GENERAL RECOMMENDED OPERATING AND MAINTENANCE

1.0 INTRODUCTION

On September 22, 1993, the United States Environmental Protection Agency (EPA) finalized the national emission standards for hazardous air pollutants (NESHAP) for perchloroethylene dry cleaners (58 FR 49354). This regulation set standards for the reduction of perchloroethylene (PCE or perc) emissions from dry cleaning operations. Included in the NESHAP were requirements that owners or operators of dry cleaning machines and control devices follow their manufacturers' instructions for the proper operation and maintenance of machines and control devices. Owners or operators are required to keep a copy of any manufacturers, specifications or operating and maintenance recommendations at the dry cleaning facility.

The EPA realizes that some dry cleaners may no longer have equipment manuals for older dry cleaning machines and control devices. Owners or operators of such dry cleaning machines and control devices should make every reasonable effort to obtain these manuals. This would include contacting manufacturers, if the manufacturers are still in business, and contacting local, state, and national trade associations in an effort to locate and obtain manuals.

The purpose of this manual is to outline general recommended operating and maintenance practices for owners or operators of dry cleaning machines and emission control devices, only where efforts to obtain manufacturers, manuals are unsuccessful. This document serves only as a last resort when other information is not available. It is never to be used to supersede available manufacturers, information. This document is only if or use when manufacturers' information is completely unavailable.

Section 2.0 of this manual presents general recommended operation and maintenance practices for dry cleaning machines and auxiliary equipment. This section includes a brief description of around the basic components in dry?to? dry and transfer machine systems, along with recommended operation and maintenance practices derived from sources with expert knowledge of the dry cleaning industry. (See references I through 5 listed at the end of this document.) Section 3.0 provides similar information for control devices. Section 4.0 presents a brief discussion of some of the most common causes of PCE vapor loss from dry cleaners.

This manual is not intended to replace specific recommendations included in existing equipment operating manuals available from manufacturers of equipment. The EPA strongly recommends that dry cleaners obtain equipment operating manuals for each machine and control device they operate, if such manuals are available from the manufacturers.

2.0 PROPER DRY CLEANING EQUIPMENT OPERATION AND MAINTENANCE

Two basic types of dry cleaning machine are discussed in this section: dry?to?dry machines and transfer machine systems. Specific information on the major components for each of these machine types is discussed in further detail in the remainder of this section.

Dry?to?dry machines clean and dry articles within the same cylinder (or drum or basket). Transfer machine systems clean and dry articles in separate machine cylinders. The remaining components of the two dry cleaning machine systems are the same. These components are as follows: heating and condensing (cooling) coils, button trap, fan, water separators and lint traps.

During the wash cycle on either machine, the machine cylinder is filled with soiled garments and then filled with PCE. Then the machine cylinder usually rotates clockwise and counterclockwise to clean garments. During extraction, the cylinder rotates at a high rate of speed, forcing excess PCE from the garments through the perforated cylinder.

The difference between dry? to?dry and transfer machine systems is that, in a dry?to?dry system, the garments remain in the same machine for drying, whereas in a transfer machine system the wet garments must be transferred to another machine for the drying process.

Heating and condensing coils are associated with the drying (reclaiming) phase of the process. For dry?to?dry machines, the drying step occurs in the same cylinder as does the washing step and for transfer machine systems it occurs in a separate machine from washing. During the drying cycle, hot air (from heating coils) is passed over the garments, volatilizing (evaporating) liquid PCE remaining in the garments. This air stream is then cooled by the condensing coils, condensing PCE vapor out of the air stream. The air stream is then reheated and recirculated over the garments. Condensing coils can utilize either water or a refrigerant as the means for cooling the circulating air. Older dry cleaning systems are more likely to use water?cooled condensing coils.

PCE overflowing from the dry cleaning machine cylinder during the wash/drain/extract cycle flows through a button trap before reaching the pump. The button trap contains a strainer and keeps buttons, pins, lint, and other small items from reaching the PCE tank, filters, and pump.

A fan provides power to circulate heated air through the machine cylinder to evaporate PCE from clean, wet garments. Complete drying of garments and articles depends on proper operation of the fan, as well as proper temperatures and properly cleaned heating and cooling coils which will provide positive air flow.

