Chlorine Evaporator C 6100

Functional description

Chlorine evaporators are for use in connection with large-scale chlorination or intermittent chlorination plants where the amount of chlorine consumed per unit of time is hogher than the amount that can be produced in the chlorine cylinders and/or tanks by the process of natural evaporation. Natural evaporation produces an amount corresponding to roughly 1% of the content of all chlorine containers connected at the same time. The evaporator consists essentially of an evaporator coil placed in an electrically heated water-bath, the temperature of which is controlled. Depending on the version, 60 or 220 kg/h liquid chlorine can be converted into the gas phase.

The water-bath is equipped with a level probe and a magnetic valve for constant level monitoring, and with an electrode for low level control. If the low level electrode is activated due to insufficient water supply, the evaporation heating is switched off immediately and the quick-acting shutoff valve at the evaporator outlet is closed. The quick-acting shutoff valve is a ball valve which is operated either pneumatically by spring return or electrically by accumulator return. In the case of a pressure or voltage loss the ball valve "closes" within seconds.

The temperature is maintained by means of a contact thermometer at between 68° and 72°C. The regulating contact thermometer has two break contacts, which cut off the current to the heating rods in two steps after the required evaporator temperature is exceeded, and reconnect the current supply depending on the chlorine consumption. The temperature of the water can also be read from the contact thermometer.

The evaporator is equipped with two thermostats for maximum and minimum temperature monitoring. These contacts respond if the temperature falls below 60°C or exceeds 80°C. The latter causes an immediate shut-down of all heating power as well as an acoustic and visual alarm. If the temperature falls below 60°C, this causes an immediate closure of the quick-acting valve at the evaporator outlet, thus preventing any liquid chlorine from entering the metering system as a result of further cooling. A contact pressure gauge with a minimum "make" contact (lack of chlorine) and a maximum break contact (chlorine pressure and thus possibly also temperature too high) is set to 1.5 and 12 bar, respectively. The minimum "make" contact can either produce an acoustic signal indicating a lack of chlorine or at the same time activate the chlorine tank change-over device to switch to a full container. The maximum break contact produces an acoustic and visual alarm and switches off the evaporator heating immediately.

If the chlorine pressure - due to incorrect operation of the evaporator - exceeds 15.5 bar, the safety disk alarm will respond. This immediately directs the flow of chlorine gas into a collecting vessel or into solution tanks provided for the purpose. The alarm contact switches off the heating at the same time.

The heated water container and the evaporator coil are both steel. They are protected against corrosion by the cathodic protection method.

The evaporation coil is integrated in a support frame. The front consists of a plastic enclosure with a panel cutaway section, with detachable cover panels at the sides.

Installation

The evaporator is delivered virtually fully assembled. Before startup, the frame must be bolted to the floor and pipe connections made to the chlorinator or the liquid chlorine containers.

All installation work and piping as well as the circuit wiring to the switch cabinet must be carried out in accordance with the local conditions.

Once installation has been completed, the water supply must be turned on. The level control will cause the container to be filled to a level 2/3 of the way up the sight glass. The water must be of drinking water quality and must not be contaminated with oil or acids. Oil will impair the heat transfer and make the cathodic protection system incapable of working properly. The screwed-in cathodic protection system consists of magnesium rods, which are designed to provide improved protection against corrosion for a long period. The anodes should be checked as a part of routine maintenance and replaced in good time by new ones as necessary.

None of the external chlorine fittings and piping to be installed in connection with the evaporator should be sealed with organic sealing materials. Only Teflon tape or sealing materials specifically approved should be used (e.g.: anaerobic sealing compound). Gaskets in contact with chlorine must be resistent to chlorine and should be pasted with silicon grease before use.

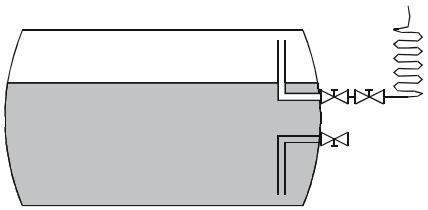
The warning rupture disk or spring-loaded safety valve is mounted on the T-piping at the discharge end. When using the spring-loaded safety valve, a contact pressure gauge is required for the collecting vessel to enable alarm signaling.

The gas pressure of the chlorine leaving the evaporator is approximately the same as the saturated vapour pressure in the liquid chlorine supply tanks. This pressure, as a function of the liquid chlorine temperature, is between 6 and 8 bar.

