Operation & Maintenance Manual

AFD ● AF ● HPP ● HPAF SERIES

Tetrasolv Filtration Liquid Filters

Liquid & Vapor Filtration
Remedial • Industrial • Municipal

CONTENTS

1.0 GENERAL DESCRIPTION

The liquid series filters utilize fixed bed filtration to treat water. The filters employ a variety of medias to remove or catalyze contaminants. Flow through the filter may be either up flow or down flow depending upon the media supplied and the operation parameters. Generally inlet and outlet locations are indicated on the filter and or the filter drawings.

Product data sheets, drawings, MSDS, etc are available from www.tetrasolv.com or call the number below or email your request to support@tetrasolv.com.

2.0 SAFETY CONSIDERATIONS

It is important that the entire O&M manual be read prior to set up and operation of the carbon system.

♦ ***WARNING: We strongly recommend the use of a relief device in all installations. Exceeding the maximum pressure of the filter could result in catastrophic failure of the vessel.***

- Always adhere to “lockout/tagout” procedures when servicing the system.
- Wear appropriate safety equipment when operating system.
- Review the MSDS sheet for the installed media prior to working with the installed carbon.

♦ ***WARNING: Wet or dry activated carbon preferentially removes oxygen from air. In closed or partially closed containers, oxygen depletion may reach hazardous levels. If workers must enter a container containing carbon, appropriate sampling and work procedures should be followed for potentially low-oxygen spaces - including all applicable federal and state requirements.***

- Understand the potential hazards of the stream

being treated by the system. The media may contain higher concentrations of the contaminants being adsorbed than is in the influent stream. In addition the media may be considered hazardous material and therefore may require specific handling precautions unknown to Tetrasolv Filtration.

3.0 INSTALLATION

3.1 Shipment

Typically filters are shipped with media installed. However, in certain instances media is shipped to the site to be installed after installation. In very large systems it may be advisable to not install the media until adsorbers have been placed into final position and secured.

3.2 Unloading

Refer to the product data sheet for weight information for appropriate sizing information for the equipment to be used.

All components should be lifted either by crane or forklift as designated by the model.

- ***WARNING: Failure to follow the procedures outlined below can result in catastrophic damage to the system.***

Crane Lift - If a crane lift is to be used we recommend the following method. A "spreader" equaling 75% of the distance between the opposing lifting eyes on each adsorber should be used to insure proper lifting force direction. Attach an appropriately sized spreader beam and lifting cables to each lift eye of the component. The use of an experienced crane operator and quality equipment is highly recommended.

Fork-Lift - When using a forklift we recommend that the fork tubes on the filter be used or a pallet if the unit was shipped on a pallet.

- ***WARNING: Never attempt to pick up an adsorber which has wet carbon installed. The lifting eyes are designed only to lift the adsorber with dry carbon installed.***

3.3 Inspection

Perform the following inspections after un-loading the filter. Note any discrepancies and contact Tetrasolv Filtration immediately.

- Check the vessel exterior for damage which may have occurred during shipment. Inspect the support structures and piping support for damage.
- Inspect the piping system for damage. Insure the valves operate properly. Check installed instruments and instrument installation points for damage.
- Visually inspect the interior (if possible) of the vessel for loose laterals and or internal damage.
- Inspect the carbon discharge, drain and vent valves for damage.

3.4 Set Up

The filter should be placed on a level concrete pad of appropriate thickness to support the system at it's maximum operational weight. The filter should be secured to the pad using appropriately sized anchor bolts.

Connect the site piping to the filter inlet and outlet connection points. It is important that all piping connected to the filter should be self supported. We also recommend in hard pipe installation that a flexible joint be used to further insulate the filter from vibration and stress.

Connect any gauges and instrumentation shipped loose with the system.

The outlet piping should be designed to allow flooded operation of the Adsorber at all times to assure effective operation. If the outlet line does not provide for back pressure on the Adsorber unit, then the discharge piping should include an elevated piping loop to assure flooded operation.

Siphoning can occur when the discharge line allows suction to be placed on the process discharge. Siphoning can cause air pockets to occur in the adsorbers. If channeling is likely to occur we recommend the installation of an appropriately sized vacuum breaker.

If the supply pump is capable of producing pressure greater than the design limitation of the filter it is recommended that a rupture disk or pressure relief valve be installed prior to the influent connection.

If water conditions such as high suspended solids exist a filter should be installed prior to the Adsorber. A simple cartridge or screen filter helps prevent pressure buildup in the media bed. Many other water issues may effect Adsorber operation and we therefore recommend you discuss your specific installation with a representative.

Connect the process inlet and outlet to the site influent and effluent process lines.

3.5 Wetting and Deaeration

Dry carbon and other medias must be wetted and deaerated prior to use. This procedure displaces air from the internal structure of the carbon granule, thus assuring that the liquid to be treated is in contact with the carbon surface.