Lint filters are located in several places in the dry cleaning machine system. Each machine has lint collection points before the PCE pump (button trap,) in the machine cylinder air flow system (prior to the heating and condensing coils) used for drying the clothes, and if used, there should be a collection point before the carbon adsorber. Some pumps have their own lint and foreign object strainer.

The proper operation and maintenance of dry cleaning machines is important to reduce PCE loss. In addition to checking for leaks and mechanical failure of the equipment mentioned above, correct operational procedures can also reduce PCE liquid or vapor loss. Proper operational procedures include, correct weight loading of the machine, adequate drying temperature, sufficient drying time, adequate cooling water or refrigerant temperature! proper water separation and adequate air flow. These procedures are discussed in greater detail in section 4.0.

2.1 Maintenance of Machine Components

Table 1.0 provides a summary of recommended maintenance practices for dry cleaning machine components. The remainder of this section discusses those practices in more detail.

Dry?to?dry machine cylinder. Although dry?to?dry machines wash and dry garments in one cylinder, potential PCE emissions can come from many sources which include the cylinder, leaking door and other gaskets and the unloading of garments that are not adequately dried (reclaimed.) Liquid and vapor PCE leaks should be detected and repaired during a weekly inspection program. If a liquid leak is detected, the seal should be replaced immediately since significant PCE loss can occur. Vapor leaks can sometimes be detected by running a finger along the entire perimeter of the door seal while the machine is operating or by placing a liquid bubble solution around the door seating and looking for bubbles. An electronic halogen leak detector is capable of locating vapor leaks that other methods might miss.

Vented dry?to?dry machines and dryers (those with add?on refrigerated condensers or carbon adsorbers) have exhaust dampers to control the flow of hot air. These exhaust dampers should be checked monthly to ensure they are functioning properly. This can be accomplished by placing and sealing a collapsed, inflatable plastic bag over the ductwork used to vent the dry?to?dry machine at point downstream f rom, the direction of flow past the exhaust damper. If the exhaust vent outlet can not be used, some minor modifications to the ductwork may need to be made, such as drilling a small, resealable test hole (resealable with a leak proof plug or tape) in the ductwork or the addition of new ductwork and/or a

TABLE 1. MAINTENANCE SCHEDULE FOR DRY CLEANING EQUIPMENT

COMPONENT	FREQUENCY	MAINTENANCE PROCEDURE
Machine Component		
Dry-to-Dry machine cylinder	weekly	leak check of door seatings and gaskets
	monthly	leak check of exhaust damper (vented machines)
Transfer washer/extractor	weekly	leak check of door seatings and gaskets
Transfer dryer/reclaimer	weekly	leak check of door seatings and gaskets
	monthly	leak check of exhaust damper
Heating and condensing coils	monthly	check for lint build up
	annually	clean coils
Button trap	daily	clean strainer
	weekly	check lid for leaks
Fan	annually	check for lint buildup and need for lubrication
Lint traps	daily	clean lint bag
	weekly	dry clean or launder lint bag
	monthly	check ductwork for leaks
	monthly	check lint build up on temperature probe
AUXILIARY EQUIPMENT:		
Filters	*	clean and change filters (filters drained and muck stored in sealed container)
Distillation unit or	weekly	leak check of seals and gaskets
Muck coker	semi-annually	clean steam and condensation coils if necessary
Water separator	weekly	clean separator tank
	monthly	check vent
CONTROL DEVICE:		

External refridgerated condenser	daily	clean any lint filters in air stream
	weekly	measure temperature on exhaust for dry-to-dry machines/transfer dryer reclaimer, measure temperature on inlet and exhaust for transfer washer
	weekly	leak check of seals, gaskets, and diverter valve
	monthly	check refridgerant coils for lint build up
	annually	clean refridgerant coils
Carbon adsorber	daily or before saturation	desorb
	weekly	measure concentration of PCE in exhaust air stream or in machine drum
	daily or accordingly	clean all lint filters
	monthly	leak check of gaskets and ductwork

Clean and change filters according to manufacturer or media supplier's specifications or recommendations. If unavailable, see Attachment A.

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manual damper f or the testing. The plastic bag is placed and sealed over the test hole during the beginning portion of the drying cycle. During the beginning portion of the drying cycle, the vent to the control device should not be in use, but should be shut off with the exhaust damper. To test to see if the exhaust damper is leaking, the plastic bag is placed over the exhaust outlet vent or test hole to see if it will inflate. if it inflates, then there is a leak and the exhaust damper will need to be repaired. It is common to find these dampers stuck in a position that does not allow them to close all the way and thus leak. Dampers are also known to wear and will need parts repaired so that they will seal properly again.

