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Excess Oil: Problem Solved

Accessory Controls Oil Levels in High-Pressure Systems

By Jack Sine
For *The News*

Excess oil on the refrigerant side of chillers is a problem that has received a lot of attention in recent years. It is a costly contaminant.

Studies conducted by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) indicate that not only does oil entrained in a chiller's refrigerant significantly degrade performance, but these chillers also use significantly higher amounts of energy. Of course, this leads to higher utility bills.

In one ASHRAE research project (601-TRP), refrigerant samples from 10 randomly selected operating chillers were analyzed for oil content. Each chiller contained varying amounts of excess oil.

The three with the lowest amounts had been serviced and had their refrigerant recycled in the last six years; their oil content still ranged from 3 percent to 7 percent. The oil levels in the remaining chillers' refrigerant ranged from 9 percent to more than 20 percent. Table 1 shows typical ranges for minor contamination levels.

To address the problem, service contractors wait until oil buildup significantly decreases capacity; then they attempt to remove excess oil from refrigerant during routine maintenance by decontaminating the refrigerant or recharging the chiller with new refrigerant.

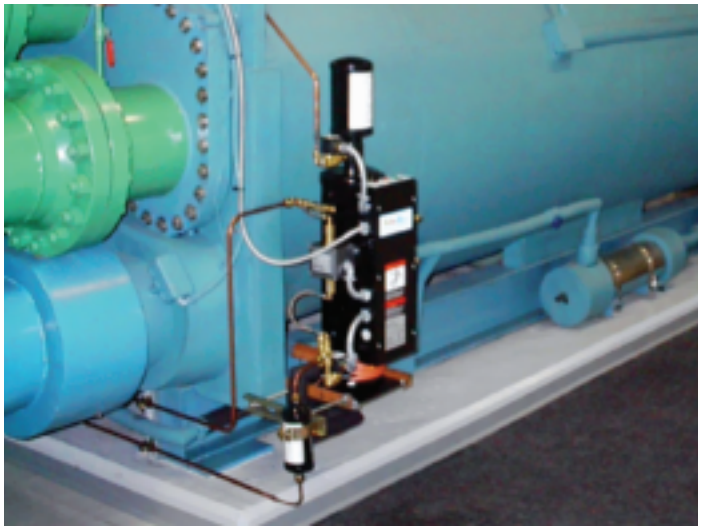
Classic Case

When there is excess oil in an operating chiller, it can cost a small fortune in higher operating costs and decreased capacity. Below is a classic example.

Bob Lee is a chief engineer for Harbor Group Management Co., a property management company. He is responsible for the maintenance of a 27-story office tower in Cincinnati.

"I had originally been an engineer in this building from 1990 to 1994, and the systems ran fine during those years," said Lee. "Then I was brought back by Harbor Group in 2002 after they had acquired the property. I noticed efficiency problems with all three chillers right away."

Bill Adkins, Chiller Group manager for DeBra-Kuempel Mechanical Contractors in Cincinnati, had been servicing the Carrier 19EA 575-ton chillers since they were installed 20 years ago. He helped explain the chillers' performance degradation.



The chiller's performance degraded from 0.89 kW/ton to between 1.1 and 1.5 kW/ton.

"The problem with excess oil started when the previous owners sold the adjoining building," said Adkins. "It had been built after the office tower and was interconnected to the original. To economize, they used the newer building's flat-plate chiller to cool the original building during the low-load times of spring and fall. That meant the three chillers only ran at higher loads during the summer. After the sale, the chillers ran for extensive stretches at low loads and the oil began to migrate to the refrigerant side."

"When I came back to the building as chief engineer, I immediately noticed the lack of efficiency," said Lee. "These chillers had a design efficiency of 0.89 kW/ton — very good for 20 years ago when they were installed. Now they were running between 1.1 and 1.5 kW/ton, and I wanted to know why. I called Bill Adkins and asked him to find the problem."

There weren't too many things to look at. Every year the DeBra-Kuempel technicians performed oil and refrigerant analyses. They did extensive preventive maintenance, and every six years they tore down each chiller for a complete overhaul.

"I was surprised when we discovered the excess oil," said Adkins. "With the annual refrigerant analysis, we thought we had it under control. But those long, low-load conditions took their

toll. We found 15- to 20-percent oil in the three chillers."

The technicians were able to pump the refrigerant load into the evaporator, boil the refrigerant back into the utility vessel, and remove the oil that remained in the vessel. It is a lengthy and costly procedure. Moreover, every time oil levels rose to a point that significantly degraded efficiency, the procedure would have to be repeated.

"If we could run steadily at 90- to 100-percent efficiency, we wouldn't have an oil problem," said Adkins. "But you can't get away from spring and fall and mornings and evenings. So we were always on the lookout for some more cost-efficient solution."

Oil Contamination

Oil In Evaporator	Performance Loss
1-2%	2-4%
3-4%	5-8%
5-6%	9-11%
7-8%	13-15%

Table 1. Typical oil levels (minor contamination) in the refrigerant of operating chillers.

A New Strategy

Adkins said he was intrigued by an oil purger for low-pressure chillers that had been introduced by one of his suppliers, Redi Controls. "We'd been getting relief valves and noncondensable purgers from them for many years," he said. "When their oil purger for low-pressure systems was introduced, it looked like a good idea on paper. It worked whether the chiller was running or not, and removed oil from the refrigerant side and returned it to the oil sump.

"I called and asked if they were working on something for high-pressure systems, thinking of the Harbor Group building problem, and to encourage them to do it if they weren't. Turns out they were working on one and would have it to market soon. I asked to be put at the head of their list."

"The Oil, Acid and Moisture [OAM] Purger was primarily designed to remove oil," said Mark Key, vice president of marketing for Redi Controls. "The acid and moisture removal are bonuses.

"Its advantages are that it connects easily to an operating chiller, performs passively and independently of the chiller whether it is operating or not, and has no effect on chiller operation, other than increasing efficiency, regaining capacity, and decreasing energy usage. Once the excess oil has been removed, the OAM Purger returns any oil that has migrated to the refrigerant side to the chiller's oil sump, where it belongs."

"We convinced Bob Lee to give it a chance on his chillers," said Adkins. "The cost of taking out the oil and the steadily dropping efficiency in between were expenses he wanted to avoid."

Doing It Right The First Time

During the installation, the DeBra-Kuempel technician took four days to put it in, as opposed to the two days suggested by the company. "We use only hard copper pipe, mechanically bent, and take our time to make sure the installation not only works the first time, but doesn't fail down the road," explained Adkins.

Once the purgers were up and running, Lee noted, "We pumped the excess oil returned from the sump into a 15-gallon drum and we filled that up the first day. Over the first few weeks we removed about 50 gallons of oil from the three chillers.

"We're just about to hit equilibrium, where the oil from the refrigerant will be sent back to the sump with no excess to extract. Then we will be running back at maximum efficiency of 0.89 kW/ton."

Lee calculated that during peak running times this summer, the purger will save about $365 a day. "It won't take long to justify [the unit] at that rate. We'll have saved what it cost us in less than a year." Ⓝ

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