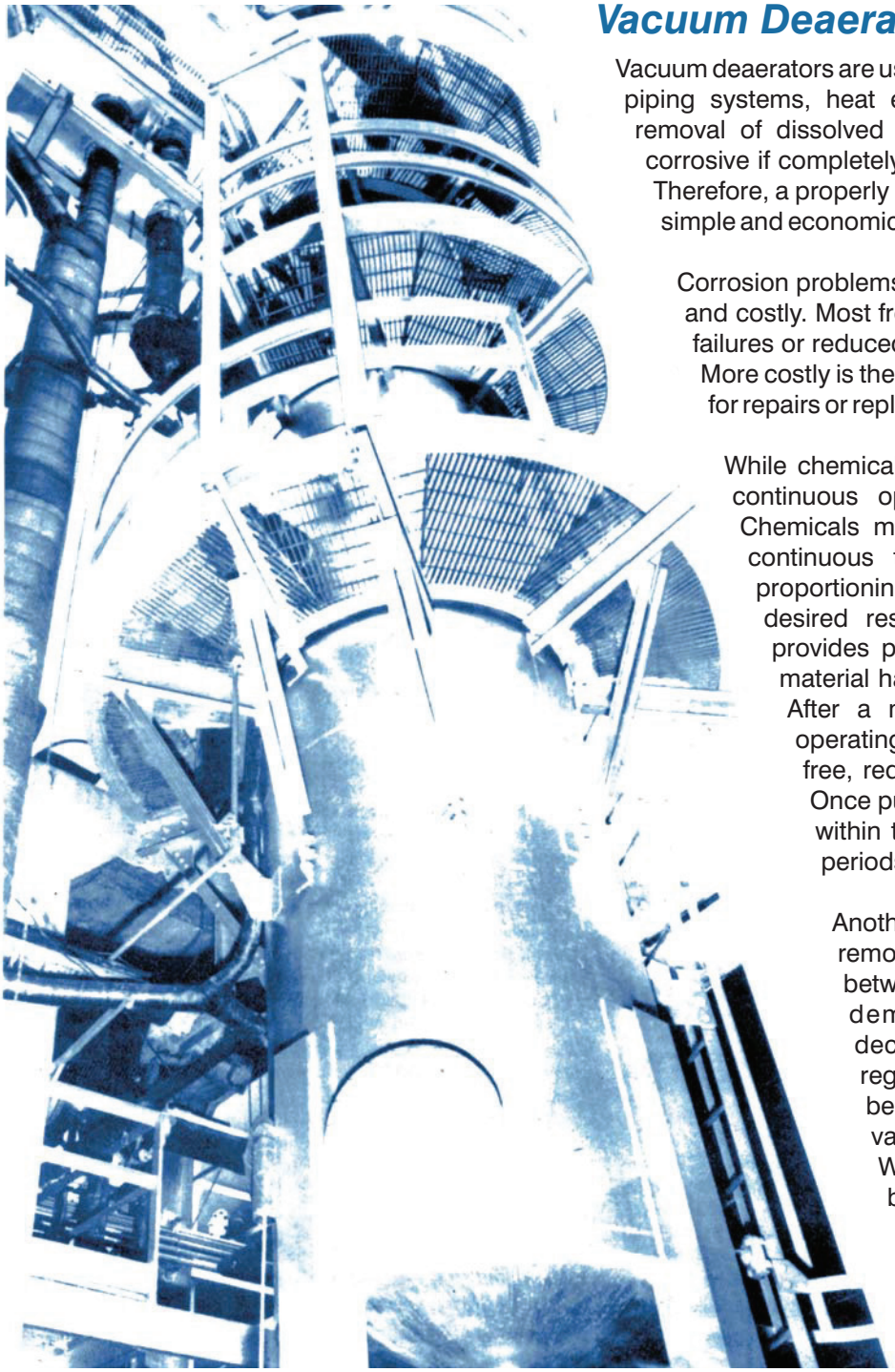
Vacuum Deaerators & Forced Draft Degasifiers



Vacuum Deaerators

Vacuum deaerators are used primarily to reduce or eliminate corrosion of piping systems, heat exchangers and process equipment by the removal of dissolved oxygen and carbon dioxide. Water is non-corrosive if completely gas-free, providing it has a proper pH value. Therefore, a properly designed vacuum deaerator is one of the most simple and economical methods of eliminating corrosion.

