# WASTE SOLVENT RECOVERY

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## 1.0 SCOPE

Solvent recovery systems vary widely in size, complexity, and operation. This data sheet provides fire and explosion protection recommendations for the two most common systems in use: (1) recovery of solvents from waste liquids using distillation systems, and (2) recovery from waste vapor streams using fixed bed adsorbers. The most common adsorber bed is activated carbon, which is referred to frequently in this data sheet. This data sheet, however, also covers adsorbers that use alternative bed materials such as zeolites or polymers.

This data sheet does not cover rotating carbon drums or fluidized bed adsorbers.

Occupancies such as printing plants, food manufacturing, and pharmaceutical secondary plants, among others, may have waste solvent recovery systems. These waste solvent recovery operations present explosion and/or fire hazards greater than the primary manufacturing operation.

Chemical processing plants (including solvent extraction plants) and distilleries also have waste solvent recovery systems. However, these solvent recovery operations present an equivalent or lesser hazard than the primary manufacturing operation. Therefore, this data sheet does not cover high-volume distillation processes typical of the petrochemical or distilled spirits industries. Refer to Data Sheet 7-14, *Fire Protection for Chemical Plants* and Data Sheet 7-111A, *Fuel-Grade Ethanol*, for recommendations on protecting chemical and ethanol processing facilities, and Data Sheet 7-74, *Distilleries,* for distilled spirits.

### 1.1 Changes

**April 2025.** Interim revision. The document was reaffirmed to be technically correct. Minor editorial changes were made.

## 2.0 LOSS PREVENTION RECOMMENDATIONS

### 2.1 Introduction

#### 2.1.1 Ignitable Liquid Hazard Scenario

FM defines an ignitable liquid as any material that, in its normal state, is a liquid and will burn. If the liquid can be ignited and will sustain combustion, it creates a specific hazard and must be treated accordingly. This applies to solvents and their associated vapors that are recovered by distillation or using carbon bed adsorbers.

The consequences of an upset condition in a solvent recovery operation are dependent on a number of factors, including the following:

- The quantity of solvent involved
- Use conditions (e.g., temperature, pressure, flow rate)
- Equipment/piping arrangements (e.g., welded, flanged fittings)
- Equipment/pipe location (e.g., indoors, outdoors, at grade, on a mezzanine, in a cutoff room, in a production hall)
- Equipment/pipe construction (e.g., steel, glass, plastic)

Regardless of the quantity of solvent in the system, it is important to control any release, limit the size of the possible pool area, and prevent ignition of the liquid. Fire severity will be minimized if the solvent can be contained within the equipment (equipment fire exposure) or limited to a small footprint on the floor (e.g., through the use of curbs to contain the release). If the ignitable liquid is released from the equipment and forms a large pool, there is the potential for a fire that will operate all exposed sprinklers.

The consequences of a fire involving a waste solvent recovery system will also be driven by the surrounding occupancy. A highly sensitive occupancy may not be able to tolerate even a few gallons (liters) of burning solvent. On the other hand, a generally noncombustible occupancy with robust construction features may be able to tolerate a significantly larger liquid fire without severe damage.

Recommendations for passive and active fire protection features will vary depending on the severity of the potential fire hazard. The intent of this data sheet is to limit the amount of ignitable liquid that can become involved in a fire.

2.1.1.1 Apply the recommendations in this data sheet to solvent recovery stills processing quantities of 5 gal (19 L) or more of solvent in a single vessel.

### 2.1.2 Explosion Hazard

2.1.2.1 A room/building explosion hazard exists for solvent distillation systems and carbon bed adsorbers when any of the following is true:

A. The ignitable liquid is processed at or above its atmospheric boiling point, and has a closed cup flash point at or below 425°F (218°C).

B. The ignitable liquid has a boiling point at or below 100°F (38°C).

C. The liquid contains nitrocellulose.

Additional information on the evaluation of room explosion hazards is located in Data Sheet 7-32, *Ignitable Liquid Operations.*

2.1.2.2 Vacuum Stills

A solvent recovery still that is operated under vacuum represents a potential ignitable liquid fire hazard. However, the intent of operating a distillation process under vacuum is to lower the boiling point of the solvent. As such, a properly designed vacuum still, in which the vapor in the still is below its atmospheric boiling point, does not present a room explosion hazard unless the liquid has a boiling point at or below 100°F (38°C) or contains nitrocellulose.