Transfer washer/extractor cylinder. Potential emissions from

the washer cylinder come from leaking door gaskets. Liquid PCE leaks and leaks from door seatings and gaskets should be detected and repaired during a weekly inspection program. These leaks should be detected in the same manner as discussed above for leaks from the dry?to?dry machine cylinder.

Transfer dryer (reclaimer As with the washer cylinder, one source of potential PCE emissions from a dryer (reclaimer) is through leaking gaskets on the door. These leaks should be detected in the same manner as discussed above for leaks from the dry?to?dry machine cylinder. In addition to leaking door gaskets, a main source of potential PCE emissions for dryers is through intake and exhaust dampers on exhaust systems. The machine damper gaskets should be checked monthly to ensure proper operation. It is quite common for these dampers to "stick" in a partially open position and not completely close. As a result, it is very important to check the operation of the damper and its closed position very closely to ensure the damper swings freely and closes completely when not in use.

Heating and condensing coils There are several sets of heating and condensing coils typically in use at dry cleaning facilities. Coils are associated with the dry cleaning machines themselves (dryers) , distillation units, muck cookers, and add?on refrigerated vapor condensers that also become part of the reclaiming section of the dry cleaning machine. This section addresses the heating and condensing coils of the dry cleaning machines themselves. The condensing section of the dry cleaning machine is often referred to as the "reclaiming" section. Heating and condensing coils should be checked for lint build up every month and thoroughly cleaned on an annual basis. Special emphasis should be placed on the fins surrounding the heating and condensing coils. Heating and condensing coils on older tilt back dryers (transfer systems only) should be cleaned daily. (See reference 2.)

As mentioned above, the coils should be cleaned annually at a minimum. However, if the coils appear covered with lint that is difficult to remove when cleaned annually, the owner or operator should clean the coils on a more frequent basis semi?annually). Heating coils can be cleaned by blowing compressed air or steam over the coils. Condensing coils can be cleaned by brushing the coils with a stiff brush to loosen lint, then picking up the residue with an industrial vacuum, or by the us e of compressed air.

Button trap. The button trap lid and strainer need regular servicing. The strainer should be cleaned daily, and the lid checked for a vapor leak proof seal during the weekly leak inspection program.

Fan.

Lint traps. The lint trap located in the air f low system usually contains a removable lint bag or f ilter. This bag or filter should be cleaned daily and washed or dry cleaned weekly (a second lint bag or filter should be used while the first is being cleaned.) Never run a dry-to-dry machine or dryer without a lint bag or filter. Once a day the ductwork in front of and behind the lint bag or filter should be checked for lint buildup. Also, machines with heat sensor probes located under or behind the lint bag or filter should be checked for lint buildup on the probe on a daily basis.

2.2 Auxiliary Dry Cleaning Equipment

In addition to the components of dry cleaning machine systems described in sections 2.0 and 2.1 above, all dry cleaning facilities have auxiliary equipment used in the dry cleaning process. This equipment is also covered by the NESHAP and includes filters, distillation units, water separators, and pumps. Spotting and pressing activities are not covered under the NESHAP and the equipment used for these activities will not be discussed in this manual. Table 1.0 provides a summary of recommended maintenance practices for auxiliary equipment. The remainder of this section provides a more detailed discussion of this auxiliary equipment and recommended maintenance practices to prevent PCE loss.

Filters. Filters are used to remove suspended particles and dyes from the PCE. There are several types of filters used at dry, cleaning facilities. Those filters currently found at dry cleaning facilities include constant pressure powder, regenerative powder, cartridge, and spin disk filter systems (powder and powderless.) Most dry cleaning facilities currently use cartridge or disk filter systems of one type or the other. Guidelines on how to maintain proper operation of constant pressure and regenerative filter systems are provided in Attachment A, in the event manufacturers information in not available for these filters. (See reference 3.)

Distillation unit. The purpose of a distillation unit is to purify and recover used PCE to recycle it back into the dry cleaning system. Distillation units typically consist of steam and condensation coils. PCE and water retrieved from the distillation process go to a water separator. Operation and maintenance of the water separator will be discussed separately. Potential PCE loss from these units can be due to leaks in seals and gaskets, build up of still bottoms on the heating coil and improper water or steam temperatures.