Corrosion problems in cold water systems are likely to be serious and costly. Most frequently, corrosion takes the form of pipe-line failures or reduced capacity from clogging due to tuberculation. More costly is the loss of productive capacity due to “down time” for repairs or replacement of corroded equipment.

While chemical additives have their place, they represent a continuous operating cost which may be appreciable. Chemicals must be hauled into the plant, handled, and continuous testing performed to make sure that the proportioning is proper at all times in order to effect the desired result. A Cochrane brand vacuum deaerator provides protection without the continuous problem of material handling and constant supervision and testing. After a modest initial investment, only a minimum operating cost is required. It is virtually maintenance-free, requiring only periodic inspection and cleaning. Once put into service, it will continue to remove gases within the limits of its designed capabilities for long periods without attention and maintenance.

Another application for the vacuum deaerator is the removal of oxygen and carbon dioxide from water between the cation and anion exchangers of a demineralizer. Removing carbon dioxide decreases chemical cost and frequency of regeneration of the anion unit in most cases, because the carbon dioxide is removed in the vacuum deaerator rather than by ion exchange. While removing carbon dioxide the Cochrane brand vacuum deaerator also removes oxygen. The removal of oxygen also renders the final effluent from the demineralizer less aggressive.

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Principle of Operation

The basic theory of deaeration within the Cochrane brand vacuum deaerator is described in the Cochrane publication "Deaeration - Why? How?" In the vacuum deaerator a vacuum is maintained so that water at inlet temperature will boil. A small amount of vapor is flashed from the inlet water and carries away the non-condensible gases as they are released.

Agitation and surface exposure are accomplished by spraying the water into the tank and then causing it to be broken up and spread into thin films repetitiously as it cascades over the packed section.

Vacuum may be produced by steam jet ejectors or by mechanical vacuum pumps. The absolute pressure within the Cochrane brand vacuum deaerator is practically the same as saturation pressure at inlet water temperature. The water which flashes into vapor during the deaerating process, while large in volume is small in pounds, thus the amount of refrigeration that takes place is practically negligible and inlet and outlet temperature may be considered the same.

Operation *(Fig. 1)*

Inlet water is sprayed into Cochrane brand vacuum deaerator through non-ferrous perforated spray pipes or through spray nozzles so arranged that the sprayed water is distributed evenly over the packed section. Initial spraying into the evacuated unit removes the bulk of the non-condensible gases present in the inlet water. The partially deaerated water then cascades through the packed section where tremendous surface exposure and maximum scrubbing take place, resulting in the removal of the remaining gases and delivery of practically gas-free water.

Vapor flashed as the water enters the unit passes downward through the packed section with the water scrubbing out the non-condensible gases and carrying them through the vent outlet to the evacuting equipment. This flow pattern affords optimum deaeration since the vacuum is greatest and the atmosphere least conducive to re-absorption at the last point of contact with the deaerated water.

Economy of operation and superlative performance are achieved by multi-staging. Basically this consists of locating two or more vacuum deaerators in series permitting the effluent water from one stage to pass by gravity to the succeeding stage through a positive water seal. While multi-stage units require increased initial investment, they have a lower cost of operation than single-stage units operating under the same conditions delivering water equally gas-free.

Multi-staging is particularly advantageous for very cold water removal of high concentrations of gases, and applications where mechanical vacuum pumps are required.

Construction

Cochrane brand vacuum deaerators are "tailor-made" with performance arrangements, vacuum producing equipment, and materials best suited to individual requirements.

