JANUARY 19, 2004

Air Conditioning | Heating | Refrigeration

the NEWS

A bnp media PUBLICATION THE HVACR CONTRACTOR'S WEEKLY NEWSMAGAZINE $3.00

Products Help Schools Conserve Energy

By B. Checket-Hanks
Of *The News* Staff

School districts have concerns in addition to teaching the three R's, and controlling energy costs is an issue that is never far from the top of the list. For two different school systems with two different sets of HVAC problems, equipment modifications that corrected chiller and temperature control predicaments have helped give the schools a greener appearance in their communities.

In the case of the chiller, oil was the culprit. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has been warning that oil entrained in the refrigerant of a chiller significantly degrades performance, resulting in capacity loss — and higher utility bills.

In one ASHRAE research project (601-TRP), samples of refrigerant from 10 randomly selected operating chillers were analyzed for oil content. All of the chillers were found to contain excess oil in varying amounts. The three with the lowest amounts had been serviced and had their refrigerant recycled in the last six years, but the oil content in these three ranged from 3 to 7 percent. The oil content in the refrigerant of the remaining chillers ranged from 9 percent to more than 20 percent.

How much does excess oil in the evaporator degrade performance? Table 1 gives typical ranges for minor contamination levels.

Compared to moisture, which creates acids and leads to machine wear and catastrophic shutdowns, oil is a relatively benign contaminant. Most mechanical contractors routinely perform oil analysis to detect moisture, acids, and metal fragments. Refrigerant analysis, which reveals the presence of oil, costs five times as much to do.

Because oil usually accumulates gradually in refrigerant through migration, the attendant loss in efficiency is usually diagnosed to be some other cause. It isn't until performance has significantly degraded that oil is suspected.

So, the typical way of dealing with oil has been to wait until it becomes a serious performance problem, belatedly identify oil as the cause, and then decontaminate the refrigerant charge or install a fresh one. Unfortunately, this is an expensive solution both in the ramped-up power demands for the chiller and the cost of decontaminating or replacing the entire refrigerant charge.

Above: Working together to solve the chiller problem at Mary Bryan Elementary school are (from left) Charlie Hendrixson, technician, MSD Perry Township Schools; Michael Hilterbrand, service manager, Choice Mechanical; Rick Bennett, service technician, Choice Mechanical; and Norm Chastain, assistant director, Facilities Management, MSD Perry Township Schools. The OAM-Purger from Redi Controls is designed specifically to remove oil from the refrigerant charge and automatically return it to the chiller's oil sump.

School District Seeks Solution

Mary Bryan Elementary School in Indianapolis had a performance problem with a 100-ton centrifugal chiller that had caused the school problems for more than two years.

"It was getting prohibitive to keep sending maintenance people over to Mary Bryan," said Norm Chastain, assistant director of Facilities Engineering for the MSD Perry Township School District. "We finally had to run the backup chiller to supplement the No. 1 system just to keep everybody cool."

Mike Hilterbrand is the service manager for Choice Mechanical, the mechanical contractor that has handled Perry Township's HVAC needs for more than a decade.

"We started noticing the problem with this chiller about two years ago," he said. "Performance had started to drop."

"We noticed the problem, but had trouble identifying the solution," he added. "Nothing showed up in the oil analysis that we performed every year; so, since the problem seemed to be reduced heat transference, we figured the evaporator tubes were dirty and cleaned them during routine shutdown. That only created a minimal improvement."

After the second chiller was brought on line to make up for diminished capacity, the contractor decided to have a refrigerant analysis performed.

"We didn't routinely perform refrigerant analysis because it cost about $125, which is five times as much as a $25 oil analysis," said Hilterbrand. "We thought this gave us all the key information we needed on dangerous contaminants like moisture, acid, and metal fragments. What it didn't give us was information on excess oil in the refrigerant, and that's what showed up in the refrigerant analysis we did this spring."

The refrigerant in the chiller contained more than 20 percent oil.

"Oil contamination is something that takes place gradually by migration of tiny amounts over a period of time," explained Hilterbrand. "Unless an oil seal breaks and capacity drops dramatically, the loss of performance occurs slowly over a period of years and is often chalked up to normal wear and tear on the system. That's why ASHRAE has been warning us about excess oil and why we've been listening. We now make refrigerant analysis a standard feature of our annual service procedures."

Now that the problem was identified, the question was what to do about it.

Oil Removal

"The standard solution," said Chastain, "would be to pull the charge, replace it with a clean charge, and send the contaminated refrigerant out for reclamation. But that is both expensive and it involved shutting the system down. Jim Vance asked us to look for a more cost-effective solution that would work over the long term."