Seals and gaskets in the distillation unit should be checked for leaks and repaired at least every two weeks. The steam and condensation coils for the distillation unit should be checked monthly and cleaned semi-annually to avoid lint build up. They may be cleaned in the same way as the coils used in the dry cleaning machine. Some stills do not require coil removal. The following practices are recommended to achieve optimum still performance and minimize PCE in the still residue:

- Never exceed 75 percent of the still kettle capacity, or the level recommended by the manufacturer;

- Condenser water flow should be set up countercurrent to PCE flow; and
- Keep the PCE return temperature at maximum of 320C (900F) to minimize evaporative loss through the PCE storage tanks. (See reference 1.)

Muck cooker. Older dry cleaning systems with tubular powder filtration systems (constant pressure and regenerative) use muck cookers to distill the residue from these systems. Muck cookers recover PCE from filter muck, which is a combination of water, PCE, filter powder, carbon, detergent, and soils. Muck cookers operate the same as regular distillation units, except they stir the muck in order to speed up the distillation process. Maintenance procedures for muck cookers are the same as for distillation units, except that at least annual lubrication of the motor and gear box is needed.

Water separator. Water separators partition PCE from the PCE water mixture that comes from the distillation unit, as well as any water that condenses out with the PCE in the drying process. Water, which is less dense (i.e., lighter) than PCE, floats to the top of the separator tank and drains into a covered container, and PCE sinks to the bottom, where it should be routed back to the PCE base tank or a covered storage tank.

To function properly, water separators are vented to the atmosphere. This vent can become clogged and should be checked each month. In addition, the separator tank should be cleaned weekly. It should be noted that separator water contains minor amounts of PCE and should be disposed of properly. It should not be poured down a drain or f lushed down a toilet. It should be treated as a hazardous waste. Disposal of hazardous waste is usually best accomplished through the use of an EPA licensed hazardous waste hauler. Proper disposal of separator water may be accomplished by using an evaporator, provided the separator water does not contain a layer of separated PCE.

3.0 CONTROL DEVICE OPERATION AND MAINTENANCE

The NESHAP allows for two types of control devices on machines installed prior to December 9, 1991 (1) refrigerated condensers and (2) carbon adsorbers (if installed prior to September 22, 1993). Machines installed after September 22, 1993 must install refrigerated condensers. In addition, existing major source facilities must keep their transfer machine systems inside a room enclosure and new major source dry cleaning facilities must install a refrigerated condenser and a secondary carbon adsorber.

Table 1.0 provides a summary of recommended maintenance procedures for refrigerated condensers and carbon adsorbers. Those maintenance procedures are discussed in further detail below.

Refrigerated condensers. The air stream coming from a vented dry-to-dry machine or dryer during the end of the drying cycle is directed through a refrigerated condenser and back to the machine. The condenser C001B the air stream to remove and recover PCE vapors. When the cycle is complete and the machine door is opened, most refrigerated condensers exhaust any remaining air out of the machine into the atmosphere. Some refrigerated condensers do not exhaust the air remaining in the machine. Both methods are permitted by the NESHAP, except for new major sources which must exhaust through a secondary carbon adsorber.

In addition to the temperature monitoring requirements of the NESHAP, all gaskets and seals should be checked for leaks during a weekly leak detection and repair program. All lint filters in the ductwork associated with refrigerated condensers should be cleaned on a daily basis.

Carbon adsorbers. Carbon adsorbers remove PCE from the vapor stream in a process called adsorption. During adsorption, exhaust from the machine is passed through the carbon adsorber where PCE is adsorbed onto carbon particles. PCE is removed f rom the carbon bed during a process called desorption. During desorption, steam is passed through the carbon bed, removing the PCE f rom the carbon particles. The steam and PCE then go to a condenser where the PCE is condensed out of the air stream. The PCE is routed to the base tank or a covered storage container after passing through a water separator.