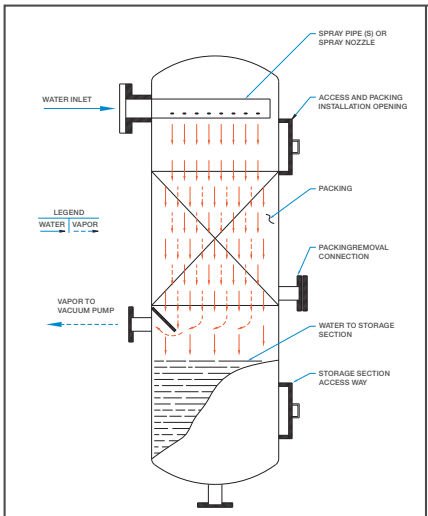

Fig.1 – Vacuum Deaerator

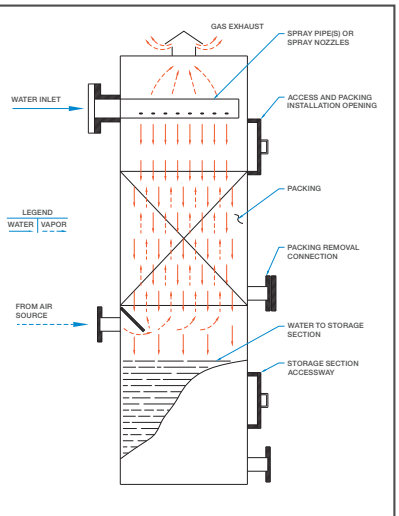

Fig.2 – Forced Draft Degasifier

Vacuum Deaerators & Forced Draft Degasifiers

Forced Draft Degasifiers

Cochrane brand forced draft degasifiers are designed to provide an economical and efficient method to remove dissolved gases, principally carbon dioxide and hydrogen sulfide.

Uncomplicated in design and operation, Cochrane brand forced draft degasifiers use the time proven principles of aeration in achieving the removal of harmful gases to levels at which they are tolerable to piping or process systems. In addition, forced draft degasifiers help to minimize the investment and chemical costs associated with other water treating equipment such as deaerators and demineralizers.

By far, the most popular application of forced draft degasifiers is the removal of carbon dioxide. While CO_2 in surface waters is usually negligible, ground water and recycled process water may be highly concentrated with CO_2 due to decomposition of organic matter in soil or contact with CO_2 in process. The removal of this CO_2 is important to insure long life of piping and process equipment, and forced degasification is the most economical method to accomplish this.

An important application of forced draft degasifers for removal of CO_2 (decarbonators) places a unit between the cation and anion exchangers of a demineralizer. Cation exchangers will convert alkalinity present in raw water to free CO_2. If not removed, this CO_2 will be removed by the anion exchanger, increasing the frequency and cost of regeneration of the anion resin. A decarbonator increases the effectiveness of the resin.

Forced draft degasifiers are capable of reducing the concentration of hydrogen sulfide in water, producing an effluent of usable quality for sanitary purposes or chemical processes where odor and sulfur are detrimental. Also, water containing hydrogen sulfide may be highly corrosive under certain conditions and in others hydrogen sulfide may be oxidized to sulfur causing serious deposits in pipelines, etc. In these cases, the reduction of the hydrogen sulfide concentration by a forced draft degasifier may be an invaluable asset.

Operation *(Fig. 2)*

As stated previously, forced draft degasifiers are basically aerators. The water to be treated enters the degasifer through a corrosion resistant distributing system (spray nozzle or spray pipe) which sprays the water evenly over a column of packing material. This packing material allows the water to form thin films which provide maximum surface area for gas stripping by air which is flowing countercurrent to the water. Stripping air is introduced to the decarbonator at a point below the packed column by a forced draft blower. The air rate or blower capacity is selected to provide sufficient dilution of the harmful gas to allow the gas to diffuse from the water. The result is an effluent with the desired level of degasification.

General Engineering and Construction Features

All Cochrane brand forced draft degasifiers utilize air flowing countercurrent to the liquid stream to accomplish degasification. Towers to house the spray system, packing material, and storage sump are normally vertical and constructed of fiberglass reinforced plastic. Towers for outdoor service are treated with ultraviolet inhibitors to prevent degradation of the plastic and insure long life. Incoming water is distributed evenly over the packed column by a PVC, fiberglass, or stainless steel spray system.

Packing materials used are saddled or ring type packing of polypropylene construction, supported within the tower by a support plate of plastic construction.

Each tower is provided with a storage sump beneath the packing support plate. A capacity of 2 minutes at the rate capacity is usually sufficient for control purposes.

