

144 Industrial Drive  
Forest City, N.C. 28043  
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# **FUME SCRUBBER**

## **Installation, Operation and Maintenance Manual**

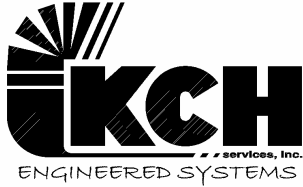
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Please completely read and understand this manual before installing  
and operating your fume scrubber

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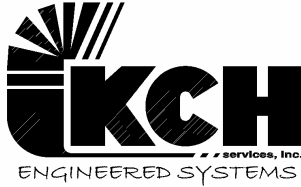
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## **PACKED BED/COLUMN FUME SCRUBBERS PRINCIPAL OF OPERATION**

Fume scrubber's work by using a chemical phenomenon of mass transfer, also called absorption, which allows gas phase chemicals in the air stream to transfer into a liquid scrubbing medium. This action will continue as long as the concentration in the liquid is low enough so that the chemical vapor pressure of the liquid phase is below the vapor pressure of the chemical in the air stream.

Gas absorption is a mechanism whereby one or more constituents are removed from a gas stream by dissolving them in a liquid solvent. This is one of the major chemical engineering unit operations and is treated extensively in all basic chemical engineering textbooks. Absorption is practiced in industrial chemical manufacturing as an important operation in the production of a chemical compound. For example, in the manufacture of hydrochloric acid, one step in the process involves the absorption of hydrogen chloride gas in water.

From an air pollution standpoint, absorption is useful as a method of reducing or eliminating the discharge of air contaminants to the atmosphere.

The gaseous air contaminants most commonly controlled by absorption include sulfur dioxide, hydrogen sulfide, hydrogen chloride, chlorine, ammonia, oxides of nitrogen, and light hydrocarbons.

A packed tower, or packed bed scrubber, is a unit that is filled with one of many available packing materials. The packing is designed so as to expose a large surface area. When this packing surface is wetted by the solvent, it presents a large area of liquid film for contacting the solute gas.

The flow through a packed column is countercurrent, with the liquid introduced at the top to trickle down through the packing while gas is introduced at the bottom to pass upward through the packing.

The flow through a packed bed unit is cross-flow with liquid introduced at both the top & front of the packed bed, while the gas stream flows horizontally through the unit.

Once through the packed section the airflow enters a mist-elimination section, usually chevron type baffles, which removes mist particles from the air stream before discharge to the atmosphere.

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## **UNCRATING AND INSPECTING YOUR SCRUBBER UNIT**

KCH Services scrubber units are inspected and pretested at the factory. Upon receipt of equipment, inspection is recommended to determine if damage or shifting occurred during shipment. Inspect equipment for damage such as cracks, dents, holes, broken brackets, broken plumbing, missing parts, etc.... If any defects are found, a claim should be immediately filed against the freight carrier.

## **INSTALLATION**

### **SCRUBBER UNIT**

KCH Services equipment should be installed by personnel experienced with the installation of air handling equipment.

Scrubbers should not be installed in ventilation systems where the inlet air temperature exceeds 140 deg. F., unless the scrubber has been designed for higher temperatures. Consult KCH Services, Inc. if in doubt.

The scrubber should be mounted on an adequate support. When the scrubber is to be mounted on a platform, the platform should be adequately braced for the operating weight of the unit. If the scrubber is to be roof supported, it is suggested that a structural engineer be consulted.

When lifting the scrubber unit from the truck bed, to carry it to its final destination, use nylon straps attached to the lifting lugs of the steel base. If nylon straps are not available chains with spreader bars can be used.

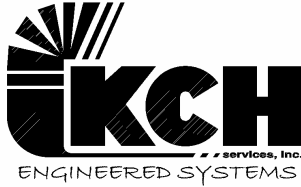
Apply silicone caulking or PVC foam gasket material to the scrubber's inlet and outlet flanges and attach the transitions to the scrubber with the mounting hardware provided.

The scrubber should be thoroughly cleaned after installation. Spray the filter media, eliminator section, scrubber housing, and transitions with a hose nozzle to wash all foreign material out of the unit. Any debris left in the bottom of the unit after flushing can be vacuumed out through the access doors.

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## PLUMBING

1. Install water supply plumbing and valves per certified drawings.
2. Install drainage plumbing to overflow and drain outlet per certified drawings.
3. Install separate fresh water wash-down for mesh pad mist eliminator pad. Ball valve to be closed except for wash down. (Where Applicable)
4. Check all valves to insure proper position. All spray header valves should be in the open position, with the handles in line with the flow. The drain valve should be closed, with the handle perpendicular to the fluid flow.

## PUMPS

### PUMP MAINTENANCE

In most applications, recirculation pumps are CPVC vertical sump pumps. The pump is mounted on a PVC plate which is part of the scrubber sump box. If the scrubber has a separate remote recirculation tank the pump is mounted on the top of the remote tank. The pump operation and maintenance manual is included with your scrubber unit separately from this manual. For details please refer to the pump O&M manual.