Prior to operation, the filter must be filled with clean, uncontaminated liquid. The recommended method for filling the vessel is through the outlet line. Open the inlet line to purge air from the system. Feed water into the outlet line until water flows from the inlet line. The wet carbon or media should be allowed to set for a minimum of 1 hours.

This is also a good time to inspect the system for leaks which may have been caused in transit and unloading the system. If leaks are spotted, tighten the fitting or flange bolts carefully until the leak stops. Do not overtighten the bolt or fitting. If the leak persists contact Tetrasolv Filtration for assistance.

After wetting, the carbon bed can be deaerated by draining the adsorber, and again filling the adsorber upflow with uncontaminated water. This procedure will eliminate any air pockets which may have formed between the carbon granules.

After completing the wetting and Dearation it is recommended that a backwash be performed. The backwash will remove media fines which can cause excess pressure drop in the system if not removed. In addition backwashing helps equalize the bed. Follow the directions outlined in Backwashing ***(refer to section 4.2)***.

After backwashing close the system valves and wait 1 hour.

The system is now ready for operation.

4.0 OPERATION

Flowrates to the filter should be determined based upon the required contact time between the liquid and the filtration media. The required contact time normally is determined prior to installation and operation of the filter.

It is important that the filters remain flooded at all times. If it is necessary to drain adsorbers while off-line it is recommend the procedures in section 3.5 “Wetting and Dearation” be repeated.

4.1 Modes of Operation

With certain applications (2) filters in series flow are utilized. Listed below are typical operational modes.

- Shutdown - Both filters completely off-line and isolated.
- Series Flow - Influent enters primary filter and exits through secondary adsorber (this is the preferred method of operation)
- Isolation Flow - Only one filter is receiving influent. This mode is typically used when the operator is maintaining the off-line filter.
- Parallel Flow - Both filters are receiving the influent as the primary. Flow is split equally between the filters. This mode is used when higher flow rates need to be achieved and contact times are not critical.
- Backwash Mode - Used when back-washing either filter.

4.2 Backwashing

IMPORTANT: Backwashing is not advisable with AFD or AF Series Filters. If a backwash is required please contact the number below or support@tetrasolv.com for assistance.

Usually backwashing is only performed in carbon adsorbers after new carbon has been installed or prior to removing the carbon from the adsorber. However, sometimes water conditions necessitate backwashing to remove suspended solids from the top of the carbon bed. Keep in mind that backwashing a carbon bed during normal service runs may cause the transfer zone to be disturbed leading to pre-mature breakthru of the carbon bed. Backwashing helps to reduce and equalize pressure drop across the media bed as well as removes

collected particulate from the top of the bed. Backwash rates for filters typically fall in the 5 to 20 gpm/ft^2. Backwash rates are dependent upon temperature of the backwash water, filter design and the media conditions. Refer to the data sheet for the supplied filter to obtain the cross sectional bed area. Refer to the data sheet for the supplied media to obtain the recommended backwash rate. Backwashing should begin at a low rate and proceed upwards.

Clean, uncontaminated, sediment free water is introduced to the filter through the outlet connection. This liquid flows upwards through the filter and exits through the inlet line - directed to a back-wash water collection point or drain. The flow rate should not be high enough to cause a significant quantity of media to exit.

IMPORTANT: Use only clean un-contaminated water free of sediments. If there is any question that sediments may be present the water should be filters through a 100 micron filter or smaller. Sediments introduced into the lateral system during backwash can cause excessive pressure build-up in the underdrain leading to underdrain failure.

If possible position an observer at the backwash discharge point. The adsorber should note excessive media loss and general appearance of the backwash effluent. If conditions warrant the observer should also instruct that the backwash be stopped.

Monitor the differential pressure for the filter being backwashed during the operation. If the differential pressure exceeds 30 PSIG discontinue the backwash and contact Tetrasolv Filtration.

IMPORTANT: Differential Pressure exceeding 30 PSIG during backwash may damage the vessel underdrain.

4.3 Monitoring

Filter units only require periodic monitoring if properly installed. The following items may be monitored:

- Pressure: Check inlet and outlet pressure. Increase in pressure differential may indicate build-up of filtered solids. Never exceed maximum design pressure of filter. If the differential pressure exceeds 20 PSIG it may become necessary to perform a backwash ***(see Backwashing Section 4.2)***

- Samples: Inlet and outlet sample points if provided for liquid analysis to determine system performance. Before pulling a sample the sample valve should be opened and allowed to flow freely for a few minutes to insure a fresh sample is obtained.

- Air: Check for trapped air by opening upper vent valve and allowing small amount of liquid to flow out. If your system was provided with automatic vent systems it is still necessary to periodically verify their operation.

