



Technical Bulletin

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COLMAC INTRODUCES DX AMMONIA WITH SMART HOT GAS 'SHG' DEFROST (PATENT PENDING)

Introduction

In the past, the application of direct expansion (DX) in industrial ammonia refrigeration systems was limited to suction temperatures above 0F (-18C). Industrial ammonia systems operating at temperatures below 0F (-18C) have typically used liquid overfeed (pumped) or gravity flooded evaporator feed.

To date the unique characteristics of ammonia relating to evaporator circuiting design, along with the influence of water in ammonia on evaporator and expansion valve performance, have not been well understood and accounted for in the design of DX ammonia refrigeration equipment and piping.

New Technology

Colmac is pleased to announce a breakthrough in industrial ammonia refrigeration technology that allows the application of direct expansion with ammonia over the complete range of operating temperatures, from -40F to +40F (-40C to +4.4C). When compared to conventional pumped and gravity flooded systems, this new approach results in industrial ammonia refrigeration systems having:

1. Reduced Ammonia Charge,
2. Reduced Operating Cost, and
3. Reduced First Cost

Incorporated in the Colmac DX Ammonia system is another breakthrough in ammonia evaporator design, the new Smart Hot Gas ('SHG') defrost. This approach to hot gas defrosting DX ammonia evaporators increases defrost efficiency by:

1. Reducing the amount of time required for pump down,
2. Shortening defrost duration (to only 7-10 minutes), and
3. Elimination of hot gas "blow-by" at the end of defrost.

Reduced Ammonia Charge

Both pumped and gravity flooded ammonia refrigeration systems require relatively large inventories of liquid ammonia circulating between various vessels and the evaporators. The Colmac DX Ammonia system operates with the minimum amount of ammonia inventory possible, thereby reducing health and safety risks associated with ammonia toxicity and flammability.

The reduced Colmac DX Ammonia charge inventory may also present the operator with the possibility of reduced insurance rates, and reduced EPA and OSHA regulatory requirements. The amount of reduction in ammonia charge (by mass) for various components is shown in the table below:

**TABLE 1
AMMONIA CHARGE REDUCTION**

Component	Reduction in Ammonia Charge
Evaporator	30X
Liquid Line	4X
Suction Line	10X
Recirculator Vessel	Eliminated

The following example illustrates the reduction in ammonia charge for a 200TR (700kW) cold store at -20F (-29C) suction temperature:

**FIGURE 1
AMMONIA CHARGE REDUCTION EXAMPLE**

Ammonia Charge Reduction Example: 200TR @ -20F SST							
Colmac DX Ammonia vs. 4:1 Pumped Ammonia							
Component	4:1 Pumped Ammonia			Colmac DX Ammonia			Charge Reduction lbs
	Size	Internal Vol cu ft	Charge lbs	Size	Internal Vol cu ft	Charge lbs	
Evaporators	8 Row	50	1500	8 Row	50	50	1450
Liquid Line	2-1/2" x 300'	10.3	443	1-1/4" x 300'	2.58	111	332
Suction Line	8" x 300'	106	51	6" x 300'	60	4.1	46.9
Recirculator Vessel	12" x 5' Liquid Leg	5	170	N/A	0	0	170
Totals			2164			165	1999

Conclusions drawn from the example above:

1. The Colmac DX Ammonia system reduced the ammonia charge by 10 lbs/TR (1.3 kg/kW).
2. The reduction in charge is in the occupied space, another health and safety benefit.

Reduced Operating Cost

The Colmac DX Ammonia system with Smart Hot Gas defrost significantly reduces electrical power consumption (and therefore CO2 emissions) due to the following:

1. Elimination of ammonia liquid recirculation pumps,
2. Continuous removal of water, and
3. Optimized hot gas defrost featuring:
 - a. Minimized defrost duration,
 - b. Minimized convective heat loss to the refrigerated space, and
 - c. No hot gas “blow-by” at the end of defrost.

Reduced First Cost

Because the mass flow rate of ammonia is reduced by 3 to 4 times compared to a pumped ammonia system, the sizes (and therefore first cost) of several components is reduced. Table 2 below shows the reduction in pipe and component sizes for the previous example (see Figure 1 above):

**TABLE 2
REDUCTION IN COMPONENT SIZE**

Component	Pumped Ammonia	Colmac DX Ammonia
Liquid Line	2-1/2"	1-1/4"
Suction Line	8"	6"
Recirculator Package	---	Eliminated
High Pressure Receiver	---	Reduced Volume

