KEEP IT COOL

REFRIGERATION ENGINEERING NEWS *from* **emanuelson-podas** | Q1.25

How AI Is Reshaping Refrigeration

AI is a hot topic that's transforming nearly every industry today. That includes the grocery business, where the integration of AI into cooler designs promises to improve efficiencies and reduce risks. Of course, automation — a form of AI — has long played a role in refrigeration. But at EP, we see AI having the most impact in three key areas:

1 Dynamic Leak Detection

It's a fundamental truth that as equipment ages, leaks develop in refrigeration systems. And even small leaks can lead to big problems. The worst leaks, of course, are those that result in compliance violations — potentially threatening the entire operation.

But identifying leak sources can be complicated. That's where AI-assisted monitoring is most effective, zeroing in on pressure changes and other issues so technicians can respond to leaks quickly. AI may even eventually become predictive — capable of pinpointing potential sources of future leaks based on such factors as age, placement, usage, etc.

2 Store Layout Optimization

AI has the potential to help unearth unique design solutions for refrigeration systems. What's more, engineers can use AI to test dozens of scenarios quickly, determining optimal placement of refrigeration equipment within a space.

For example, a designer seeking to balance cooling loads and reduce pipe costs without overloading the cooling system can leverage AI to run calculations on multiple design scenarios. Designers can also use AI to identify spots where leaks and other problems are most likely to occur and create extra space in the design that allows technicians to more easily access the area for repairs.

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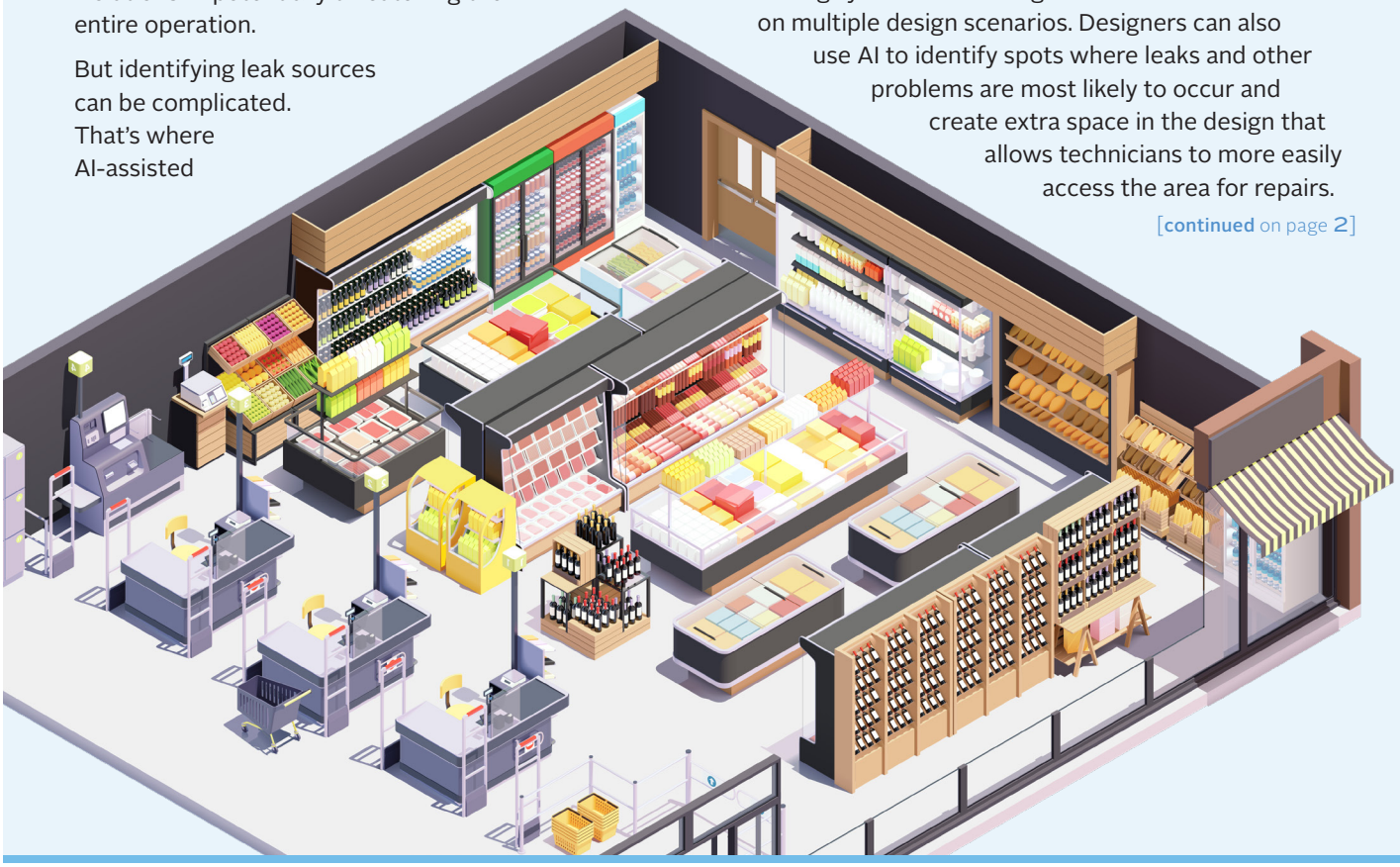


