent ruptured
- 30 gallons – drum spill during solvent delivery
- 25 gallons – tanker truck hose coupling failure
- 275 gallons – AST hose coupling failure
- 50 gallons – spill during delivery

Equipment Maintenance

- 20 gallons – filter gasket not secured
- 10 gallons – filter gasket not secured

- 25 gallons – filter change
- 10 gallons – filter change

Equipment Failure

- 20 gallons – pipe burst
- 20 gallons – hose coupling failure
- 15 gallons – filter gasket failure
- 150 gallons – filter gasket failure
- 100 gallons – filter system failure

Equipment Operation

- 20 gallons – tank overflow

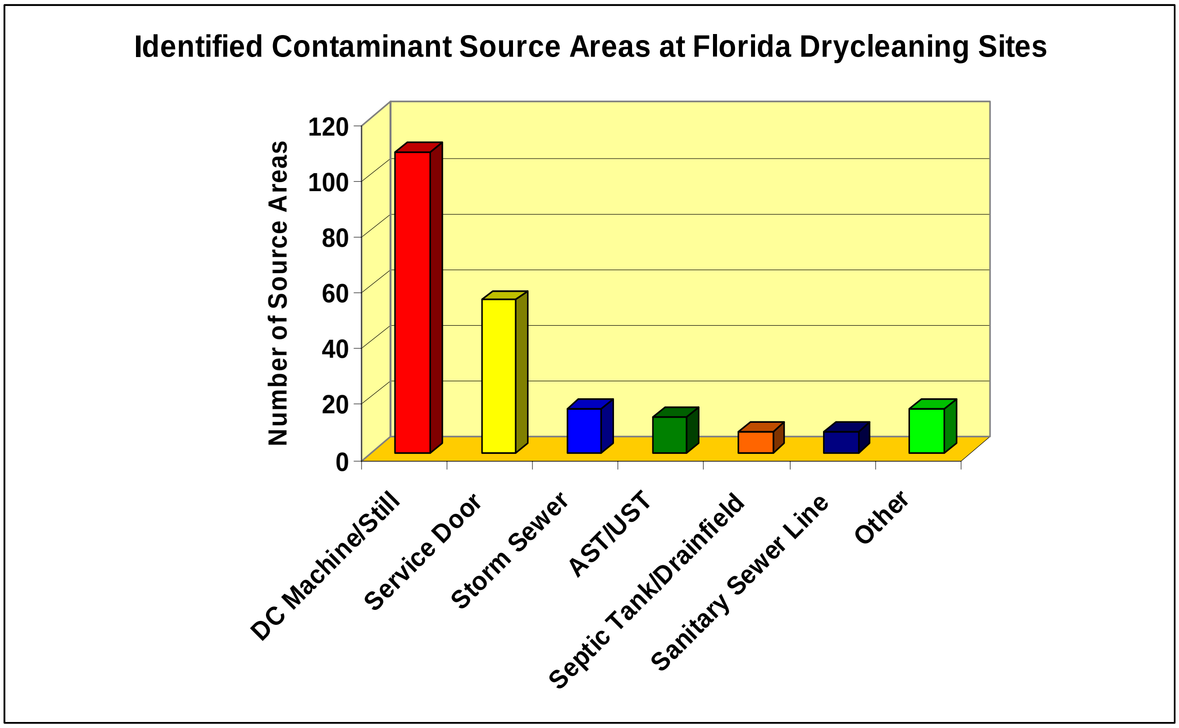
“Other” Spills

- 20 gallons – AST vandalized
- 110 gallons – recovered from catch basin, origin unknown
- > 500 gallons - pumped from storm sewer, origin unknown

Conclusions/Application

A study of drycleaning solvent contamination in California concluded that “The main discharge point for dry cleaners is the sewer line” (Izzo, 1992). The California study identifies contact water – primarily separator water discharged to sewers as the primary waste stream responsible for contamination from leaking sewer lines. In PCE drycleaning operations, separator water is generally saturated with respect to PCE and some free-phase PCE is often present as well. Historically, sanitary sewers and septic systems have been a primary discharge point for contact water from drycleaning operations, including separator water, vacuum water and mop water. In a 1988 equipment and plant operations survey of drycleaning operations located in the United States conducted by the International Fabricare Institute, 643 of the 909 drycleaning plants that responded (over 70.7%) indicated that separator water was being discharged to either the sewer or a septic system (IFI, 1989).

