Simple Solutions Distributing LLC.

Makers Of *Wolverine Brand* Industrial Vapor Phase Adsorbers

Simple Solutions Distributing
6 Jacobs Rd.
West Milford, NJ 07480

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1-973-846-7817 (inside NJ and Outside of the US)
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Industrial Activated Carbon Adsorbers

Operation & Maintenance Manual

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Handling and Storage

1. Before proceeding with assembly read and understand these instructions.

2. Inspect all equipment when it is received. Notify the carrier and Simple Solutions Dist LLC of any damage that occurred during shipment. No material or equipment may be returned without our prior written consent. Our written reply, if granted, will contain return shipping instructions for you to follow.

3. When unloading or moving equipment, take care to prevent injury to personnel and damage to the equipment.
   a. If the equipment is on a skid, moving by lift points provided on the skid using a crane, sling and spreader bar is the recommended method for moving the unit. Only apply vertical force at the lift points.

   b. If only a fork truck is available, the forks MUST span the full length of the skid and that the skid is secured to the truck to prevent the equipment from "sliding" off the forks.

4. STORAGE: If equipment will be stored before installation.
   a. Store in clean, dry and safe area.

   b. Protect from direct sunlight. Use a reflective covering and arrange it in such a manner that air is allowed to circulate around the equipment in order to protect it from excessive heat and moisture.

   c. Cover flanges and couplings in order to prevent accumulations of dirt and moisture in the unit.

   d. Periodically rotate shafts on equipment like fans and motors in order to

      circulate the bearing lubricant to protect bearings from premature failure.

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Installation

1. The vessel must be located on a level surface able to support the operating weight of the equipment and which uniformly supports the base of the skid. The mounting surface must be free of debris in order to prevent warping of the skid and/or damage to the vessel's bottom. Bottom support should also extend beyond the outline of the vessel by at least twelve (12) inches in order to provide enough strength for anchoring.

2. Grout or shim under skid hold down flanges to prevent applying uneven stress that might "twist" the skid or stress the vessel when the anchor bolts are tightened. If the unit has NO skid and vessel is to be bolted directly to a concrete pad, tighten mounting bolts AFTER carbon has been loaded into the vessel. Be careful not to over tighten mounting bolts through Poly brackets.

3. Carbon should not be added until the entire system has been installed and checked for proper operation.

If impregnated carbon is used, it <u>MUST NOT</u> be added until the system can be run uninterrupted for five (5) days straight. This is because airflow through the carbon is required to remove heat buildup from chemical reactions. IF AIRFLOW IS STOPPED WITHIN THE FIRST FIVE DAYS OF OPERATION WITH IMPREGNATED CARBON, <u>A BED FIRE CAN RESULT</u>. Regular non-impregnated carbon has a much lower tendency to start fires and does NOT need the air flow.

The following items must be examined before start up.

a. Exhaust duct and components as well as all instruments and electrical connections must be in place and operating properly.
b. Check to see that fan motor and impeller are rotating in the proper direction and not hitting anything.
c. Start the fan with the damper <u>half closed</u>. When the fan is up to speed, adjust the fan damper to provide discharge pressure equivalent to the static pressure loss of the carbon bed (designed air flow should result). Check motor amperage. If there is no damper on the system, disregard this instruction.

<u>CAUTION</u>: Fans require the most horsepower when they are allowed to move as much air as possible. Large fans are frequently designed to rely on system static pressure loss to restrict the airflow through the fan. In such a system, running the fan disconnected from the system may cause a greater horsepower requirement than the rating of the motor. This can overload the motor and cause motor failure. DO NOT RUN THE FAN WITHOUT A LOAD.

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4. Check system for excessive vibration and air leaks.

5. Carbon may be added to the vessel at this point. Follow the procedure outlined below. **SEE CARBON WARNING BELOW**

6. CARBON INSTALLATION.
    a. Remove the vessel cover.

    b. Place the polypropylene screen and tension ring over the carbon support grate. This prevents the carbon from falling through the bed support. If there are multiple sections of screen, they must overlap adjacent sections by one-third to one-half of their width. The screen must be long enough to run up the vessel wall 4" to 6" around the entire inside circumference of the vessel. The screen should go between the vessel wall and the tension ring and can fold back onto the grate or be attached to the wall with duct tape. The screen does NOT have to be stretched tight.

    c. After the screen is properly positioned, bucket small amounts of carbon on top of the screen to hold it in place. After bottom is covered, larger amounts of carbon can be added from drums or supersacks. Use a rake or board to level the bed surface. Follow the precautions on the MSDS and use safety equipment to protect yourself from harm. Minimum equipment should include dust respirator, goggles, and chemical resistant gloves.

