



Advanced DX Ammonia (ADX) Proves Sustainability

Case Studies

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#1 Project Drivers

What is behind the resurgence in interest in Ammonia DX Systems?

- *Ammonia is a natural refrigerant with excellent heat transfer characteristics,*
- *Ammonia has zero ODP and zero GWP*
- *Ammonia is toxic and, in unusual cases, can be flammable*
- *Therefore, the size of a refrigerated facility's charge is of keen interest from a number of perspectives:*
 - ✓ *Regulatory*
 - ✓ *Liability*
 - ✓ *Practicality*

#2 Joliet Cold Storage

The Facility

Project Description:

- *Owner: Joliet Cold Storage, Joliet, IL*
- *New Public Refrigerated Warehouse, 403,000 sq ft*
- *Total Refrigeration Load: 1,007 TR*
 - ✓ *-10 deg F Freezer and Convertible Rooms @ 801 TR*
 - ✓ *+40 deg F USDA Room and Loading Dock @ 206 TR*
- *Economized screw compressors with thermosyphon oil cooling*



Evaporator Design and Construction



Liquid Feed Valves and Controls



#4 Considerations

- **Energy Considerations:**
 - Power consumption is less than with HFC
 - Power consumption is same or less compared to pumped ammonia
 - No pumps
 - No wet suction lines
 - No variable recirculation rates
- **Refrigerant Charge Considerations:**
 - DX Ammonia Charge: 7,300 lbs (7.2 lbs/TR) – well below current TQ
 - Estimated Pumped Ammonia Charge: 25,175 lbs (@ 25 lbs/TR)
 - Risk factors decreased
- **Cost Considerations:**
 - First cost approximately \$150,000 less than PRL System
 - Operating costs should be significantly less
 - Energy
 - Personnel
 - Regulatory requirements

#5 Meeting The Challenges

- *Advanced DX Ammonia allows industrial refrigeration systems as large as 1,800 TR with a system ammonia charge under 10,000 lbs.*
- *Offers a value-added alternative to HFC commercial systems.*
- *Addresses technical challenges critical to proper operation of DX ammonia at low temperatures:*
 - *Stratified/wavy flow in evaporator tubes*
 - *Water in ammonia*
 - *Refrigerant distribution in evaporators*
 - *Supply of clean, dry, subcooled ammonia to evaporators*

#5 Meeting The Challenges

- ***Optimal performance is achieved through:***
 - *Advanced evaporator designs*
 - *Proper liquid distribution – ensuring complete wetting of internal tube surface*
 - *Liquid feed valves which can precisely meter refrigerant flow*
 - *Reliable sensors, controllers, and control algorithms*
- ***Danfoss electronic controllers and motorized valves have demonstrated the viability of Ammonia DX, even at low temperatures, for over a decade.***

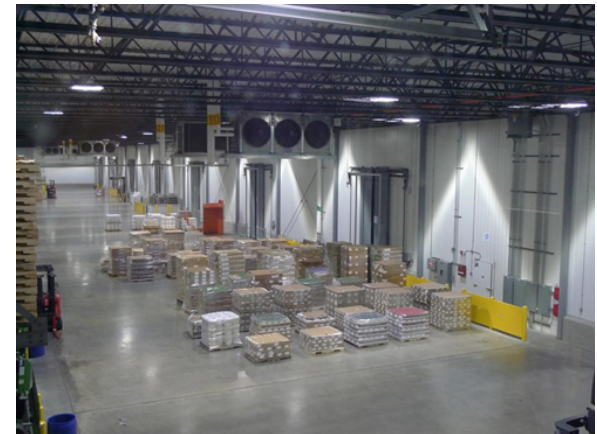
#6 What Does The Future Hold?

Accelerating Adoption of Advanced DX Ammonia!

Joliet Cold Storage – Joliet, IL*
United States Cold Storage – Laredo, TX
Bolthouse Foods – Bakersfield, CA
Preferred Freezer – Richland and Lynden, WA
Shepherds Egg Farm - Spanish Fork, UT*
Bidvest Tamworth & Perth - Australia*

*Several new facilities in design phase
at this time*

**Projects originally proposed using HFC's.*



#6 What Does The Future Hold?

Joliet Cold Storage, Originally proposed using HFC's

- **HFC's first considered:**
 - *Due to lower first cost for facility owner*
 - *Reduced installation time for contractor*
 - *Initial regulatory requirements*
- **Ammonia's advantages led to the ultimate decision:**
 - Lower energy cost for facility owner
 - Lower life cycle cost of system
 - Future move from HFC's not required
 - Ease of maintenance with central plant
 - Room for future expansion with limited additional equipment

*Advanced DX Ammonia now represents a proven technology.
However, successful operation depends on:*

- ***Electronic Controls***
 - *Proper sensor locations*
 - *State of the art control algorithms*
- ***Water and Oil Management***
- ***Evaporator design***
- ***Technician capability***

Charge Reduction is a key area of concern for the business person and, in particular, for the owners of Public Refrigerated Warehouses.

There are many emerging technologies in various stages of development targeting the reduction of refrigerant charge at either the component or system level.

What lies ahead in terms of regulation and oversight is unknown but it is a safe bet that the rules will not ease up. It is a good business decision to eliminate potential “hot spots” early in the design process.

Advanced DX Ammonia systems offer a safe, proven technology for all industrial refrigeration system designs, while potentially eliminating a large amount of the regulatory and liability burden that accompanies large charge systems.

#9 Conclusions

- *Ammonia is a proven refrigerant with some of the best heat transfer characteristics of all refrigerants*
 - *It is a natural refrigerant*
 - *It is inexpensive*
 - *It is plentiful and does not look like it will be a procurement risk in the years to come*

- *Advanced DX Ammonia is now a proven technology and is becoming more popular every day*

Questions