The effectiveness of carbon adsorbers depends upon proper desorption. If carbon adsorbers are not desorbed properly, PCE vapor in the air stream will pass through the carbon adsorber without being adsorbed. This means that the carbon adsorber must be desorbed (or "stripped") on a regular basis. The frequency of desorption depends to a great extent upon the amount of dry cleaning performed and the concentration of PCE in the air stream. It is recommended that owners or operators determine the maximum quantity of PCE that the carbon adsorber can hold, and then desorb the carbon adsorber daily, unless the daily return of PCE from the carbon adsorber is less than 50 percent of that capacity. One way to determine the maximum capacity a carbon adsorber can hold is to check the carbon adsorber exhaust with a colorimetric detector tube. Once the exhaust reads over 100 parts per million of PCE on the colorimetric detector tube, the carbon adsorber is considered saturated. The saturated carbon adsorber should then be completely desorbed by steam desorption for one hour. The amount of PCE returned from this desorption will be the maximum quantity of PCE that the carbon adsorber can hold. (See reference 2 and Attachment B on operating and maintaining carbon adsorbers.)

In addition to the monitoring requirements of the NESHAP, all lint filters and screens associated with carbon adsorbers should be cleaned on a weekly basis. All gaskets and duct work associated with the carbon adsorber should also be included in a weekly leak detection and repair program.

A carbon, adsorber's maximum holding capacity can diminish substantially over time depending on how the carbon is used. It is recommended that owners consider replacing or reactivating the activated carbon every 5 years, as performance may degrade to the point where the carbon adsorber will allow PCE to "break through" in the carbon adsorber exhaust past the 100 ppm, limit before the next desorption. The recommended 5 year interval for replacing or reactivating the activated carbon may be more or less frequent depending on the type of use the activated carbon sees. (See reference 1.)

4.0 OTHER COMMON CAUSES OF PCE LIQUID AND VAPOR LOSS

There are many potential causes of PCE liquid and vapor loss that could occur at a dry cleaning facility. (See reference 2.) Most of these causes were discussed in the previous sections on machine and control device operation and maintenance. Other significant causes of PCE losses may be:

1. Leaking exhaust damper;
2. Improper cooling water or drying temperature;
3. Insufficient drying time;
4. Over or under loading of machine; and

Even though item (1) above, the leaking exhaust damper, was discussed under Section 2.1. above, it can not be overemphasized the need to check that the exhaust damper is not leaking. It is a well known fact that this exhaust damper has been a major source of PCE losses. Unfortunately, these exhaust dampers are usually located in difficult to get to areas of the dry cleaning plant, such as in the back of the dry-to-dry machine or dryer which is often placed against a wall, thus making repairs burdensome. Nevertheless, it is very important to repair the exhaust damper, if it is found to be leaking.

If the cooling water or refrigerant temperature is not kept cool enough, the condenser coils cannot cool the air stream enough and drying takes longer. One indication of this problem is if clothes have a PCE odor after the end of typical drying cycle. This can be a problem in summer months at dry cleaning facilities in warmer climates using water cooled condenser coils and using water cooling towers. Some potential solutions to this are: to increase drying time, to use a water chiller, or to use a city water supply during these times.

Drying temperature is important f or the same reasons as proper cooling temperature. If the temperature is not hot enough, clothes will not be dry when the cycle is completed. Care should be taken to maintain adequate steam pressure to keep the drying temperature between 140OF and 1500F.

The length of the drying cycle should be adjusted to ensure that garments are completely dry when it is finished. In addition to the two reasons mentioned in the previous paragraphs, the proper cycle length may vary according to the amount of air flow through the machine. To ensure the maximum amount of air flow in the machine, keep the steam and condenser coils and lint bags clean.

Finally, to ensure that clothes are completely dry and machines recover the maximum amount of PCE, it is recommended that machines be under loaded by at least 5 pounds, but not by more than 25 percent of the machine's capacity. (See reference 2.) Otherwise, the normal PCE losses due to running the machine will outweigh the PCE savings gained by slight under loading.

5.0 REFERENCES

1. National Task Force on the Reduction of Solvent Emissions from Dry Cleaning Facilities, Environmental Code of Practice for the Reduction of Solvent Emissions from Dry Cleaning Facilities. Draft Document prepared for the Canadian Council of Ministers of the Environment, April 1992.

2. Neighborhood Cleaners Association (NCA), Keep It Clean: Guidelines to Reduce or Eliminate Perchloroethylene Releases to the Air, Soil and Wate-r.