To make sure that the chlorine metering units connected to the discharge side can operate correctly, and to prevent any re-condensation if the chlorine-carrying pipes suffer from cooling, the gas pressure should be reduced to 2...3 bar. The chlorine pressure reducing valve is used for this purpose.

Leakage test

Before first startup all valves, including the manual shutoff valves up to the chlorine drums must be closed. For the leakage test described below the evaporator must be connected to one of the chlorine drums on the gas extraction side (i.e. not on the liquid chlorine supply side, as it is required for actual operation).



Turn the operating selector switch in the switch cabinet to "Heat up", and the main switch on. When the evaporator has reached its operating temperature (approx. 70°C) set the operating selector switch to "Continuous chlorination".
Now open all valves from the chlorine drum towards the evaporator in stages, one after the other. After opening of each valve check for leaks by moving an open bottle filled with ammonia solution around in the immediate vicinity of the point to be tested.
If a leakage is discovered, the gas extraction valve on the chlorine drum must be closed immediately and the chlorine gas exhausted via the ejector. If the contact pressure gauge indicates 0 bar, the installation must be switched to the "OFF" position.

Startup

After eliminating any possible leakage or a successful leakage test, connect the evaporator to the liquid chlorine supply side of the chlorine drums.
Once the evaporator has been switched to normal operation (e.g.: discontinuous chlorination), it will normally not require any further individual attention, since it is monitored fully automatically by the control program. Rupture disk, contact pressure gauge and thermostats ensure that the evaporator is kept under control.
In the case of emergency, however, the evaporator can be shut down at any time simply by turning the operating switch in the switch cabinet to OFF.

Shutting down the installation

If the installation is to be shut down for a short period of time, the chlorine inlet valve on the evaporator must be closed and the operating selector switch turned to "Continuous chlorination". If the contact pressure gauge indicates 0 bar, switch the installation to "OFF". If it is to be shut down for a longer period of time, clean the installation as described below under "Cleaning".
In piping systems where several valves are installed at intervals, never close all valves on the liquid chlorine side at the same time. The reason for this is that liquid chlorine has a very high coefficient of expansion which might cause a considerable pressure increase in the pipes and thus damage the piping system.

Maintenance

If there are no rules/specifications (e.g. GUV 8.15) or special annotations prescribing shorter maintenance intervals, all JESCO chlorinators have to be maintained and tested by an authorized specialist firm at least once a year. Preferably this should happen at the beginning of a high-rate period, prior to a downtime or a restart.

Filling with water

Some loss of water is to be expected as the result of evaporation. This loss is compensated for automatically by the level control. If the controller fails, the low level electrode causes an alarm signal in good time.

Manual valves

Manual valves, if left in the same position for a longer period, may become difficult to move after a while. It is therefore advisable to operate all manual valves approximately every two weeks. If a valve is very stiff, wind a wet cloth around it.

Cathodic protection device

It is necessary to check the anodes in the cathodic protection device once a year. Under normal operating conditions the anodes will last about three years. Before new anodes are fitted, it is recommended to remove the water from the installation, so that the water, the tank and the coil can all be checked. If the cathodic protection device has been effective little or no corrosion will be found on the steel components.

Maintenance and cleaning of chlorine lines

Initial testing for leakage in chlorine lines is normally done by putting the chlorine gas piping system under full pressure and then checking all connections for leaks with the fumes of a strong ammonia solution.
NEVER USE WATER OR HUMID COMPRESSED AIR FOR PRESSURE TESTING OF CHLORINE LINES.

Impurities

Commercial chlorine is in general very pure. However, if in the course of time large amounts are processed it is possible that the chlorine lines are gradually damaged or locked due the accumulation of impurities. For example, with 0.01% contamination, the evaporation of 10 t of chlorine may result in a residual 1000 g of foreign substances. As these foreign substances are invisible in the piping, the first sign of this kind of trouble will be a locked line or dissolved foreign substances entering the chlorine installation. When this happens, it is often thought that the chlorine container has particles of dirt in it, but this is seldom the case. The accumulation of foreign substances in the piping is restricted to certain areas, so that most of the piping system appears to be relatively clean.
Impurities to be found in chlorine lines include iron salt (mostly iron perchloride) and chlorinated hydrocarbon (liquid to solid). Iron perchloride is predominant in the liquid chlorine line to the evaporator and in the evaporator coil. Chlorinated hydrocarbon is to be found between the chlorine pressure reducing valve and the chlorine installation itself.

