

WATER SUPPLIES DEPARTMENT
STANDARD SPECIFICATION EM-02-06
CHLORINE EVAPORATOR

The specification shall be read in conjunction with the following WSD Standard Specifications :

- (a) EM-02-01 for Chlorination System – General and Design;
- (b) EM-02-02 for Chlorinator; and
- (c) EM-02-09 for Chlorine Pressure Gauges.

1. DESIGN

1.1 General

The chlorine evaporator shall be of electric immersion water heater type for transformation of liquid chlorine to gas chlorine. It shall be automatically controlled with self adjustment of chlorine evaporation rate, liquid chlorine level, make up water level, and water bath temperature.

The evaporator shall comprise a pressure cylinder immersed inside an electrically heated and vapour vented water bath. Heat transferred from the water bath shall transform the liquid chlorine into superheated chlorine gas. The evaporator shall be designed for the best efficiency in heat transfer for assurance of uniform heat distribution and avoidance of any hot spot in the pressure cylinder.

1.2 Operation and Control

The liquid chlorine level in the pressure cylinder shall be self-adjusted to maintain equilibrium inside the cylinder to meet the gas withdrawal rate under normal operation. To prevent outflow of liquid chlorine from the evaporator into the gas outlet piping, the vacuum regulator-check unit integrated with electrical operated actuator and installed at downstream of the gas outlet shall be closed automatically on detection of the following conditions :-

- (a) Loss of power supply
- (b) Low water bath temperature
- (c) Low water bath level
- (d) Low gas temperature at the vacuum regulator-check unit

The water bath temperature shall be automatically regulated by controlling the heater via a thermostat. The thermostat shall be set to acquire the required superheat. The gas chlorine shall be superheated to at least 11°C above the chlorine evaporating

temperature on leaving the evaporator to prevent chlorine reliquefaction in the process piping. The nominal operating temperature of the water bath shall be approximately 82°C. The water bath shall have an automatic level controller incorporating electrodes for accurate level sensing and top up control. High and low water level alarms shall be initiated when water level is beyond the control limits. The water filling shall be controlled automatically by a solenoid valve. The heating system shall be cut-off on low water level alarm or high water temperature alarm conditions.

1.3 Protection

1.3.1 Gas chlorine outlet piping

A pressure relief system shall be provided in the gas outlet to prevent excessive gas pressure build-up inside the pressure cylinder. The relief system shall be of the 2 stage type. Stage 1 of the system shall have a non-fragmenting rupture disc, which shall be rated according to the nominal water bath operating temperature, and connect to a diaphragm sealed pressure switch for alarm initiation and indication in the event of a ruptured disc. The rupture disc shall be suitable for vacuum operation on the pressure side. Stage 2 shall have a pressure relief valve which will be set to open at 3800 kPa. The pressure relief valve will be connected to the vent line leading to the location of the nearest leak detector and the intake of the chlorine scrubber extraction system.

The diaphragm sealed pressure switch shall initiate an external alarm before the relief of the gas pressure. The pressure relief valve shall automatically reset when the pressure is reduced. A chlorine gas filter (spray-catcher) shall be installed in the gas discharge piping for filtering purpose and to safeguard against carry-over of impurities and liquid chlorine.

1.3.2 Liquid chlorine inlet piping

A pressure relief system shall be provided for the protection of liquid chlorine inlet piping against hydrostatic rupture due to thermal expansion of liquid chlorine trapped between closed valves. The system shall consist of a tee for connection to the liquid line, a non-fragmenting rupture disc of approximately 2760 kPa, expansion chamber and a diaphragm sealed pressure switch. The expansion chamber shall be designed for a minimum service pressure of 3800 kPa and shall have a minimum capacity of 20% of the liquid chlorine piping to be protected. Any trapped liquid chlorine shall be contained in the expansion chamber after expansion. The pressure switch shall be used to initiate an external alarm.

All interconnecting pipework, mounting brackets, supports etc shall be included. A metal or hard plastic tag shall be provided with each rupture disc assembly, for attaching to the fitting. The tag shall indicate the part number, size and rupture pressure of the disc.

All fittings including the expansion chamber shall be constructed according to the recommendations of the chlorine institute or similar body. The expansion chamber shall also meet the unfired pressure vessels code or standard of the country of manufacture.

1.3.3 Cathodic protection

The evaporator bath shall be cathodically protected against corrosion by long lasting sacrificing magnesium anode. The cathodic current shall be monitored and adjusted manually.

1.4 Instrumentation and control

Instrumentation and control of the chlorine evaporator shall comprise the following :-

- (a) Automatic water bath level top up control
- (b) Automatic water bath temperature control
- (c) Water bath level sight glass
- (d) Water bath high and low level indication lamps and volt-free outgoing contacts
- (e) Water bath temperature high and low indication lamps and volt-free outgoing contacts
- (f) Water bath temperature gauge
- (g) Chlorine gas temperature gauge
- (h) Evaporator outlet chlorine gas pressure gauge in compliance with WSD Standard Specification EM-02-09
- (i) Cathodic protection system control with milli-ammeter and potentiometer
- (j) Water bath recirculation pump control (where applicable)
- (k) Outgoing control contacts for vacuum regulator-check unit for automatic shut-off

2 CONSTRUCTION

- (a) The evaporator shall be designed and fabricated in accordance with Pamphlet 9 of Chlorine Vaporizing Systems by the Chlorine Institute, INC., Section VIII - Div. 1 of the ASME Boiler and Pressure Vessel Code and comply with all statutory requirements of the Hong Kong Special Administrative Region.
- (b) The minimum rated pressure of the cylinder shall be 3800 kPa.
- (c) The pressure cylinder shall be hydrostatically tested to 1.5 times the rated pressure for at least 30 minutes.
- (d) The unit shall be suitably lagged with thermal insulation blanket to achieve the

best thermal efficiency.

- (e) The water heater shall be easily accessible for replacement and servicing without the requirement for draining of the water bath. For water heaters over 5 kW, the electricity supply shall be 380V, 3-phase, 4-wire, 50 Hz.
- (f) The water bath piping system shall have a nominal pressure rating of 1600 kPa. The piping for overflow, drain and vapour vent shall be provided for the water bath. The water bath shall be hot-dip galvanized steel or corrosion resistant stainless steel.
- (g) Large and easy access chamber or lift off lid shall be provided for the routine inspection and cleaning of pressure cylinder.
- (h) Provision shall be made for anchoring of the unit on the floor.

3. AUXILIARIES

The following auxiliary equipment shall be provided :-

- (a) Chlorine gas and liquid piping pressure relief system completed with pressure switches for initiation of alarms and automatic shut off of liquid chlorine supply
- (b) Water bath inlet valve, drain, overflow, vapour vent piping
- (c) Chlorine gas filter (spray-catcher)
- (d) Pressure gauge at evaporator outlet (reference to EM-02-09)

The following consumables and spares shall be supplied with the evaporator unit:-

- (e) Gas filter membrane units
- (f) Spare gaskets
- (g) Tool kit
- (h) Sodium sulphate (500g) for the cathodic protection system
- (i) Rupture discs
- (j) Pressure relief valve