## 2.2 Construction and Location

2.2.1 Isolate solvent recovery stills and carbon bed adsorber tanks from surrounding occupancies in detached buildings or fire-rated cutoff rooms designed to contain the potential fire and liquid release. Adhere to the design guidance in Data Sheet 7-32, including the following:

A. Location of the waste solvent systems and associated equipment, piping, and pumping systems

B. Design and construction of cutoff rooms, detached buildings, and/or exterior recovery processes

C. Containment and emergency drainage (or alternatives to emergency drainage)

D. Damage limiting construction (per Data Sheet 1-44, *Damage-Limiting Construction*) where a room explosion hazard exists per Section 2.1.2.

2.2.2 Ensure ducts that convey solvent-laden air to recovery systems are made of metal or other noncombustible material, or FM Approved ducts are used. When exterior insulation is provided on duct systems, use noncombustible or FM Approved Class 1 materials. Refer to Data Sheet 7-78, *Industrial Exhaust Systems,* for additional details on the construction and location of ductwork.

## 2.3 Protection

### 2.3.1 General

2.3.1.1 Protect rooms or buildings containing solvent distillation systems, and any other areas containing ignitable liquids, in accordance with Data Sheet 7-32.

2.3.1.2 Protect ducts carrying solvent-laden air to recovery systems per Data Sheet 7-78.

2.3.1.3 Protect outdoor stills or tanks with an automatic water spray system designed in accordance with Data Sheet 4-1N, *Fixed Water Spray Systems for Fire Protection.*

### 2.3.2 Carbon Bed Adsorbers

2.3.2.1 Provide protection against a potential fire in adsorber beds as follows:

A. Provide automatically actuated, overbed fixed deluge water spray nozzles inside the adsorbers to wet down the bed in the event of overtemperature or fire. Provide a minimum density of 0.3 gpm/sq $ft^2$ (12 mm/min) of projected bed area. Do not use underbed flooding since this may cause solvents to float and put the upper volume of the vessel within the explosive range.

B. Design the adsorber vessel and its supports and foundations to be capable of withstanding the weight of the water filled vessel.

C. Unless the vessel is capable of withstanding the maximum available pressure from the water spray system, provide a drain line equipped with an automatic opening device or liquid relief valve. Design the drain line to be a minimum of 2 in. (5 cm) in diameter and as straight as possible to minimize plugging by loose wash carbon.

D. Equip the vessel with sufficient venting capabilities, such as pressure relief devices or automatic opening vents, hard piped to a safe location outside important buildings, to account for any pressure increase resulting from discharge of the water spray system.

2.3.2.2 Automatically actuate the deluge system by one of the following:

A. An increase in the carbon monoxide (CO) levels over the bed.

1. Locate the sampling points in both the clean air exhaust duct (for detection when the unit is in the adsorption mode) and the adsorber proper (for detection at all other times).

2. Most adsorbers will develop a background carbon monoxide level. The specific background level will vary and may be determined by experience for the particular installation. This level may be negligible, but also may be as high as 3000 ppm. Set the alarm point for the detector 50% higher than the background level. Set the trip point for system shutdown and automatic operation of the water spray system 100% above the background level.

B. Actuation of line-type heat detection installed within the bed.

1. Install the detector wire to provide complete coverage, frequently winding it back and forth within the bed so no more than a 1 ft$^2$ (0.1 m$^2$) fire can develop prior to detection. Refer to Figure 2.3.2.2-1 for an example of this heat detector spacing.