Iron perchloride becomes liquid, i.e. it extracts and retains water from the atmosphere, until it is ultimately dissolved in the water it attracts. If dry iron perchloride is exposed to the ambient atmosphere, a dark reddish brown liquid will very soon be formed.
There is a risk that the inside of the chlorine pipes and fittings are exposed to the humid atmosphere. The iron perchloride layer becomes wet within a very short time. If chlorine is dissolved in this water, hydrochloric acids are formed which affect most of the materials, especially iron and steel.
When the liquid chlorine supply is reconnected, the liquid chlorine takes the iron perchloride with it, so that it reaches the chlorine tanks of the evaporator and causes corrosion.
This type of corrosion shows at the line ends exposed to air. For this reason one of the most important safety measures is to ensure that every pipe connection from which the piping has been removed is isolated with a plug. Normally the flexible connecting line between collecting pipe and supply container is the one mostly affected. If signs of corrosion appear in the form of the rust-brown deposits already described, the affected parts should be carefully cleaned and pressure-tested immediately; in the case of more severe corrosion they must be replaced by new parts.

Cleaning

The best method for cleaning chlorine lines is to use steam. The piping should be dismantled into manageable sections through which steam can be blown, until each section of pipe has been heated to approx. 100°C. If clean steam can be seen at the outlet aperture, and the whole pipe is properly heated to 100°C, the steam can be turned off. Dry air, carbon dioxide or nitrogen must then be blown immediately through the piping to remove any residual steam.
If a pipe section is locked, use an appropriate item to clear it. Never use water for this purpose.

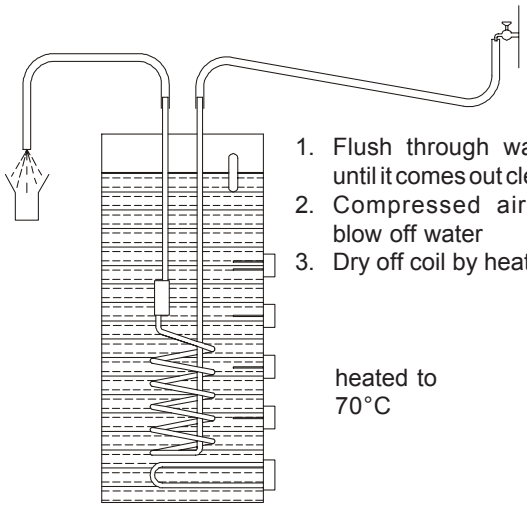
Cleaning with solvents
(for short pipe sections only)
If pressurized steam is not available, and if the piping can be disassembled into short, straight sections, cleaning with solvents is possible. Synthetic alcohol or methanol are best suited to clean liquid chlorine lines. Most varnish thinners are blends of solvent agents, and are suitable for cleaning wet and dry chlorine lines.
Proceed very carefully. The majority of organic solvent agents react with chlorine under release of heat. This reaction may generate a high temperature and pressure in closed parts of the installation, so that there is a danger of explosion. These solvent agents should accordingly be used for short pipes sections only which are not locked. Water should also first be passed through the piping to remove the chlorine.

For short line sections, it is permissible and advantageous to use water, because it can later be removed with absolute certainty. The line must be free from water or solvent before it is used for chlorine again. For this purpose blow warm or very dry air, or nitrogen, through the pipe.

Cleaning the C 6100 evaporator

An G 1/2 water connection with a minimum pressure of 0.7 bar (10psi) is required.
It is important for the temperature of the water in the evaporation water chamber to be maintained during the washing procedure. Therefore switch the evaporator to "Ready (for operation)".
Appropriate safety measures, such as wearing a gas mask, must be taken during the following procedures, since chlorine gas will escape from the deposits in the evaporator.

1. Close main and auxiliary valves on the chlorine containers.
2. Switch installation to "Continuous chlorination" and wait until pressure gauge indicates 0 bar.
3. Close inlet valve of evaporator and loosen flange connection of inlet valve on the evaporator side (the valve remains in closed position on the line). Switch installation to "Continuous chlorination" again, so that the ejector now pulls air through the evaporator and thereby flushes it.
4. Dismantle both elbows, with fittings.
5. Connect tubing connections fitted with flanges to evaporator inlet and outlet flanges.
6. Connect water pressure connection to inlet flange and water discharge tubing to outlet flange.
7. Flush coil until water emerges.
8. Turn off water supply and leave water in pressure tank for about 1/2 hour to allow temperature to rise to 70°C. This will assist softening and dispersal of the deposits.
9. Remove tubing from evaporator inlet. Blow off water from coil by compressed air or nitrogen through the evaporator inlet.
10. Remove tubing from evaporator outlet.
11. If it is assumed that the coil has a harder encrustation inside, a tube scraper (a flexible shaft with a cleaning head, electrically operated) can be inserted into the coil from both sides.
12. Leave coil exposed for about another 30 minutes so that the last drops of moisture are evaporated by the heat of the water chamber.
13. After re-assembly, check for leakages as described under "Startup".