7. After the complete carbon charge has been loaded, close the adsorber and start up the unit according to the section on "System Start-up".

<u>IF YOU ARE USING IMPREGNATED CARBON</u> - Once loaded, air flow through a system with fresh carbon MUST start immediately and continue for at least 5 consecutive days. Fresh impregnated carbon is very reactive and generates a large amount of heat when treating contaminated air. Air flow through the carbon bed removes the heat generated by chemical reactions. If the air flow is stopped, heat producing reactions continue and bed temperature will continue to rise. The amount of heat generated can exceed the ignition point of the carbon.

<u>FIRE CAN RESULT</u>

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Principle Of Operation

Activated carbon works by the process of adsorption. Adsorption is when one material adheres to the surface of another material by means of physical and/or chemical attraction between the materials. Activated carbon is full of holes. This network of connected pores inside the carbon gives it a large surface area (approx. 1000 sq M per gm of carbon). Organic odor molecules from the air are attracted to the internal carbon surface. These contaminates accumulate on carbon's interior surface until an equilibrium level is reached between the concentration on the carbon surface and the concentration left in the air. The lower the residual concentration required in the air stream, the greater the relative amount of carbon required to achieve that level.

The capacity of activated carbon to adsorb a compound depends on several factors including air temperature, the chemicals boiling point, molecular weight, and concentration in the air stream. The mass transfer zone (MTZ) is the area in the bed where adsorption takes place. The chemicals concentration and air flow rate change the size of the MTZ. The lead edge of the MTZ has no contamination in it while the trailing edge is completely saturated (to the level of contamination in the inlet air). As the MTZ moves through the carbon bed and approaches the end of the bed, breakthrough occurs. The carbon becomes saturated with adsorbate and the contaminate can be detected in the exhaust. When the outlet concentration exceeds a specified limit the bed is spent. The carbon must then be replaced or regenerated. Samples of the carbon drawn from various levels of the bed can be tested for their remaining capacity and used to predict the remaining bed life. In this way, bed replacement can be scheduled in advance of the actual need and avoid timing problems.

Activated carbon can be impregnated with chemicals to enhance its ability to control problem contaminates. Control of acid gases such as Hydrogen Sulfide and Mercaptans is greatly enhanced by impregnation with a caustic compound. GC-IPH carbon is treated with Potassium Hydroxide (KOH) for this purpose. The KOH gives carbon the ability to chemically neutralize acidic gases and increase the volume of air able to be treated by the carbon.

For applications with high H2S concentrations, bed life can be partially renewed by a process of in situ "regeneration". The procedure soaks the bed in a caustic solution that dissolves accumulated sulfur. This process is not recommended by Simple Solutions Dist. LLC. because only a limited amount of life can be restored to the carbon.

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Use And Care Of Activated Carbon

For odor control applications, granular activated carbon that has been manufactured from coconut shell or bituminous coal is used. In some cases the carbon has also been impregnated with caustic or other inorganic materials in order to enhance its capacity for various compounds. Important physical and chemical properties of the activated carbon that is used in this application will appear elsewhere in this manual.

Activated carbon should be stored in a cool, dry, well ventilated area. While temporary outdoor storage is possible, indoor storage is recommended. Exposure to direct sunlight should be avoided. Storage of open carbon containers (especially if the plastic liner has been opened) should also be avoided since the exposed carbon will begin to adsorb vapors from the air.

Contact with skin, eyes, or mucous membranes should be avoided, especially when using caustic impregnated carbon (IPH). Dust as well as the carbon itself can be irritating. Protective clothing MUST be worn when handling the carbon. This includes use of chemical-resistant rubber gloves, full face shield, and dust mask. A material safety data sheet is located at the back of this manual for further information.

Static electrical charges can accumulate when adsorption tanks are fabricated from non-conductive materials such as FRP, PP and PE. In order to prevent electrical shock or an ignition hazard, the treatment system must be well grounded. A grounding lug is located on our metal skids or Poly vessels.

