Chapter – 21 Purge and Refrigerant Transfer

Purge

Purge Unit is to remove none condensable gases and moisture from the refrigeration system. Non-condensable gases are mainly air and moisture. Moisture mixes with refrigerant might cause harmful acids and is harmful to the performance of the refrigeration system. Non condensable gases in the system are accumulated in the high side such in condenser; cause the condensing temperature to rise which increases the power consumption. Therefore, the main purpose of use purge is to improve the system efficiency and to reduce the power consumption.

Where to use purging unit:

1. Purge unit is used for the refrigerant refrigeration system when the refrigerant pressure is below atmospheric pressure under normal temperature.

2. Use for refrigeration system that the suction pressure is below atmospheric pressure.

3. Very often, refrigeration system is improperly evacuated or purging after a portion of the system is opened for service or maintenance, particularly large refrigeration system. Purge unit is a very effective tool to restore the optimum efficiency of the refrigeration system.

In any case, the purge is a relatively inexpensive item as compared to total capital spending and yet is one of the best investments to ensure the peak efficiency of the refrigeration system.

Connecting point for purge:

For air cooled condenser or evaporative condenser system – The purge connection should be on top of the receiver if the receiver is located in a cool place. If the receiver is located in a warm space, the purge connection should be located at the top of liquid outlet of the air cooled or evaporative condenser.

For water cooled condenser system – The purge connection should be on top of the water cooled condenser if no receiver. Otherwise, the purge connection should be on top of the other side of the receiver away from the liquid inlet.

Methods of purge:

The least expensive way of purging is just use a manual purge valve. A lot of
refrigerant is wasted if the manual purging is done directly to atmosphere without a refrigerated purge, because non-condensable gases are mixed with refrigerant. Therefore, manual purging is not economical and also might not be acceptable to environment concern.

Thermal drum refrigerated purge is the most popular purge arrangement being used for refrigeration application today. Figure 21-1 is a typical single drum purge arrangement and Figure 21-2 is a typical double drum thermal purge unit. Compressor type purge was used in the old days and is rarely used in today’s application.

The double drum purge unit is used for those cases that a greater degree of refrigerant recovery in the purging operation is desired and it is often used for low temperature refrigeration systems.

The working theory of thermal drum purge is to introduce high pressure liquid from receiver and evaporating in the coil inside of the drum. The mixture of refrigerant and non-condensable gases enters to the drum; the refrigerant vapor is condensed and returned to the system. The build-up of non-condensable gas pressure in the drum will activate a pressure regulating valve and is released to atmosphere. Any water moisture which is condensed along with the refrigerant vapor will float on the surface of the refrigerant liquid in the bottom of the drum and is to be bled of manually.

**Refrigerant Transfer**

The transfer unit is used to transfer the refrigerant from one part to another part of the refrigeration system for the conveniences of service and maintenance. Transfer unit is mostly provided for centrifugal refrigeration system because centrifugal compressor cannot be used for refrigerant evacuation. Transfer unit is rarely used for reciprocating or screw compressor system because both reciprocating and screw compressor are positive displacement machine, it can be used to pump the refrigerant down to receiver without the transfer unit.

The typical flow diagram for refrigerant transfer unit is shown in Figure 21-3. The scope of a transfer unit includes a small compressor of 3 HP, 5 HP, 7-1/2 HP or 10 HP, water cooled or air cooled condenser and service valves as shown in Figure 21-3. Connection (A) is usually connected to top side of the condenser or evaporator; Connection (B) and Connection (C) are usually connected to a receiver.

Some case the transfer unit is included as part of the centrifugal system which is with storage receiver to provide the service convenience.

**Pumpout System**

If the transfer unit is not part of the system and it is constructed with a receiver as a portable unit, this unit is a pumpout system and it is shown in Figure 21-4. The receiver in this pumpout unit is referred to as pumpout receiver. Figure 21-4 shows a typical pumpout system connected to a critical charged centrifugal refrigeration system. Critical charge system is a refrigeration system without a storage receiver. For off season shutdown or for system service and maintenance, the refrigerant is pumped out to the pumpout receiver."
Figure 21-2  Double Drum Thermal Purge Unit
Figure 21-3  Typical Transfer Unit with Air-Cooled Condenser
The operation of the pumpout system is described as the following:
1.0 **Liquid drain from evaporator to pumpout receiver** – Open V1, V2, V3, V4 and V8, close other valves. The pumpout receiver needs to be located below the evaporator for this operation.

2.0 **Transfer liquid from evaporator to pumpout receiver** – Open V1, V6, V3, and V4, close other valves, run the compressor of the transfer unit.

3.0 **Evacuate refrigerant gas from system to pumpout receiver** – Open V4, V8, V7, V9, and V5, close other valves, run the transfer unit.

4.0 **Transfer liquid from pumpout receiver back to the system** – Open V1, V4, V8, V7 and V2, close other valves, run the compressor of the transfer unit.

The process of evacuating refrigerant from the system to a pumpout receiver is referred to as pumpout cycle.

**Pumpdown Cycle**

If the refrigeration system is equipped with storage receiver as part of the system and the compressor is a reciprocating or screw, the refrigerant in the system can be pumped down to the receiver for system service. The process and operation of pumping down the refrigerant to storage receiver is referred to as pumpdown cycle. The pumpdown cycle can be designed for automatic operation with automatic valves and low pressure cutout.

**Liquid Transfer from Suction Trap (Scrubber)**

Suction trap (scrubber) is to prevent any liquid slug over from the evaporator. When the refrigerant liquid in the suction trap (scrubber) is accumulated over the setting of high level alarm, the liquid must be removed from the suction trap for continuous safe operation of the refrigeration system. The suction trap must be provided with some means of facility for liquid removal; otherwise, the system will face a great deal of operational difficulty in case the trap is full of liquid.

There are several ways to remove the liquid from the suction trap without shutdown the refrigeration system, the followings are some of the possible arrangements:

(a) Figure 21-5 shows a method of liquid removal by draining. The liquid drains to the external drum first and then close the drain and equalizing valves, use high pressure gas to push the liquid back to intermediate receiver or intercooler through a pressure regulating valve. The liquid can be gravity drain back to system receiver if the external drum is high enough to allow gravity drain passage.

(b) Figure 21-6 shows the methods by evaporating the liquid inside of the suction trap. One is to use electric heater and one is to use steam or hot water through the heat exchanger coil; the liquid is evaporated and return to compressor suction. It is important to drain the water completely out from the coil after the operation if steam or hot water is used, otherwise the water inside of coil will freeze and it might create a great deal of damage.
Figure 21-5  Liquid Removal by Draining

Figure 21-6  Liquid Removal by Evaporating
Figure 21-7  Liquid Removal by Discharge Hot Gas

Figure 21-8  Liquid Removal by Liquid Pump
(c) Figure 21-7 shows the method to remove the liquid by using compressor discharge hot gas. The hot gas is condensed in the coil, liquid in the suction trap is evaporated and return to compressor suction. The condensed liquid is collected in the liquid receiver then returns to intermediate intercooler, or drains to high pressure receiver if pitch slop allows.

(d) Figure 21-8 is the method use refrigerant liquid pump to return the liquid back to the system.

All the above methods can be designed and constructed for automatic instead of manually operated.