1. Flush through water until it comes out clean
2. Compressed air to blow off water
3. Dry off coil by heating

heated to 70°C

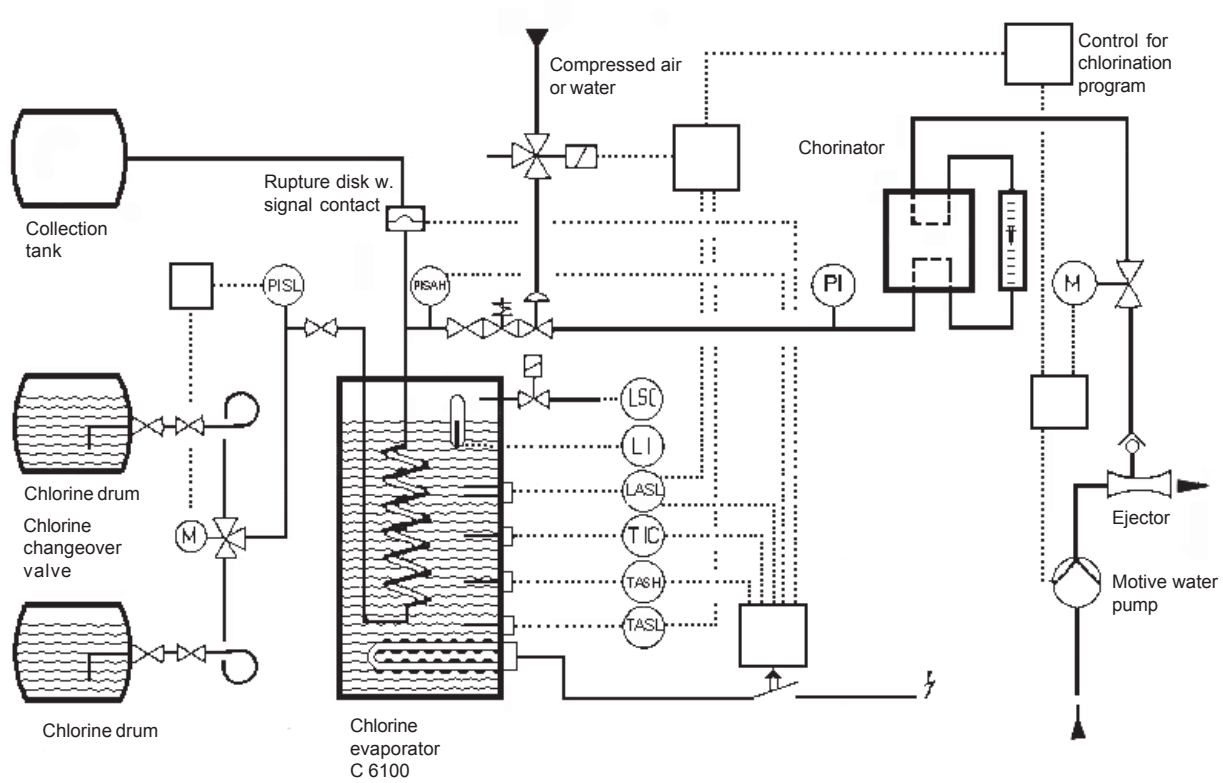
Maintenance

JESCO chlorinators have to be maintained and tested by specialist staff at least once a year (cf. also local rules or specifications, e.g. GUV 8.15).

Any parts that failed due to normal wear or external influences, can be ordered by mentioning the corresponding part numbers. In the case of any queries, it is recommended to return the defective parts to us, if possible.

Note

The installation should be given a daily external inspection check, with particular attention to leakage.



Legend

LSC	Level control
LI	Level indicator
LASL	Low level alarm
TIC	Contact thermometer with MIN and MAX contact
TASH	Max. temperature alarm
TASL	Min. temperature alarm
PI	Pressure gauge
PISL	Pressure gauge with MIN contact
PISAH	Pressure gauge with MAX contact