2. Refer to Data Sheet 5-48, *Automatic Fire Detection,* for additional installation guidelines.

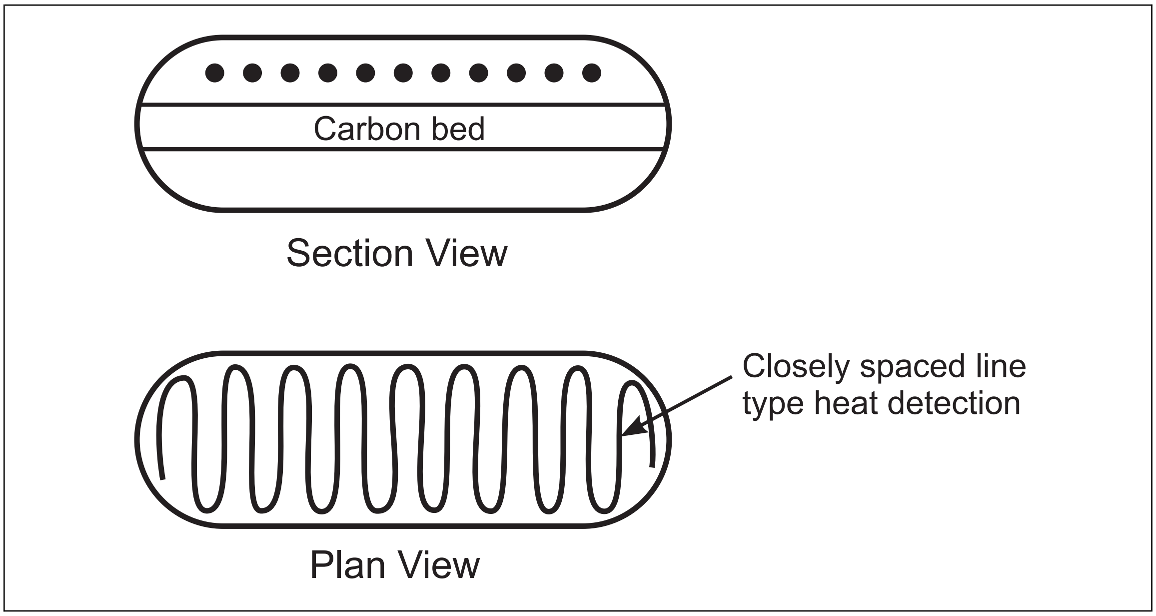

*Fig. 2.3.2.2-1. Example of carbon bed heat detector spacing*

## 2.4 Equipment and Processes

### 2.4.1 General

2.4.1.1 Provide areas containing solvent distillation systems and carbon bed adsorbers with ventilation systems in accordance with Data Sheet 7-32.

2.4.1.2 Design and install all heating equipment, measurement and observation instruments, piping systems, and transfer systems in accordance with the recommendations in Data Sheet 7-32. Provide automatic safeguards and interlocks arranged to shut down all ignitable liquid and flammable vapor flow in and to the impacted area in the event of a fire.

2.4.1.3 Ensure a continuous supply of cooling water for condensers by providing any of the following instrumentation:

A. Cooling water pressure or flow sensor (measured on downstream side of the condenser)

B. Cooling water pump running indicator

C. High-temperature sensor on the solvent discharge line from the condenser.

Should cooling water be lost or other adverse conditions exist, arrange for an alarm to automatically sound to warn operators, and shut off heat to the still or shut down the steam supply for desorption, as applicable.

### 2.4.2 Solvent Distillation Systems

2.4.2.1 Provide the following safeguards for solvent stills and equipment:

A. Design and construct pressure vessels in accordance with applicable codes, standards, and local laws and regulations.

B. Equip stills with vacuum and pressure-relief devices hard-piped to a safe location outside important buildings. In addition, pipe any condenser vents to a safe location. Terminate the vents at least 20 ft (6.1 m) above ground and 6 ft (1.8 m) above roof level, and located so vapor will not reenter the building. Equip vent terminals with flame arrestors.

C. Provide dirty and clean solvent tanks and the still vessel with high- and low-liquid level switches interlocked to stop solvent pumps and sound an alarm when adverse conditions occur.

D. Provide the still with a high-temperature sensor, independent of any process controls. Interlock the sensor to sound an audible alarm and shut off the heating supply if temperature exceeds 50°F (28°C) above the normal operating temperature of the unit.

E. For steam-heated stills, provide a pressure-relief valve on the steam supply downstream of the reducing valve with a setting of 5 to 10 psi (0.3 to 0.7 bar) above the normal operating pressure. The relief valve may be omitted if the steam heating system is designed for a working pressure at least equal to the maximum main line steam pressure upstream of the reducing valve.

F. Provide FM Approved continuous sampling combustible gas detectors in still rooms that are not constantly attended, to provide early warning of a flammable vapor or ignitable liquid leak. Locate detectors at floor level, below and within 2 ft (0.6 m) of the still vessel. Arrange detectors to sound an alarm at 10% of the lower explosive limit (LEL), and to safely shut off the process at 25% of the LEL.

G. For solvent recovery stills operating under vacuum, provide an interlock to automatically shut down the process upon loss of vacuum.