The recirculation pump is a sealess pump and should rarely require maintenance because it has no seals or bearings that can wear out. The pump can be ran dry without harm. There are times when, due to inadvertent installation or maintenance miscalculations, removal and replacement may be required.

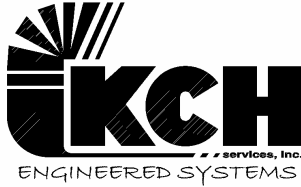
**WARNING:** Reverse rotation can cause severe damage to the pump! Check pump rotation before filling sump! The direction of rotation can be checked by momentarily bump starting the pump and observing the motor cooling vanes. The pump motor should rotate clockwise when viewed from top of pump. A label on the pump motor also indicates proper rotation direction.

The motor should be cleaned and inspected at regular intervals. Continuous operation in a hot dirty or dusty environment requires frequent attention. Check bearings when any unusual noise or vibration develops in the motor, and it has been determined that the noise or vibration is not caused by cavitation or a low sump liquid level. Check bearings for roughness by removing the pump from sump box and turning the pump impeller by hand. If the bearings bind in spots, replace the bearings.

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## **PUMP TROUBLESHOOTING TIPS**

Situations may arise where the pump does not perform per design or as it did when first installed. Below are some tips to assist you in identifying a condition or a problem that may exist.

### **A. At start up the pump performance does not meet the design conditions**

1. Check sump liquid level
2. Check for vortices in sump
3. Check rotation (clockwise viewed from top)
4. Check that the pump suction is free from debris
5. Check actual RPM
6. Check for adequate clearance between the pump suction pipe and bottom of sump

### **B. Noticeable Vibration**

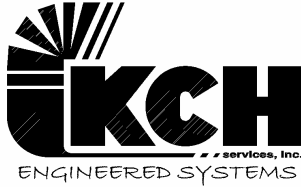
1. Check sump liquid level
2. Check for vortices in sump
3. Check flow for pulsing that is synchronized with vibration
4. Check flow rate and pressure to insure pump is operating on design curve
5. Check that the pump is securely mounted and setting level
6. Check alignment between pump and motor
7. Remove pump and inspect impeller for damage

### **C. After Continued Use Flow performance is less than previously experienced**

1. Check sump liquid level
2. Check for vortices in sump
3. Check that the pump suction is free from debris
4. Check that the shaft coupling is not spinning on shaft
5. Check discharge valves for position or blockage
6. Remove pump and inspect impeller for damage

### **D. Pump motor is running rough.**

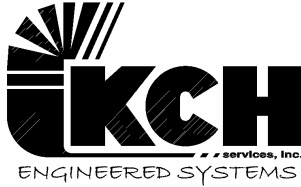
1. Check motor and thrust bearing for grease levels.
2. Disconnect coupling, rotate shaft to check lower bearing condition.



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## STARTUP AND OPERATING PROCEDURE

1. Check process line tank levels and chemical composition.
2. Open the water supply valve that feeds the scrubber.
3. Flush out pipe lines and clean any water line strainers that may be installed.
4. Fill the scrubber to its operating or overflow level.
5. Open all ball valves to spray headers.
6. Turn on the “Control Power” to the Motor Control Console.
7. Turn on the “Three Phase Power” on the control panel.
8. Start the “Fume Scrubber Recirculation Pump”.
9. Start the system “General Exhaust Fan”.
10. Recheck the units Recirculation System for proper operation. Inspect spray nozzles to verify liquid flows.
11. Turn on the Electric Heaters for heated tanks and allow tanks to heat up.
12. Turn on the Tank Air Agitation Blower and set air rates using manual valves at each tank.



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## **MAINTENANCE INSTRUCTIONS**

### **PUMP REMOVAL AND REPLACEMENT**

NOTE: PLEASE FOLLOW STANDARD COMPANY PRACTICES FOR LOCKOUT/TAGOUT BEFORE DISCONNECTING POWER TO THE PUMP

1. If the scrubber is operating, reset the pH to 7, drain and rinse the sump prior to removing the pump so there is minimal exposure to any chemicals.
2. Lockout and tagout the electrical power circuits to the pump being removed and disconnect the wiring to the pump motor.
3. Disconnect the pump discharge pipe at the union.
4. Remove the four bolts from the pump mounting plate and remove pump by lifting it straight out of the sump box or recirculation tank.
5. Return the pump to the factory for repair or replacement.
6. Reverse above steps to re-install, insuring that the pump is wired for the correct rotation (clockwise viewed from top).