3. International Fabricare Institute (IFI), "An Equipment Handbook," Focus on Drycleaning, vol. 8, No. 3, July 1984.

4. Multimatic Incorporated, Owner's Manual, February, 1994.

5. Michigan Department of Public Health (MDOH), Division of Occupational Health, Drycleaning Section, Class IV Establishment Rule P.A. 368 of 1978.

ATTACHMENT A
(See reference 3.)

<u>Constant Pressure Filters</u>

Constant pressure filters are only used in powder filtration systems. The pump must run continually to keep the powder adhered to the filter. The type of constant pressure filters presently in use are rigid tube filters. The diatomite filter powder is lightweight, organic, and composed of fossil shells. The powder forms clusters, which remain porous and allow PCE to flow through while trapping soil particles. The powder built up on the tube should be cleaned off and fresh powder reapplied to the tube when the PCE flow rate decreases to 1 gallon per minute for each pound of rated load capacity to enter the wheel. This will vary depending on the amount of clothes cleaned, the size of your filter, and the size of your pump.

<u>Excessive Filter Pressure</u>

Excessive filter pressure is a common problem. The causes of excessive pressure include the accumulation of muck in the filter to a point above the manifold, which reduces the filtering area, PCE in poor condition, nonvolatile residue which causes slime to deposit on the filter plate if the filter is drained and not refilled, damp filter powder, and improper precoating or insufficient precoat. All powder should be kept in a dry place to avoid absorbing moisture. Determine the correct amount of filtering powder for your filter by using either the filtering area. For example, 1 and 1/2 pounds per 10 square feet of filtering area for precoat and at least 1/2 pound per 100 pounds of clothes to provide a sufficient amount of powder in the PCE to maintain the filter coating. Rigid tube filters need at least 4 1/2 pounds of powder per 1,000 gallons per hour rated flow, or

30 square feet of filtering area for a good precoat.

Loss of Precoat

Some common causes for loss of precoat are back pressure, air in the filters, and obstructions or air leaks in the inlet line to the pump that result in uneven settling of the filter powder. Slipping pump belts or badly worn tubes could also be reasons for the loss of precoat.

Regenerative Filters

Regenerative filters are the most widely used powder filters. They consist of flexible tubes that are constructed of braided metal wire, metal helical springs, or braided knit fibers. Two and one-half pounds of powder per 10 square feet of area are used to precoat regenerative filters since no body feed is needed. Regenerative filters do not require body feed as constant pressure filters do since the precoat is bumped off after each load and is reapplied to the tube before the next load. The chief advantage of regenerative filters is that they do not require as much filter area as constant pressure filters. Only 60 square feet is needed for a 100 pound washer using a regenerative filter, compared to 150 square feet for a constant pressure filter. The braided wire tubes in regenerative filters can become crimped during the bumping operation, leaving holes in the tubes which result in leakage. Damaged tubes allow powder and carbon to pass through the filter and muddy the PCE. Correct this by repairing or replacing damaged tubes. When you see carbon or powder in the load, or your filter isn't working well, inspect the filter for holes. Replace the filter if you discover holes. Tubes can also become clogged. If the PCE flow is not continuous, air may enter the filter and the precoat may be dislodged, allowing soil, powder, or carbon to enter the washer and cause high redeposition. There must not be any interruption of PCE flow after precoating and while PCE is flowing into the washer. Always be sure the tubes are seated properly. You may be able to correct this condition by backwashing. If not, remove the tubes and clean them with trisodium phosphate. A-2

Liquid Leakage

Look for the brown residue of PCE soluble nonvolatiles on the under side of fittings as a sign of leakage in pipe fittings, welds, elastomers, and plastic hose connections. Loose pipe connections are generally caused by wear, normal expansion and contraction created by temperature, and vibration of equipment. Check connections, unions, and couplings as soon as they start to leak. When required, replace the packing on the valves. Loss from pipe fittings can be considerable. PCE dripping at the rate of one drop per second means losing a gallon of PCE in an eight hour work day. Routine checkups with a halide leak detector can detect vapor losses before they become leaks.

Cartridge Filters

Cartridge filters require less maintenance than regenerative or constant pressure filters because you don't have to worry about precoating or body feed. The filters come in a range of sizes, and use various filtering media. Because cartridges are changed routinely, manufacturers' information for cartridges is always readily available and should always be used.