H. Arrange the equipment for remote manual shutdown in the event of a fire or leak.

### 2.4.3 Nitrocellulose

Design solvent recovery stills processing nitrocellulose-laden inks and solvents as follows:

A. Design the waste still pot to minimize the buildup of nitrocellulose sludge. A steep cone design, for example, will minimize the accumulation of dried nitrocellulose residue and will be less prone to developing hot spots.

B. Provide a means of continually agitating the waste still pot, such as scrapers, to prevent the accumulation of residue on the sides of the pot. Design the agitation system and use materials to prevent sparks.

C. Provide a temperature sensor within the waste still pot designed to alarm if the temperature within the still is at or above 194°F (90°C), and to shut down the distillation process and agitating equipment at 212°F (100°C).

### 2.4.4 Carbon Bed Adsorbers

2.4.4.1 Maintain flammable vapor concentration entering adsorbers below 25% of the LEL. The normal concentration may be 50% of the LEL if FM Approved continuous vapor concentration indicator/controllers are provided, as follows:

A. Design and install the system in accordance with Data Sheet 5-49, *Gas and Vapor Detectors and Analysis Systems.*

B. Design the system to sound an alarm prior to reaching 50% of the LEL. Automatically shut down the equipment at no more than 50% of the LEL.

2.4.4.2 Monitor for potential overheating of the carbon bed using one or both of the following methods:

A. Carbon monoxide (CO) monitoring within the bed (refer to Section 2.3.2.2.A).

B. FM Approved temperature sensing and recording devices on the inlet and outlet of the adsorption vessel.

2.4.4.3 Minimize the possibility of spontaneous heating during the desorption phase as follows:

A. Maintain at least 75% of the normal airflow through the carbon bed when not steaming.

B. Program the desorption phase so the steaming is extended and the drying/cooling phase is completed just prior to the start of the next adsorption phase, with the performance goal of allowing the carbon bed to remain wet through most of the desorption phase.

2.4.4.4 Desorb, cool down, and seal the units prior to night and weekend shutdowns. Keep any installed monitoring devices and automatic water spray systems operational during shutdowns.

2.4.4.5 Idle Periods

2.4.4.5.1 To minimize the possibility of spontaneous heating during extended shutdowns, do one of the following:

A. Maintain the airflow at a minimum of 75% of normal.

B. Remove the carbon.

C. Keep the bed wet (saturated) by periodically spraying it with water or steam.

D. Inert with nitrogen or carbon dioxide so the oxygen content inside the units, including the void spaces in the beds, does not exceed 1% by volume.

2.4.4.6 Ensure a continuous supply of steam for desorption by providing appropriate instrumentation (e.g., pressure sensor, temperature sensor, flow sensor). Should steam be lost or other adverse conditions exist, automatically shut down the equipment and sound an alarm to warn operators.

2.4.4.7 Do not use superheated steam for desorption.

2.4.4.8 Design adsorbers to provide even distribution of air through the carbon bed.

### 2.5 Operation and Maintenance

2.5.1 Operate, maintain, test, and inspect all equipment in accordance with Data Sheet 7-32 and the equipment manufacturer's instructions. Establish a complete preventative maintenance program designed to ensure equipment is operating as it has been engineered to operate. Refer to Data Sheet 9-0, *Asset Integrity*, to evaluate existing programs or as a guide to developing a new one.

2.5.2 Review carbon bed adsorber temperature charts on an ongoing basis (e.g., at least daily by operating personnel and weekly by supervisory personnel as a check on operating procedures and conditions) to observe real-time temperatures and any trends in the data. For adsorbers operating on single or double shift schedules, check temperatures at the start and at the end of each shift.

2.5.3 Where nitrocellulose-laden inks or solvents are recovered in a continuous process, inspect the waste still pot at regular intervals for the formation of nitrocellulose deposits. The interval between inspections will depend upon the accumulation rate.

2.5.4 Where nitrocellulose-laden inks or solvents are recovered in a batch process, clean the waste still pot following each batch.

2.5.5 Maintain and test all system safety interlocks in accordance with manufacturer recommendations or at least quarterly. Maintain records of these tests.

2.5.6 Develop and implement a formal operator audit procedure to ensure compliance with established standard operating and emergency response procedures. Conduct these audits at least semiannually.

2.5.7 Conduct a full review of all planned changes (e.g., changes to the bed material in an adsorber system) before the changes occur.