- Inspect the discharge stream periodically for filtration media. If filter media is present in the exit stream shut down the system and contact Tetrasolv Filtration immediately.

Note: When the system if first started up small amounts of fines may be present. This is normal and should discontinue within a short period of time.

5.0 FILTRATION MEDIA REPLACEMENT

Prior to servicing the unit should be closed off from influent and effluent lines and any electrical devices or connections should be tagged off.

After removal of the filtration media is complete, it is recommended that the inside of the filter be washed to remove all contamination and any trace of spent media. After the filter has been washed, the filter should also be checked thoroughly and any minor maintenance conducted.

5.1 Media Loading - Dry Method

Fill the adsorber 1/4 full of clean water to protect the lower manifold and limit the amount of dust generated.

- ***WARNING - Dry activated carbon generates considerable dust. While activated carbon poses no health risk the dust can cause respiratory irritation and occasional skin rash. Therefore we recommended the use of proper clothing and dust mask during filling operation.***

Super Sacks - Hoist the bag over the manway and untie the outer bag exposing the inner chute. Untie the inner chute while clasping it shut. Remain holding the chute and carefully lower the chute into the manway. Un-clasp the chute and allow the carbon to discharge from the sack. The carbon should flow out very quickly and completely. When finished shake the bag and invert the chute into the bag.

If at any time you wish to stop the flow of carbon simply re-grasp the chute up high and cinch. Re-tie the bag.

5.2 Media Loading - Slurry Method

In this method dry-activated carbon will be delivered to the site in a slurry truck or slurry capable hoppers. To add the carbon to the filters use the following method:

- ***WARNING: Carbon slurry operation is a potentially hazardous operation which should only be performed by experienced operators with prior slurry experience. If you are un-trained do not attempt to perform a slurry without assistance.***

1. Use an appropriate sized hose connected to the carbon supply line for the adsorber. **Be sure the slurry line is adequately secured and the cam-lock mechanism is completely engaged. If the slurry line disconnects or fails large amounts of carbon will be expelled.**

2. Fill the adsorber 1/4 full of water to cushion the vessel internals from the entering carbon.

3. Completely cover the fresh carbon with clean water. Connect air source to the slurry container capable of producing 10 PSIG of air at 175 cfm.

4. Open the adsorber process outlet valve to allow excess water to escape the system (note: depending upon your discharge piping configuration this may not allow sufficient water drainage under non-pressure operation, consult Tetrasolv Filtration). Open the slurry in valve. Fresh carbon should begin flowing quickly into the filter. During this process it may become necessary to stop the slurry and allow excess water to drain from the adsorber.

5. When transfer is complete the transfer hose will begin blowing air only. It may be necessary to inspect the transfer hopper for carbon which did not transfer. If a sufficient quantity is present wash the carbon to the center using clean water and add enough water to re-cover the carbon and repeat the above procedures.

6. Close the valves and proceed to Section 3.5 “Wetting and Deaeration” then perform a backwash.

5.3 Media Removal - Slurry Method

This method can only be used with slurry equiped HPAF Series!

In this method spent activated carbon will be removed from the spent adsorber into a slurry truck or slurry capable hoppers. To remove the carbon from the filter use the following method:

- ***WARNING: Carbon slurry operation is a potentially hazardous operation which should only be performed by experienced operators with prior slurry experience. If you are un-trained do not attempt to perform a slurry without assistance.***

Backwashing the adsorber to be serviced for a few minutes prior to servicing will make the slurry occur more easily. It is important the the adsorber to be backwashed be full of water prior to attempting the slurry.

1. Connect the carbon discharge line to the carbon discharge connection on the adsorber to be emptied.

2. Connect an air source to the carbon fill line capable of producing 50 PSIG of air at 175 cfm.

- ***WARNING - The inlet air should be closely monitored to insure the pressure does not exceed the design pressure leading to rupture disc activation. If this can not be done the use of a pressure limiting device which still allows adequate air flow should be used.***

3. Open the air vent valve and pressurize the adsorber to 15 PSIG.

IMPORTANT: The initial pressure required for slurry transfer will be between 10 and 20 PSIG. Because of the compressibility of air the pressure should be reduced as the adsorber empties. If the operator supplying compressed air into the adsorber cannot see the pressure gauge there must be another operator who can call out the pressure reading during the transfer.

4. Open the slurry out valve. Spent carbon should begin flowing quickly out of the carbon vessel.

5. When transfer is complete the transfer hose will begin blowing air only. Bleed all air from the adsorber, remove the manway and inspect the adsorber for carbon which did not transfer. If a sufficient quantity is present wash the carbon to the center using clean water and add enough water to re-cover the carbon and repeat the above procedures.