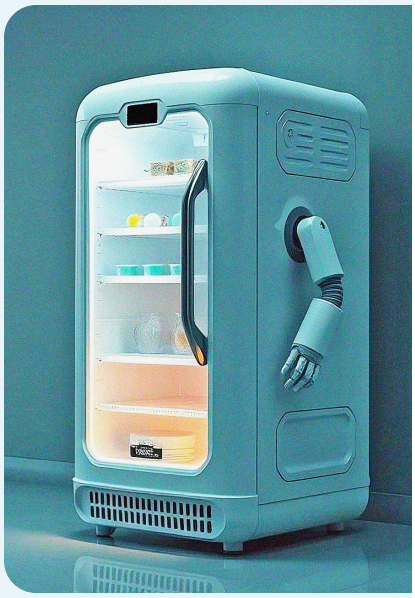
3 Digital Twins for System Simulation

If you haven't already heard of digital twins, it's only a matter of time. Making an AI replica or "twin" of a refrigeration system allows designers and operators to simulate store conditions. We can test different refrigeration setups before installation, reducing design flaws and ensuring optimal airflow and energy use.

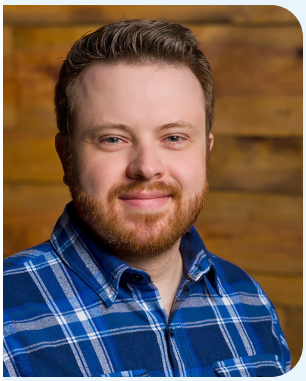
For designers, digital twins promise to reduce errors by flagging flaws in the system design before it is built. The twin acts as a virtual model, allowing engineers to "test" the system for potential problems prior to construction. An additional application for digital twins could be training new employees, allowing them to develop their skills at understanding or troubleshooting the system in a virtual model.

Looking Ahead

It's too early to predict how extensively AI will change refrigeration design. And in all these cases, it's important to comply with the client's privacy policies. But one thing seems clear: AI can benefit designers and operators — and at least in refrigeration design, that means it's here to stay.



Six Things MEP Designers Need to Know about Refrigeration



Refrigeration design involves challenges that go beyond basic MEP work. EP engineer Kaben Hoffman learned that firsthand when he took on his first refrigeration-design gig a few years ago. Now, with several jobs under his belt, he's a pro — and is able to tell our partners why they should hire a professional when designing grocery or other spaces that require cooling. Courtesy of Kaben, here are six things designers need to know about refrigeration:

1 Remember the case cooling credit.

The added cooling from refrigerated display cases needs to be accounted for in your heating and cooling loads. You should calculate your heating and cooling loads as normal, and then subtract the case cooling from your cooling load and add it to your heating load. Be aware that some load-calculating programs do not handle the calculations well if you add this into the program.

2 Account for humidity levels and condensation.

Because the cases and walk-ins generate lots of cool air, it can be challenging to dehumidify the space. You'll need to de-couple the HVAC system's ability to cool and to dehumidify (dry) the air to avoid overcooling to dry already cooled air. To deal with humidity, the system should use dual path cooling for a main AHU or Dedicated Outdoor Air System units. Dual path cooling is when the unit has separate cooling coils for the outdoor air and the return air so it can cool the air streams separately before mixing them. Keep in mind you want to distribute air to avoid disturbing the air curtains of open cases. Most of the air should be distributed in exterior zones, near service counters, and the dry goods section. Directional or low throw/velocity diffusers can be useful to avoid disturbing air curtains on cases.

3 Remember clearances required for exhaust.

Purge exhausts are required to be 20' from operable openings and air intakes into the building. Most of the time this will mean you want to go through the roof with the exhaust since the required separations plus space for other utilities requiring outdoor wall space is a difficult constraint.

4 Factor in makeup air.

You need to make sure you provide adequate makeup air for when the refrigerant leak-exhaust is running. Per code, it cannot be transfer air or part of another system, so it needs to be brought in from outside the building. If you are in a cold climate, you will need to make sure you provide enough heat to prevent freezing in your machine room.