2.5.8 Post critical procedures for proper operation and shutdown of the equipment under normal and emergency conditions. Post them in a place easy to access for reference purposes.

### 2.6 Training

2.6.1 Train operators in the hazards of the process, and develop safe standard operating procedures and emergency response plans in accordance with Data Sheet 7-32.

### 2.7 Contingency Planning

2.7.1 Where solvent recovery operations are critical to maintaining primary operations, implement a contingency plan to allow recovery processes to continue. At a minimum, include the following:

A. Provide redundant recovery systems

B. Ship waste solvent to other facilties

C. Rent temporary equipment, such as carbon beds

### 2.8 Ignition Source Control

2.8.1 In areas containing solvent distillation systems and carbon bed adsorbers, control ignition sources in accordance with Data Sheet 7-32. At a minimum, include the following:

A. Install FM Approved hazardous location-rated electrical equipment in accordance with Data Sheet 5-1, *Electrical Equipment in Hazardous (Classified) Locations,* and national or local codes.

B. Electrically bond and ground equipment in accordance with Data Sheet 5-8, *Static Electricity,* Data Sheet 5-19, *Switchgear and Circuit Breakers* and Data Sheet 5-20 *Electrical Testing*. Proper grounding and bonding of equipment reduces the potential for buildup of electric charge on separated pieces of equipment due to static accumulation or stray electric currents.

C. Implement hot work controls per Data Sheet 10-3, *Hot Work Management.*

## 3.0 SUPPORT FOR RECOMMENDATIONS

### 3.1 General

Because of environmental concerns, difficulty of disposal, and high product value, users of solvent-based materials may employ in-house recovery of solvents. Solvent recovery systems are commonly used in printing and coating facilities where solvent is recovered from waste printing or coating solutions and/or vapors are collected from ovens and dryers. Because printing and coating are part of many manufacturing operations, solvent recovery is widespread and is increasing. It is also prevalent in the chemical, semiconductor, aircraft, automotive, pharmaceutical, textile and industrial dry-cleaning industries.

### 3.2 Solvent Distillation Systems

#### 3.2.1 Process Description

Recovery from waste liquid products is done primarily by purification in small package stills. In the process, waste solvent-laden material is batch or continuously loaded into the still where it is heated at or above the boiling point of the solvent (note that for distillation systems operating under vacuum, this operating temperature will be below the atmospheric boiling point). The vaporized (purified) solvent is condensed by water cooling and sent to storage for reuse. Residual still bottoms (liquids and sludge mixtures) may be further processed or discarded. (See Figure 3.2.1-1)