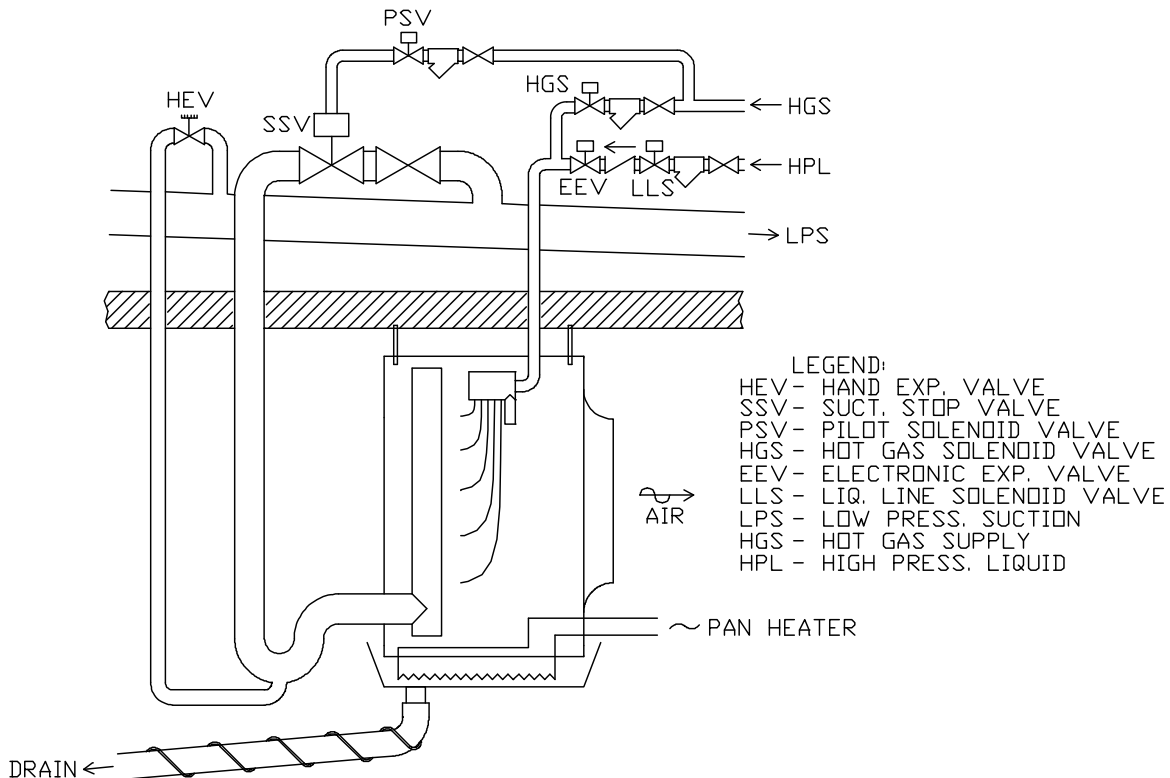
First cost is also reduced due to:

1. Smaller ammonia system charge (less ammonia to purchase), and
2. Simplified, smaller, defrost control valves.

Colmac Smart Hot Gas Defrost Piping

Hot gas defrost piping is greatly simplified with the new Colmac Smart Hot Gas Defrost system. Figure 2 shows typical defrost piping arrangement for a ceiling hung air cooler with piping and control valves mounted overhead. Note that pan heating is provided by electric resistance. This feature minimizes the number of roof penetrations and allows close control of pan pre-heating and post-heating during the defrost cycle. Pan heating by hot gas pan loop is also available.

**FIGURE 2
SMART HOT GAS DEFROST PIPING DIAGRAM**



Typical Smart Hot Gas Defrost Sequence of Operation

1. Air pressure differential sensor indicates frosted condition (coil ready for defrost)
2. Liquid Line Solenoid (LLS) closes
3. Timed pump out for 5-10 minutes
4. Fan(s) stop
5. Pan heaters energized for timed pan preheat (2-3 minutes)
6. Hot gas solenoid and pilot solenoid (closes suction stop valve) open
7. Timed defrost (6-8 minutes)
8. Hot gas solenoid closes
9. Suction stop valve opens after 2 minutes
10. Open LLS
11. Pan heater de-energized
12. After 5 minute cool down delay fans restart

Colmac DX Ammonia with Smart Hot Gas Defrost Benefits

- Energy Efficient
 - Demand initiated defrost
 - Minimized defrost time
 - Maximized defrost efficiency
 - Electronic Expansion Valve technology maximizes evaporator performance
 - Integrated VFD fan speed control available
- Cost Effective and Reliable
 - Simplified control valve group
 - Automatic Operation
- Safe
 - Lowest possible ammonia charge in refrigerated space
 - No control valves or flange joints located in the refrigerated space (reduced risk of ammonia leaks)
- Innovative
 - Microprocessor-based controller communicates with standard BMS protocols (BACnet, LonWorks, Modbus, etc)
 - Patent Pending

Conclusion

The new Colmac DX Ammonia system with Smart Hot Gas (SHG) defrost, is now available and offers ammonia refrigeration operators the following important benefits when compared to conventional pumped and gravity flooded ammonia designs:

1. Improved Health and Safety
2. Reduced Environmental Impact
3. Increased Profits, and
4. Greater ROI

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