Standard Cartridge

Standard-sized (7 3/4 in. diameter and 14 1/4 in. high) cartridges are made using various media for filtering. Carbon core cartridges remove both insoluble soil and color. They have a normal lifespan of approximately 1,000 pounds per cartridge, depending on the type of work being processed and the amount of soil, moisture, and lint it contains. All-carbon cartridges primarily remove color.

Adsorptive Cartridges

Adsorptive cartridges, 13 1/2 in. diameter and 18 in. high, contain more activated clay and carbon. A later development cut the height of these cartridges in half (9 inches) which makes them easier to handle.

Adsorptive cartridges are designed to remove insoluble soil and nonvolatile residue along with the color. Most full-sized adsorptive cartridges are built to process 2,000 pounds before being replaced. (Half-sized cartridges or "splits" are made to process 1,000 pounds before being replaced.) Don't exceed this recommendation because the cartridges ability to remove nonvolatile residue may be exhausted before a pressure rise indicates its capacity for insoluble soil has been reached.

Changing Cartridges

Change cartridges either by pounds cleaned or by pressure increase as recommended by the manufacturer and according to manufacturer's instructions. Change cartridges that are to be changed at a specific pressure (or pressure increase over the original) according to instructions. Never let the pressure exceed 40 pounds per square inch. Exceeding this pressure may force soil through the filter and rupture it. If PCE starts to become too dark or streaks and swales appear, change cartridges or increase your distillation rate. Otherwise, change cartridges according to the manufacturer's instructions.

Make sure gaskets or felt washers used between the cartridges are seated properly. Damaged gaskets or ones used too long can allow soil to leak out. Some all-carbon cartridges take a different sized gasket than other cartridges made by the same manufacturer. Read the manufacturer's instructions carefully. Replace gaskets frequently.

Excess moisture or poorly dispersed moisture in the filter will cause a rapid increase in pressure. The same result may occur when some water repellents or fabric finishes are removed from fabric by the PCE and carried over into the filter.

A new set of cartridges will often leak insoluble soil and/or carbon until several loads have been cleaned. Run only dark loads until this leakage stops.

Inspect new cartridges for physical damage before installing them. They are rarely damaged, but the few minutes it takes to inspect them is worth it.

ATTACHMENT B
(See reference 2.)

Operating and Maintaining Carbon AdsorberChanging Cartridges

Operator maintenance is all important with carbon adsorption. If a carbon adsorber is in poor repair or not desorbed frequently enough, it can be a useless piece of equipment.

The lint screen must be cleaned regularly or it will clog and block the air flow that must exhaust from the vented dry-to dry machine or dryer.

Be sure that the damper that restricts steam from entering the adsorber does not leak. If it does, the carbon bed will become wet and not adsorb PCE vapor.

You should restrict desorption (steam stripping) to a maximum of 60 minutes, whether or not PCE is still returning. It is extremely important to dry out the adsorber for at least 15 minutes after desorbing. If water remains in the carbon bed, it cannot adsorb PCE.

After an undetermined period, the carbon bed may become coated (contaminated) with petroleum distillates or other products that may enter the air stream. It will then adsorb reduced quantities of PCE. At that time, you may want to try an extended (all day) steam stripping at the highest possible steam pressure. If that does not burn off the contamination, the carbon bed may have to be replaced.

Most important, the carbon adsorber must be desorbed as frequently as necessary, often daily. If you don't desorb on schedule, escaping PCE will pass through the adsorber into the outside air or if you have no stack leading to the outside air, into your plant.

You determine how often to desorb by how often the adsorber fills up, not by the loads or poundage cleaned. The frequency is directly related to your personal method of dry cleaning and the condition of your reclaiming equipment. An adsorber's capacity of PCE is determined by the pounds of carbon it contains. Typical adsorber capacities are 2 gallons, 4 gallons or 6 gallons.

To establish a desorption schedule, begin by desorbing (stripping) every day. If your capacity is 4 gallons and every day produces less than 2 gallons but at least 1/2, strip every second day. If the stripout produces more than 2 gallons, strip every day. If the stripout produces 4 gallons every day, you must strip twice daily or better still, determine why so much PCE is getting to the adsorber and remedy the problem. If you get back no more than one gallon daily, strip the carbon adsorber every third day.

Use simple arithmetic to determine the proper schedule for your carbon adsorber. Remember to base your calculations on the PCE capacity of your own adsorber.

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c. COSATI Field/ChuaP
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