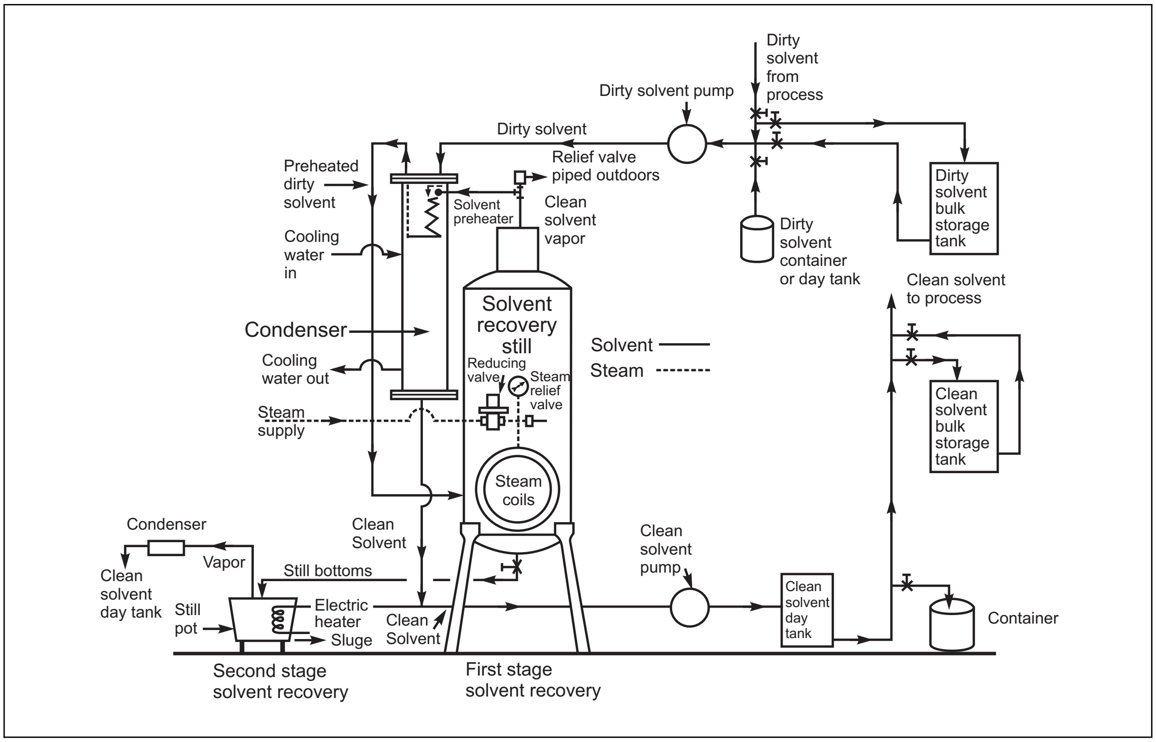

*Fig. 3.2.1-1. Steam heated/water condensing solvent recovery process with second stage electrically heated bottoms purification still (alternate methods of handling and transferring clean and dirty solvents are shown; one or more of these methods may be used for a given recovery operation)*

Smaller stills are designed to process waste materials directly from a drum or smaller nonpressurized container. The drum or container is placed inside an enclosure and connected by the operator to the still, which is in an adjacent enclosure. Reclaimed solvent is captured in another drum or can. The entire system may occupy less than a few square feet in area and may be portable.

Larger volume operations usually involve fixed processing equipment. Waste material is received via permanent piping from underground tanks or from portable tote bins located in the still room or in nearby ignitable liquid rooms.

Solvent capacity of package stills may vary from less than 1 gal (3.8 L) to several hundred gallons in volume.

Stills may be heated by steam, electricity, or heat transfer fluid. Normally, recirculated water cools the still. Refer to Figure 3.2.1-1 for an example of a typical package still using steam as the first stage heating medium and electric heat for a second stage bottoms purification.

### 3.2.2 Hazards

Both fire and explosion hazards exist with solvent distillation. If the solvent is being boiled above its atmospheric boiling point, a room explosion could occur if boiling solvent or vapor is released from the vessel and ignited. A leaking gasket, mechanical damage, or overpressurizing the vessel could cause such a release. If buildings or rooms are not specifically designed to the hazard, a fire or explosion could severely damage important process equipment, causing an extended production outage.

### 3.2.3 Vacuum Stills

Vacuum systems are typically used when the boiling point of the solvent being recovered is high (often above 230°F [110°C]). The use of a pump to maintain the system under vacuum during operation will reduce the boiling point of the solvent. This may reduce the operating temperature of the equipment by more than 100°F (38°C), increasing the efficiency of the system and resulting in a safer operating environment.

### 3.2.4 Nitrocellulose

Some printing occupancies use inks that contain a percentage (typically less than 15%) of nitrocellulose. These nitrocellulose-laden inks are typically used in the flexible packaging industry (e.g., plastic bags for food). The nitrocellulose component serves as a binding polymer necessary for the printing operation. Although the nitrocellulose offers advantages in the printing process, it also constitutes an increased hazard under certain conditions. At the percentages typically used, the presence of nitrocellulose in the liquid ink does not create an unusual fire hazard beyond that associated with the ignitable liquid. However, the potential for rapid decomposition of the nitrocellulose when in its dry state can present a severe fire hazard and the potential for rupture of any container holding the material. Additional information on the hazards associated with nitrocellulose is provided in Data Sheet 7-86, *Cellulose Nitrate.*

As with other printing facilities, those using nitrocellulose inks will commonly employ waste solvent recovery systems. This creates the potential to concentrate the nitrocellulose in the still pot (see Figure 3.2.1-1). The contaminated sludge will have the potential to spontaneously combust if the sludge (and the nitrocellulose in particular) is overheated or dries out. Overheating in this part of the still has been reported by some printing clients.

While there is a fire and rapid decomposition hazard associated with the nitrocellulose, it is not expected that the property damage resulting from these events will be significantly greater than for a fire or explosion involving the solvents within the still. The presence of the nitrocellulose does, however, increase the likelihood of a fire or explosion occurring since there will be a potential ignition source present (based on nitrocellulose's ability to spontaneously combust). The recommendations in this data sheet are intended to limit temperatures in the sludge and prevent drying of the nitrocellulose component.