Blowers to furnish stripping air are available in aluminum and steel construction, either belt or direct driven. Belt guards and inlet screens are provided for safety purposes; when plant atmosphere is extremely corrosive or dirty, the blower can be furnished with protective coatings or filters. Drive motors are always selected to meet the expected service.

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Provide _____ vacuum deaerator(s) warranted to deliver up to _____ GPM water at _____° F with an oxygen concentration not exceeding _____ ppm and a CO_2 concentration not greater than _____ ppm. Vendor shall assume that the water entering the deaerator is saturated with air at the design temperature stated above. CO_2 concentration of the untreated water is _____ppm.

The vacuum deaerator shall be vertical, constructed of welded (carbon, stainless) steel plate and designed for _____ psig and full vacuum in accordance with the ASME Code for Unfired Pressure Vessels. Code stamp is required. All wetted surfaces of carbon steel units are to be coated with corrosion resistant material.

Water entering the vacuum deaerator shall be evenly distributed over a column of saddle type packing which shall be designed in a manner which encourages redistribution of the water as it flows downward through the column. The vacuum connection on the deaerator shall be located below the column of packing material so that all “flash” water vapor produced is actively utilized throughout the column. This connection must be baffled and of sufficient size to prevent carryover of liquid droplets.

The bottom section of the vacuum deaerator shall provide storage capacity for _____ gallons of deaerated water measured to the high level line. The vendor shall select a working or normal level so that adequate capacity is reserved for catching water retained in the packed column.

The vendor shall provide _____ vacuum system(s). Vacuum systems shall be (steam jet ejectors, mechanical vacuum pumps) sized and applied properly for the operating conditions stated above. (Dry saturated steam, electric power) available is (_____ psig, 3 phase, _____ cycle, _____ volts). Cooling or sealant water will be available at _____° F.

The vendor is encouraged to quote multiple stage vacuum deaerators where such units may provide definite operating advantages to the purchaser. Each stage of the vacuum deaerator must be provided with an independent vacuum system, preferably interchangeable between stages.

The purchaser will provide all foundations and piping, erection, and installation labor.

Accessories

The vendor shall provide accessories and controls as checked below.

One (1) air operated water control valve. Water pressure available is _____ psig.
- Level control system consisting of:
  - One (1) level transmitter to provide 3 - 15 psi air signal to a wall mounting level controller which in turn will provide a proportional air signal to the water control valve (or positioner, if used).
- One (1) set gauge glasses to cover the stored water range of the sump. Gauge fittings shall be suitable for vacuum service.
- Two (2) level switches or level transmitter with pressure switches to provide high and low water alarm signals.
- Vacuum Gauge - 30” Hg vacuum to 60 psig.

In order to allow us to properly select materials of construction for the above accessories, please provide information concerning your application in as much detail as possible.

_____
_____
_____
_____

Provide _____ forced draft degasifier warranted to reduce the (CO_2, H_2S) concentration of _____ GPM water at _____° F from _____ ppm to _____ ppm.

The degasifier shall be vertical, constructed of fiberglass reinforced plastic, designed for atmospheric operation, and suitable for (indoor, outdoor) installation. The tower shall be provided with a storage sump of _____ gallons capacity.

Ring or saddle type packing material constructed of polypropylene shall be provided, the size and quantity to be determined by the manufacturer. Stripping air shall enter the tower through a baffled connection below the packed bed. Air shall be provided by a forced draft blower, belt or direct driven by an electric motor suitable for operation on the available 3 phase, 60 cycle, _____ volt power supply. An inlet screen and belt guard shall be furnished. Provisions should be made by the manufacturer as required for (clean, dusty, corrosive) plant atmosphere. The purchaser will provide all foundations, piping, duct work, erection and installation labor.

Accessories

The vendor shall provide accessories and controls as follows:

One (1) air operated water control valve. Water pressure available at the valve inlet is _____ psig.
One (1) level controller.
Two (2) level switches.
One (1) gauge glass assembly to cover the stored water range of the sump. Glasses shall be tubular type complete with shut off valves.
_____ motor driven transfer pump(s) rated _____ GPM at _____ psig discharge pressure.

In order to allow us to properly select materials of construction for the above accessories, please provide information concerning your application in as much detail as possible.

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