6. Inspect the internals prior to refilling the adsorber.

Inspect the interior lining. Do not place the adsorber back into operation if any defects are noted.

6.0 MAINTENANCE

6.1 Extended Shut Down

If the filter will be shutdown for extended periods certain procedures should be taken to protect the filter.

If possible backflush the filter. Drain all water from the adsorber utilizing the effluent connection and the drain port if available. When draining allow air to enter the system by venting the influent line. Store the drained filter with system vented.

Caution should be taken during system startup following exposure to freezing conditions as the media may still be in a frozen state days or weeks after.

Prior to placing the adsorber back into service it is recommended the procedures outlined in section 3.5 "Wetting and Dearation" be followed.

Monitor the filter closely after extended shutdown for signs of potential problems such as interior manifold failure or leaking valves and gaskets.

6.2 Manway Opening & Closing

When it becomes necessary to open a manway the following methods should be closely followed:

- ***WARNING: Opening a manway while a vessel is pressurized can cause serious injury or death. Always verify pressure is relieved before attempting to remove a cover.***

- ***WARNING: Opening the lower manway on an filter which contains media can result in large quantities of media being discharged. Worse still the manway may not be able to be successfully sealed without removal of the media.***

Verify vessel is isolated and relieve pressure using filter vent valve.

Round T-Bolt Closures

1. Carefully loosen retaining nuts around manway ring. If while loosening the bolts you hear a hissing or any other indication of pressure immediately re-tighten the bolts and verify pressure has been relieved.

3. Swing all T-Bolts away from manway cover and slowly open cover. If gasket sticks to manway cover gently pry away to avoid tearing the gasket.

4. Clean O-Ring surface. Lubricate gasket with petroleum jelly.

5. Close manway and tighten bolts. It may be necessary to further tighten bolts after pressure has been applied to filter to prevent leaking.

Elliptical Closures

1. Slip a bent bar between the manway handle and the flange frame. ***This is to insure the manway does not fall into the vessel when the yokes are removed.***

2. Carefully loosen both large nuts holding the yokes to the manway. Remove the yokes.

3. Slide the bar out of the handle while holding it. Push the manway in and tilt to allow the manway to be pulled out of the filter.

Closing the manways:

1. Clean the gasket surface and replace if necessary. Apply tape to the gasket and the cover to hold the gasket in place while it is placed into position.

2. Slip a bent bar between the manway handle and the flange frame. ***This is to insure the manway does not fall into the vessel when the yokes are removed.***

3. Place the yoke into the manway cover slot and hand tighten. Carefully inspect the gasket to be sure it can be seen around the inside surface of the manway opening.

4. Wrench tighten nuts.

7.0 Troubleshooting

The following situations are typical problems which may arise during the operation of filters. If these problems cannot be resolved by using this guide or problems occur which are not addressed in this guide please contact TetraSolv Filtration at the number listed below or e-mail **support@tetrasolv.com**

Situation:

High pressure drop or inadequate flow through filters at expected pressure drop levels.

Probable Cause:

a) Verify effluent and influent lines to and from adsorber are not restricted.

b) Sediments or solids may have clogged the surface of the media. Remove the top manway cover and inspect the surface of the media. Backwashing the media should resolve this issue. Explore the possibility of pre-filtration ahead of the media filter to limit future problems.

c) Air is trapped in the top of the filter or the system piping. Relieve air using vent valves.

d) Underdrain collection baskets clogged. Contact Tetrasolv Filtration for recommendations.

Situation:

Manways failing to seal. Water leaking from.

Probable Cause:

a) Manway not installed properly.

b) Missing or damaged gasket

c) Debris trapped between gasket and ring

Solution:

Tighten the bolts on the manway first. If this does not solve the problem remove and reinstall manway as outlined in 6.4 if possible. If problem persists contact TetraSolv Filtration for further assistance.

Situation:

Premature filter exhaustion.

Probable Cause:

a) Inadequate contact time between the media and the liquid stream.

b) Contaminants in stream not originally accounted for in initial design or higher levels of contaminants than originally accounted for.

c) Trapped air or solids on bed causing channeling.

Solution:

Sample and analyze the influent water stream. Verify proper conditions exist. Also look closely at suspended and dissolved solids.

Verify contact time sufficient for contaminate being adsorbed. Decrease flow rate or install additional media.

Inspect surface of filter for fouling.

Release excess air from top of filter through filter vent line.

Situation:

Activated Carbon bed discharge stream has higher level of contaminants than influent stream.

Probable Cause:

Carbon bed has reached saturation. Carbon beds will often release larger amounts of contaminants than they are adsorbing as the mechanical bonds are broken when the carbon has reached it's saturation point.

Also, activated carbon will preferentially exchange more easily adsorbed compounds for ones already trapped in the carbon surface releasing the compounds trapped in unpredictable levels.