## 3.3 Carbon Bed Adsorbers

### 3.3.1 Process Description

Capture of solvent from waste vapor streams is commonly transferred to a solid adsorbant surface. Typically, this solid surface is activated carbon, although zeolites, polymers, and other materials have been less commonly used. Waste Solvent Laden Air (SLA) is exhausted by a fan system from the solvent process via ductwork into two or more vessels containing activated carbon beds. The solvent is adsorbed into the carbon while the air stream passes to atmosphere or other processing. This process is called "adsorbing" because the solvent is captured on the surface of the bed. The solvent is not "absorbed" into the bed material. Steam is used to capture the recovered solvent from the bed and carry it to a condenser. Collected solvent from the condenser is decanted from the water layer and sent for further processing or to storage.

Adsorbers are normally carbon steel pressure vessels designed to 15 to 30 psi (1 to 2 bar) working pressure. Other metals may be used for corrosion resistance. The tanks may be horizontal or vertical (see Figure 3.3.1-1).

Adsorbers will eventually reach a saturation capacity in which the material can no longer capture solvent vapor. When this limit is reached, the unit must undergo a regeneration or desorption phase. Desorption consists of steaming out the bed, followed by drying and cooling with air to prepare it for the next adsorption cycle. Steam and solvent are condensed and separated in downstream equipment. A small amount of adsorbed material is retained on the carbon.

Often, two or more adsorbers are installed in parallel. While one unit is adsorbing and removing up to 2% solvents or contaminants from an air stream, the other unit is undergoing a desorption phase. Occasionally, the time required for the desorption phase is considerably shorter than the adsorption phase; in such cases, a unit will be on standby with no air passing through it for a period of time.

### 3.3.2 Hazards

Fires have occurred in carbon bed adsorbers when operators were unaware that steam supply for desorption had failed. However, the primary hazard with carbon bed adsorbers is fire during the standby period prior to or following steaming, or soon after the adsorption phase. The fires are believed to have been caused by spontaneous heating of easily ignitable or easily decomposable materials on the very active surface of the carbon. The formation of hot spots may result from several factors:

- Inadequate preconditioning of new carbon
- Physical characteristics of the bed material, resulting in thermal instability
- Prolonged exposure of the bed to waste solvent vapor without desorption
- Adsorption of solvents subject to self heating