Care is required to avoid a rapid rise in bed temperatures and subsequent ignition of the carbon. Such fire hazards are usually the result of the following conditions;

1. High heat of adsorption given off by the carbon treating very concentrated vapors through the carbon bed.

2. Accumulated heat of reaction caused by oxidation of vapors during the use of impregnated carbon (IPH).

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Fires hazard can be minimized by use of the following:

1. Dilute concentrated vapors with outside air or inert gas.
2. Humidify the inlet air stream using water vapor to help carry away heat that is generated.
3. Maintain proper air flow and distribution to prevent localized heating effects and insure adequate heat dissipation from carbon bed.
4. Never shut the carbon bed down with carbon that has been in use for less than one month. If a long shut down is expected, remove all carbon regardless of time in use.

CAUTION: *Although dry in appearance, activated carbon contains 11-15% moisture by weight. Wet carbon can rapidly adsorb free oxygen from the air. Any entry of carbon vessels should follow all guidelines for confined space entry and/or depleted oxygen supply areas as established by OSHA and other state, local and federal agencies.*

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System Start-Up

1. Partially close the fan damper, if present, to restrict the air flow. Restricted air flow is required on larger systems to prevent carbon bed fluidization by large capacity fans.

2. Start the fan and adjust to the proper air flow. Flow rate can be adjusted by setting the system static pressure (2.3-2.5"wc). The damper (if present) is used to accomplish this.

3. Record initial conditions in log book.

Note: If you are starting the system up after "in situ" regeneration or after adding fresh carbon, be sure to continue operation for a minimum of 120 continuous (uninterrupted) hours to age the carbon. Do not interrupt the airflow during that time.

If airflow is stopped, fire can result

System Shut Down

1. Turn off the fan and close all dampers to isolate the vessel.

2. If the system is to be down for more than a few days, the vessel must be completely sealed to prevent any air flow. This will prevent problems caused by reactions of adsorbed products that may foul the carbon or generate dangerous amounts of heat.

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Operating Log

Simple Solutions Dist. LLC. recommends that you maintain a record of operating data in order to facilitate troubleshooting and to ensure that proper maintenance is done at regular intervals. The frequency of these observations will vary according to the application, but the maximum interval should be no greater than one week. Data should include the following information:

1. Date
2. Air Flow Rate and / or Differential Pressure
3. Observations and Comments - should record all events of unusual or out-of-the-ordinary occurrence.

Maintenance

The only short term maintenance requirement is to look at the unit every week to see that it is operating in a normal manner. Things to check are uncharacteristic noises, fan motor sounding okay and not hot, unusual vibration, high/low static pressure and new odors to the area. In the cooler months, the condensate drain valve should be opened to drain accumulated water.

Carbon samples can be collected on a quarterly basis. Simple Solutions Dist. LLC. can test the samples to determine the condition of the carbon. Sample ports are optional on all vessels, as is a “hatch card” H_2S indicator gauge. A "grain thief" is used to remove carbon samples at different bed depths to see where "breakthrough" has occurred.

A specialized H_2S indicator gauge can be used to determine when breakthrough occurs. This gauge uses a treated “hatch card” that changes color in the presence of H_2S. Connected to a sample port located part way through the bed, it visually shows when breakthrough has gotten to the port location and that a change out will be needed shortly. Other indicators are available for a limited number of compounds.

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Troubleshooting

1. Low Air Flow Rate.
   a. Fan Speed Too Low - probably due to loose belt, wrong size drive sheaves, three-phase motor missing power leg. Correct drive problem.

   b. System Pressure Too High - probably due to obstruction such as narrow ducting, closed damper, fouled screen or carbon, or foreign object in air pathway. May be other system changes (such as additional duct or equipment) that increase static pressure losses. Remove obstruction or change fan to accept higher load.

2. High Differential Pressure.
   a. Fouled Carbon/Screen - due to accumulation of dust, moisture, or other material on the carbon or the screen. Requires chemical or mechanical cleaning.
   b. High Air Rate - due to improper sizing or control of fan. Adjust to design rate.

3. Carbon Bed Problems.
   a. Top of carbon bed does not remain level - probably due to high surge of air when first starting fan. Follow instructions regarding partial closing of inlet damper for start-up.
   b. Loss of Carbon - probably due to fluidization because of too high air rate. Reduce air rate or install bed limiter (screen) on top of the carbon bed.

4. Poor Removal Efficiency
   a. Needs Regenerating/Replacement - due to exhaustion of carbon capacity. Have carbon samples tested to determine whether regeneration or replacement is recommended.
   b. Insufficient Bed Depth - due to loss of carbon or failure of design. Replace lost carbon and correct situation causing the loss. Reevaluate design basis to ensure that it is adequate for existing conditions.