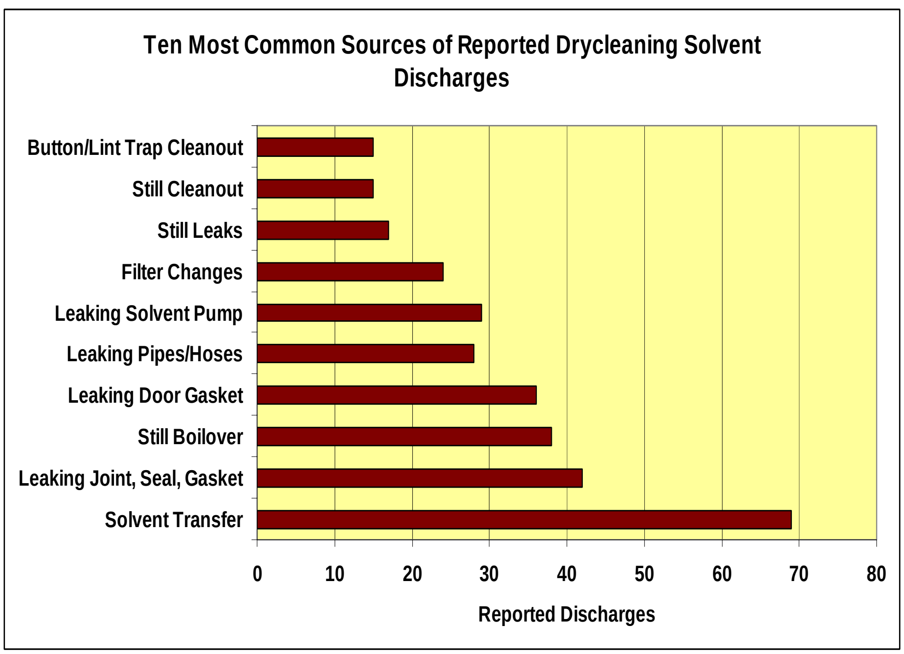
Based on the study of solvent discharges and the results of numerous contamination assessments conducted at Florida drycleaning sites, it appears that drycleaning solvent discharged during solvent transfer, solvent storage, drycleaning machine/still operation and machine maintenance may be a more important contaminant source, in terms of mass, at drycleaning sites than contact water discharged to leaking sanitary sewers or septic systems. A compilation of contaminant source areas identified from contamination assessments conducted at 150 Florida drycleaning sites shows that the number one contaminant source area identified at Florida drycleaning sites is the soil beneath the drycleaning facility floor slab in the vicinity of the drycleaning machines/distillation units (47.4% of identified source areas).



This is the area where solvent and solvent waste discharges occurred associated with filling the machine with solvent, operating the machine and distillation unit, and performing maintenance on the drycleaning machine. The second most commonly identified contaminant source area at Florida drycleaning sites is the area near the service door where solvent deliveries were received; solvent was sometimes stored; spent cartridge filters were sometimes stored and solvent-contaminated wastes (particularly contact water) were discharged (24.1% of identified sources).

A solvent leak, dripping at the rate of one drop per second will result in one gallon of solvent being discharged during an eight hour (working) day (EPA, 1994). Effective January 1, 1997, secondary containment was required to be installed in solvent storage, solvent use and solvent-containing waste storage areas at Florida drycleaning facilities. A survey conducted by the Florida Department of Environmental Protection during facility registration activities in 1995 found that only 61.2% of the active drycleaning facilities (1075 facilities responding) had some form of secondary containment in place. Installation of secondary containment in solvent use, solvent storage and waste storage areas, and utilization of closed-loop solvent delivery systems should help to contain most solvent discharges in the future at Florida drycleaning sites.