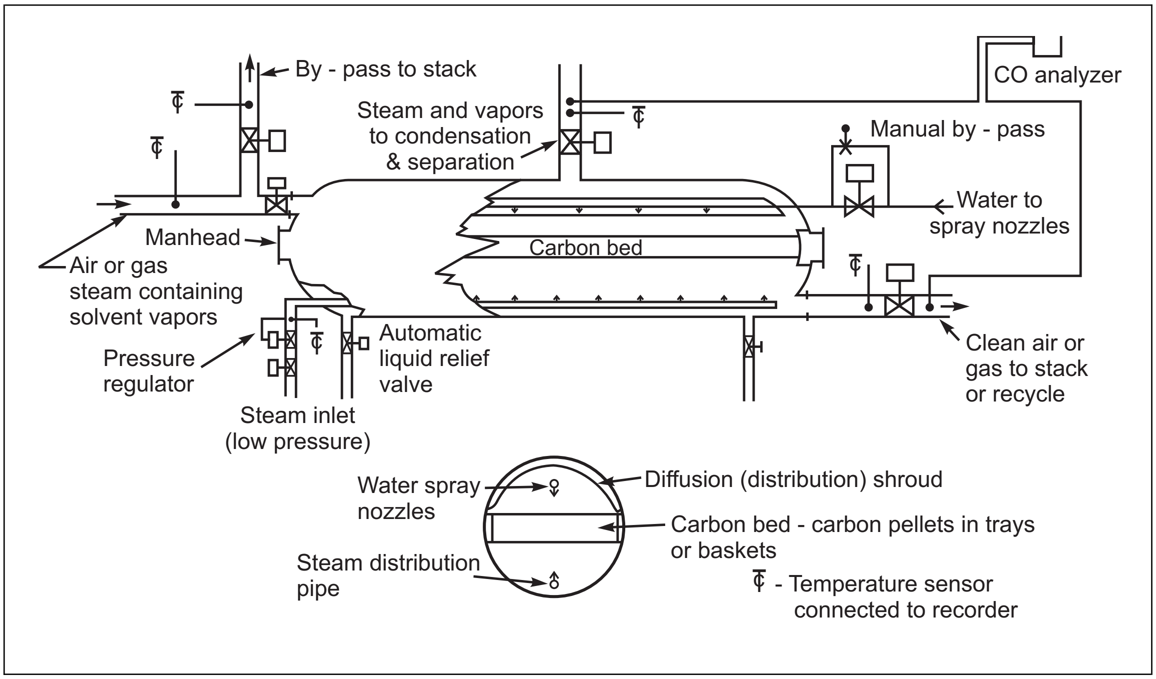

*Fig. 3.3.1-1. Typical carbon bed adsorber, usually provided in pairs. (Horizontal vessels shown; vertical vessels can also be used).*

Materials subject to spontaneous heating include ketones, aldehydes, organic acids, organic peroxides, and the unsaturated compounds of the vinyl and acetylenic type. Fires have also occurred in units with new carbon beds where solvents such as acetone, methyl ethyl ketone, and acetaldehyde (oxygenated hydrocarbons) have been used. Under quiescent standby conditions, hot spots slowly develop. Resumption of the air flow fans the hot spots to flaming combustion. Maintaining sufficient airflow during standby prevents the establishment of hot spots by removing the heat of reaction as quickly as it is generated.

Based on loss history, explosion hazards do not usually exist inside carbon bed adsorber tanks. However, a flammable vapor explosion hazard can exist inside buildings housing carbon bed tanks. For example, vapor may be released from solvent-laden air duct work or fan housings.

## 4.0 REFERENCES

### 4.1 FM

Data Sheet 1-44, *Damage-Limiting Construction*
Data Sheet 4-1N, *Fixed Water Spray Systems for Fire Protection*
Data Sheet 5-1, *Electrical Equipment in Hazardous (Classified) Locations*
Data Sheet 5-8, *Static Electricity*
Data Sheet 5-19, *Switchgear and Circuit Breakers*
Data Sheet 5-20 *Electrical Testing*
Data Sheet 5-48, *Automatic Fire Detection*
Data Sheet 5-49, *Gas and Vapor Detectors and Analysis Systems*
Data Sheet 7-14, *Fire Protection for Chemical Plants*
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-74, *Distilleries*
Data Sheet 7-78, *Industrial Exhaust Systems*
Data Sheet 7-86, *Cellulose Nitrate*
Data Sheet 7-111A, *Fuel-Grade Ethanol*
Data Sheet 9-0, *Asset Integrity*
Data Sheet 10-3, *Hot Work Management*

## APPENDIX A GLOSSARY OF TERMS

**FM Approved:** References to “FM Approved” in this data sheet mean the products and services have satisfied the criteria for FM Approval. Refer to the *Approval Guide,* an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

**Ignitable Liquid:** Any liquid or liquid mixture that will burn. A liquid will burn if it has a measurable fire point. Ignitable liquids include flammable liquids, combustible liquids, inflammable liquids, and any other term for a liquid that will burn.

## APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

**April 2025.** Interim revision. The document was reaffirmed to be technically correct. Minor editorial changes were made.

**April 2015.** The following major changes were made:

A. Revised terminology and guidance related to ignitable liquids to provided increased clarity and consistency. This includes the replacement of references to “flammable” and “combustible” liquid with “ignitable” liquid throughout the document.

B. Reorganized the document to provide a format that is consistent with other data sheets.

C. Clarified the explosion hazard associated with solvent recovery systems, placing an emphasis on room explosion hazards associated with solvent distillation and fixed bed adsorber systems.

D. Added information on solvent recovery stills operated under vacuum.

E. Added information on nitrocellulose, as well as equipment, process design, and operational guidance for solvent distillation systems processing nitrocellulose-laden inks and solvents.

F. Added guidance regarding the design of detection devices for carbon bed adsorber fire protection systems. This includes the installation of an automatically actuated fire protection system and additional guidance on various detection methods.

G. Added information relative to emergency response and operator training.

H. Added information relative to ignition source control.

**September 2010.** Minor editorial changes were made for this revision.

**January 2000.** This revision of the document has been reorganized to provide a consistent format.

**August 1997.** General information update.

**October 1986.** Expanded to a data sheet and added distillation recovery processes.

**July 1979.** Original publication as a Technical Advisory Bulletin covering carbon bed adsorbers only.