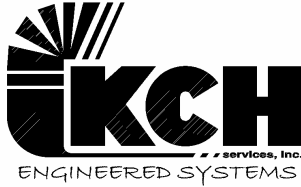
### **MIST ELIMINATOR ACCESS**

1. Disconnect the duct from the scrubber air outlet. For the Phaser Series Unit remove the duct from the outlet transition and for the Omni Series Unit remove the duct from the fan discharge.
2. Unbolt and remove the outlet transition if the scrubber is the Phaser Series. For the Omni Series Scrubber lockout and tagout the electrical power circuits to the fan motor and disconnect the wiring to the motor. Then unbolt and remove the fan section from the scrubber housing.
3. The mist eliminator is one assembly of baffles just below this joint, and can be lifted out by hand. When re-installing the transition or fan section, use silicone rubber caulking on the flanges or plastic gasket material for proper sealing.

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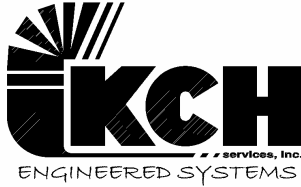
## **SPRAY HEADER REMOVAL AND MAINTENANCE**

The spray headers may be removed for ease of servicing. The scrubber unit does not have to be shut down to do this. Clear access doors have been designed into the scrubber unit for observation and maintenance of the spray nozzles.

1. Close the ball valve in the manifold supply line.
2. Loosen the union nut on outlet side of ball valve to free the manifold header.
3. Remove bolts connecting manifold flange to scrubber body.
4. Remove the manifold from the scrubber
5. Remove the nozzles by unscrewing them from the manifold.
6. Clean the nozzles and back flush the manifold.
7. Reverse above steps 1 – 5 to re-install spray manifold.
8. Re-open the spray header supply ball valve. Do not overtighten bolts in the manifold flange, or union nuts on the ball valves.

## **PACKING MEDIA MAINTENANCE**

The packing media should be checked periodically for scaling or build-up of solids, once the scrubber has been put into operation. If plugging appears evident, the packing may be flushed with a chemical solution or removed through the packing access door provided on the side of each unit and cleaned or replaced. Refer to the “Chemical Cleaning” section below.



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## GENERAL CLEANING

In general most of the cleaning done around the PVC scrubber will require the use of a mild soap (liquid dish washing soap), warm water and a soft rag. Soft Scrub and Windex can also be used. The only place that a solvent should be used is to clean the grease and dirt around the fan and motor bearings. When cleaning items like the chevron mist eliminator blades the use of a kitchen bottlebrush, that can be bent, may be required to get between the blades. An access door is provided in the top of the sump cover for inspection and maintenance. The sump can be cleaned with a shop vac through this access door after the sump has been drained.

## CHEMICAL CLEANING FOR FOULED PACKING

The pressure drop across the packed section should be checked monthly. Fouling of the packing will cause a gradual increase in the pressure drop. Whenever the pressure drop creeps up to twice its initial value, it's time to shut down the scrubber system and clean the packing. If this is not done, then scale may accumulate to the point where column performance is impaired by channeling (uneven flow through the media) or reduce air throughput. If the packing becomes severely encrusted, it may no longer be possible to clean it in place, or even to remove it from the scrubber unit without damage, but when the pressure drop has increased to 100% or less, the amount of scale is usually not excessive, and a brief shutdown for cleaning will often restore the packing to its original condition.

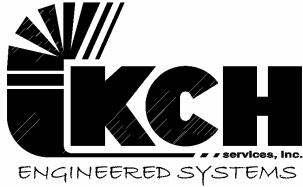
Mineral scale, caused by precipitation of iron and manganese oxides or calcium and magnesium carbonates from hard water, can be removed by washing with muriatic acid (hydrochloric acid). Algae growth can be removed by washing with caustic solutions of bleach (sodium hypochlorite). Sometimes fouling deposits include both inorganic and organic matter. When in doubt, a simple lab test with a few pieces of fouled packing can identify the most effective cleaning agent.

To dissolve mineral scale without removing the packing from the scrubber unit, drain the sump and fill it with diluted muriatic acid (3% HCl). With the fan turned off, recirculate the acid over the packing, and check the pH of the acid solution once an hour. If the pH rises above 4, then the acid has been exhausted. If so, drain the sump, refill it with fresh acid, and repeat the procedure. If the pH remains below 4 after 3 hours, then the packing should be fairly clean. Drain the sump, neutralize and dispose of the spent acid, and rinse the packing with fresh water. The column can then be put back into operation.

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A similar procedure, using 2-3% sodium hypochlorite, will often dislodge biological growth.

Some customers prefer to remove packing from the scrubber unit and clean it mechanically using high-pressure water hoses, or by agitation in a cement mixer or other moving chamber. While these procedures avoid the use of cleaning chemicals, they require much more labor and down time, and are more likely to damage the packing.

In cold climates, it is sometimes possible to dislodge scale from the packing by simply turning off the water flow long enough to allow wet deposits to freeze, and then washing them off with water. In hot weather, drying the packing will sometimes turn tenacious slime into a brittle solid that flakes off easily.