Much of the contamination at Florida drycleaning sites found beneath the drycleaning facility floor slabs is likely the results of leaks and spills from solvent transfer (filling the machine with solvent), drycleaning equipment operation and maintenance, and equipment failure.



Based on these findings, sampling activities during contamination assessments to identify contaminant source areas should be focused in the following areas:

- Current/former locations of drycleaning machines and distillation units - both front and back of the machine. Former machine locations can often be identified by the presence of cut off lag bolts (used to anchor the machines) in the floor slab or concrete patches in the floor slab where the lag bolts were formerly located. The presence of coffee-colored stains on the floor denotes the former location of distillation units where boilovers occurred or still bottoms or cooked powder residues were spilled during still cleanouts. When choosing soil sampling locations, for samples to be collected beneath the facility floor slab, look for cracks and expansion joints located near solvent use, solvent storage and solvent transfer areas. These joints and cracks acted as pathways for solvent migration into the soil.

- Current/former solvent storage areas (ASTs & USTs). Find out how solvent is/was delivered to the facility; where it was stored and how it was transferred to the drycleaning machine.

- Area around the service door of facility

- Along sanitary sewer lateral lines, particularly near the junction of the facility sewer line with the sewer lateral.

- Septic tanks/drainfield systems

- Floor drains

- Waste storage/disposal areas. Interview employees regarding disposal practices – especially past disposal practices.

Acknowledgements Support to Ms. Mixell for this report has been provided through an Environmental Careers Organization (ECO) grant funded by the US EPA Technology Innovation Office. The ECO is a private non-profit organization which offers a wide variety of paid, short-term environmental training experiences for college students. Florida State University and the Florida Department of Environmental Protection have also provided support to this grant.

References

Andrasik, Ivan. 1997. Maintenance of Perc Drycleaning Machines. Silver Spring: International Fabricare Institute Industry Focus No. 1.

Beak Consultants Limited. 1990. Hazardous Waste Management Practices in the Ontario Dry Cleaning Industry. Ottawa: Queen's Printer for Ontario.

International Fabricare Institute Education Department. 1991. Preventative Maintenance Programs – Keep Your Equipment In Good Working Order. Silver Spring: International Fabricare Institute Special Reporter, Vol. 19, No. 2.

International Fabricare Institute Education Department. 1980. What's Wrong with Your Water Separator? Silver Spring: International Fabricare Institute Practical Operating Tips.

International Fabricare Institute Technical Services Division. 1989. IFI's Equipment and Plant Operations Survey. Silver Spring: International Fabricare Institute Focus On Drycleaning, Vol. 8, No. 3.

Izzo, Victor J. 1992. Dry Cleaners – A Major Source of PCE in Ground Water. Sacramento: California Regional Water Quality Board, Central Valley Region.

Leppin, Betty. 1992. Maintenance Schedule Guide for Drycleaning Machines. International Fabricare Institute Bulletin Reprint – Technical Operating Information No. 644.

Meijer, Jon. 1984. An Equipment Handbook. Silver Spring: International Fabricare Institute Focus On Drycleaning, Vol. 8, No. 3.

National Clothesline. 2001. Perc Useage Continues 16-Year Decline. Willow Grove: June 2001, Vol. 41, No. 9.

Phillips, Lorraine. 1990. Maintenance of Water Separators. Silver Spring: International Fabricare Institute Bulletin Reprint, Technical Operating Information No. 621.

University of Tennessee Center for Industrial Services. 1994. Cleaning the Air on Clean Air – Strategies for Perc Drycleaners. Knoxville: The University of Tennessee Center For Industrial Services.

U.S. Environmental Protection Agency. 1994. Perchloroethylene Dry Cleaning Facilities – General Recommended Operating and Maintenance Practices for Dry Cleaning Equipment. Research Triangle Park: office of Air Quality Planning & Standards, EPA-4531R-94-073.