Designing for DX Technology: Four Steps

The movement toward low-charge systems is growing in popularity in the ammonia refrigeration industry for several reasons, and one effective way to significantly reduce ammonia charge is to design and operate evaporators using DX [direct expansion] technology.

The reduction in the amount of ammonia needed to refrigerate a facility reduces the risks associated with an ammonia release, both to people and to products. A smaller system ammonia charge makes for a safer facility, reducing the potential for unforeseen regulatory requirements for small facilities operating with ammonia.

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large facilities and opens the industry to potential new applications for ammonia in smaller commercial systems.

The use of DX ammonia can reduce the evaporator charge by as much as 30 to 30 times compared with bottom-feed flooded or pumped designs. In other words, when the evaporator is operated with DX ammonia, it contains only 1/30th to 1/50th the amount of ammonia used in traditional pump ammonia evaporators, significantly minimizing safety risks. In addition to reducing the ammonia charge, DX technology also reduces power consumption and greenhouse gas emissions by eliminating the need for the liquid overloaded pumps and by minimizing suction line pressure losses — a result of operating suction lines dry instead of wet. Finally, because of smaller vessel and monia to freezers, blast freezing and other low-temperature applications,” said Bruce Nelson, president of DX system manufacturer Colmunc Coil Manufacturing and author of the DX Ammonia Piping Handbook.

The magnitude of the reduction in ammonia charge made possible by DX ammonia also reduces regulatory requirements of the Environmental Protection Agency, Occupational Safety and Health Administration and the Department of Homeland Security, and potentially cuts insurance risk and premiums. That is because DX technology allows the building of a large cold storage facility, one with up to 1,500 tons of refrigerating capacity, using a total on-site ammonia charge under the 10,000-pound regulatory threshold.

“Once you get over 10,000 pounds all three federal agencies take an intense interest in what you’re doing,” Nelson said. “With the new DX technology now available, you can operate a large facility with only six to seven pounds of ammonia per ton of refrigeration. When you use secondary fluids to cool the higher temperature rooms, you can drive that down to less than three pounds of ammonia per ton of refrigeration.”

Before designing and installing a system using DX technology, Nelson said the following four steps should be followed:

1. The evaporator must be carefully selected to include the proper type of tubing which includes an internal enhancement design specifically for DX ammonia. The high ratio of vapor to liquid specific volume of ammonia at low temperatures, combined with its very high latent heat of vaporization, creates an unavailable separation of vapor and liquid phase inside evaporator tubes. This separation of phases causes the liquid ammonia to run along the bottom of the tubes, leaving the top of the tubes completely “dry.” The result is extremely poor evaporator performance and low-voltage safety. The new DX technology solves this problem with an enhancement technique that mitigates that separation to improve performance even at low temperatures.

2. The system must be designed to capture and remove water from the ammonia. Even small amounts of water in the ammonia will significantly penalize DX ammonia evaporator performance.

3. There must be proper piping for handling defrose condensate. In a pumped ammonia system, defrost condensate is normally returned to one of the recirculator vessels where it is simply pumped back out, or “recirculated,” to the evaporator. In DX ammonia evapor者的 system, condensate is not recirculated and must be carefully considered in the system design. The best approach is always to return defrost condensate to the high-pressure suction accumulator or intercooler, where it can be used to do useful work such as subcooling high-pressure liquid and intercooling low-pressure discharge gas.

4. Proper control and distribution of the expanded ammonia to the evaporator coil is critical for good performance. Using an electronic expansion valve with its matched superheat controller is key to stable control of the evaporator. A suitable evaporator distributor is also important to ensure uniform delivery of the expanded ammonia to all of the evaporator circuits while also allowing unrestricted flow of hot gas during defrosting.

In summary, DX ammonia technology offers three major benefits.

First is the inherently safer design resulting from the significant reduction in ammonia charge. Second, DX ammonia reduces power consumption and operating costs making it attractive not only for industrial facilities but also for commercial applications previously dominated by HFCs. Finally, the cost of installing DX ammonia is lower than traditional pumped ammonia designs.

“First and foremost, DX ammonia technology reduces the amount of ammonia needed to refrigerate a facility, so it is inherently a safer technology,” Nelson said. “You’re also offering the end user the very attractive benefits of lower first cost and lower operating costs.”

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