5 Know the local code.

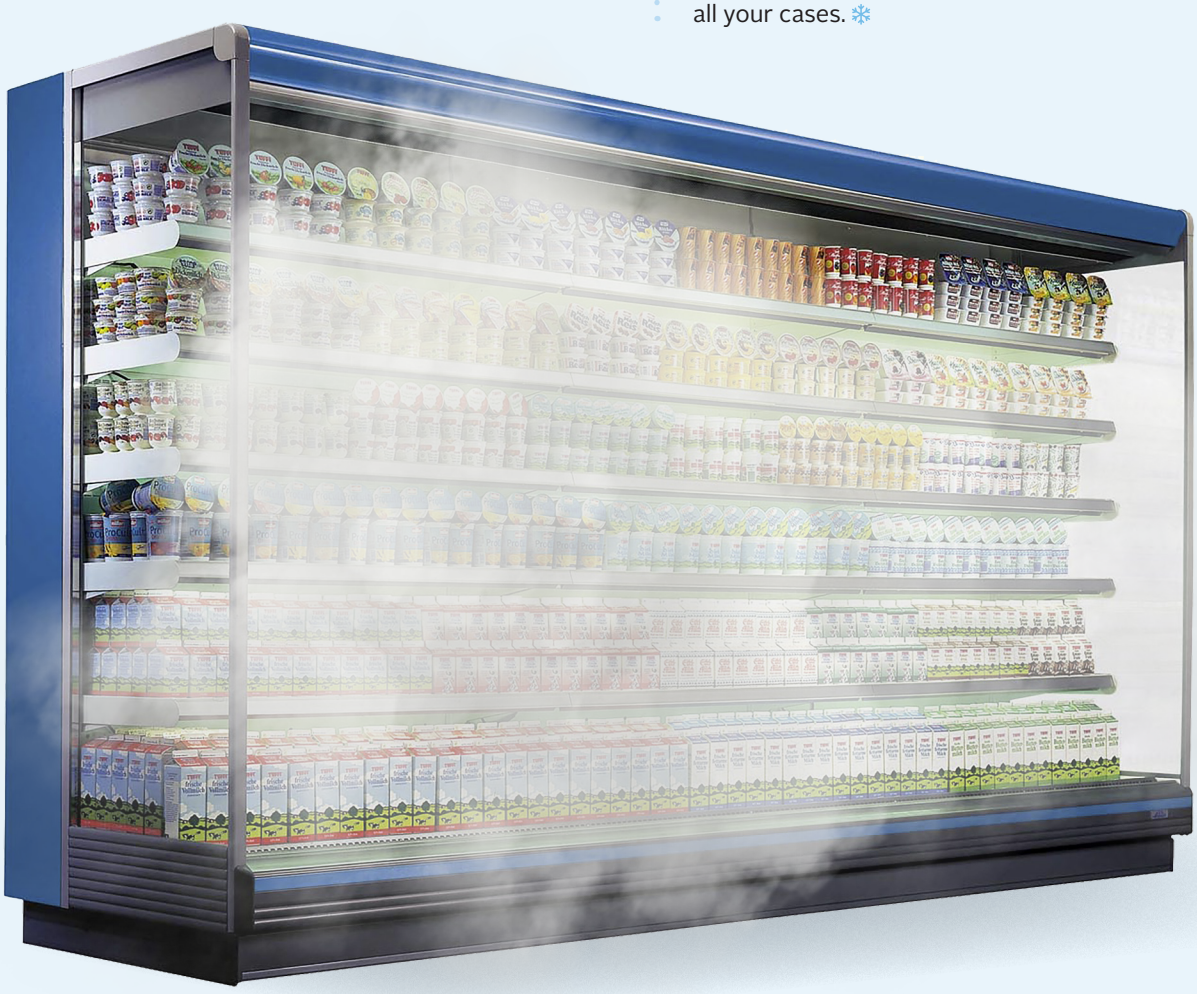
Many jurisdictions will have requirements for combi waste systems and circuit vented systems.

You will want to take advantage of some form of specialty or engineered venting system to drain condensate from remote cases and reduce the installation cost of the plumbing waste and vent system in the building. Some jurisdictions will have requirements for the types of drains that are allowed for refrigerated case condensate — be it hub drains, floor sinks, or floor drains with funnels.

Also, utilities can sometimes request that condensate be drained into storm or into a dry well. The MEP engineer will need to effectively communicate the differences of condensate from food zones, such as refrigerated cases versus condensate for space cooling.

6 Evaluate options based on what is available.

Condensate vacuum systems or condensate pumps can be useful alternatives to a more conventional waste/vent system. They don't require cutting into an existing slab if you do not have the sanitary invert to conventionally drain all your cases.



SCENE & HEARD

Back in February we participated in the 2025 AHR Expo in Orlando. EP staff members Kevin Galbraith, John Nordstrom, and Kaben Hoffman attended multiple sessions, and here are a few of the highlights:

- Multi Stack had a large air source CO_2 heat pump on the show floor. These are amazing pieces of equipment, harnessing CO_2's advantageous heat capacity and high thermal conductivity. We were impressed!
- The technical sessions we attended on A2Ls had good information. The general consensus is that legal challenges aren't likely to change the course of requirements for use of low-GWP and A2L refrigerant.
- We especially enjoyed the technical session by Trevor Mathews from Refrigeration Mentor on supermarket CO_2 refrigeration design.