Jim Vance is MSD Perry Township's energy manager. His duty: to minimize operating costs and maximize energy efficiency in the 22 buildings that compose the school district's facilities. He has been exceptionally effective during his tenure, according to Energy Education, an outside contractor that monitors the success of such programs. Vance's efforts have reduced costs by $7.6 million over the last seven years.

"Jim Vance and Norm Chastain came to us and asked if we had a better way of dealing with oil contamination," said Hilterbrand. "We told him we'd do some research. We thought with the recent emphasis on oil contamination there might be some new technology that could fill the bill."

Hilterbrand called Redi Controls. The manufacturer was in the process of bringing to market a new, patent-pending product named the OAM-Purger (short for oil, acid, and moisture purger), designed specifically to remove oil from the refrigerant charge and automatically return it to the chiller's oil sump. Redi Controls had retained an independent lab (Intertek Testing Services ETL Semko, an ARI- and ETL-approved lab) to perform efficiency testing, and the company was looking for a case study site. Hilterbrand's timing couldn't have been better.

The purger is designed to remove oil, acid, and moisture, but its primary purpose is to remove excess oil.

"We designed this system primarily 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, operates 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."

Dramatic Results

Vance, Chastain, and Hilterbrand were hesitant at first; the performance literature on the purger seemed to be too good to be true, but the benefits outweighed the risks. Besides, the OAM-Purger worked without taking the chiller off line, so student comfort wouldn't be sacrificed.

Michael Shows, representing Intertek ETL Semko (ITS), oversaw the test at Mary Bryan Elementary School. First he needed to establish the current state of the chiller.

"It was not possible to achieve and maintain the standard rating condition of 55˚F entering and 45˚ leaving water temperatures," he reported. "During the initial test on May 7, 2003, the chiller was found incapable of achieving the standard condition without assistance from a second chiller at the facility."

The reason cited was excess oil in the first chiller. The conclusion of the test was scheduled for June 20, 2003, but some interesting events happened shortly after the testing began.

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

Table 1. Typical ranges for minor contamination levels.

"On the Friday following ITS' initial work, we installed the OAM-Purger," said Hilterbrand. "Since there was so much oil mixed with the refrigerant, we installed a 30-gallon cylinder to collect the excess oil. After approximately two to three weeks from installation, about 125 pounds of excess oil was removed from the system. The chiller was brought into equilibrium with the correct amount of oil and refrigerant, and the purger and the chiller have been operating efficiently and effectively."

Mary Bryan Elementary School in Indianapolis had experienced a performance problem with the school's 100-ton centrifugal chiller. Technicians determined that excess oil entrained in the refrigerant was diminishing the chiller's capacity. The standard solution would be to pull the charge, replace it with a clean charge, and send the contaminated refrigerant out for reclamation, but the school's maintenance department found that installing Redi Controls' OAM purger solved the problem and cost less than the alternative.

Verified By Testing

Shows reported that the unit's performance increased significantly between May 7, 2003, and June 20, 2003. "On the evaporator side of the unit, the measured tonnage increased from 75.2 tons to 92.8 tons. This was a measured increase of over 17 tons, which is a 19 percent increase in capacity.

"By taking this measure in concert with power usage, the kilowatts per ton [kW/ton] was calculated for both tests. There was a significant increase in kW/ton produced by the unit. The rate per ton of cooling decreased 19 percent (nearly a 20 percent de-crease in energy usage). This does not take into account the amount of additional cost savings associated with the decrease in operation of the second chiller, as the first chiller now obtains efficient cooling capacity alone."

Succeeding independent tests showed trace amounts of oil — 1.35 percent on July 28, 2003, and 0.88 percent on August 21, 2003.

Those results decided things for Vance. "We have asked Redi Controls and Choice Mechanical for bids on installing these purger systems in our two high schools," said Vance. "That's five chillers in total. If they work as well as they did at Mary Bryan Elementary School, we'll look at putting them in our other facilities as well." Ⓝ

Reprinted from
Air Conditioning | Heating | Refrigeration
the NEWS

Additional Installations

Joseph Davis Mechanical recognized oil entrained in a chiller's refrigerant charge at the 3M facility in Buffalo, NY. The OAM-Purger was recommended as a possible solution. The OAM-Purger regained system capacity and decreased energy usage.

Rod Carroll, Service Manager for Premium Mechanical (MO) noted that Gallatin County Schools (IL) had a chiller experiencing oil loss and an associated decrease in capacity. A refrigerant analysis confirmed oil entrained in the refrigerant charge and recommended the OAM-Purger to solve the problem. Excess oil has been removed and the chiller has been brought into equilibrium.

Debra-Kuempel (Cincinnati, OH) installed 3 OAM-Purgers on 3 high pressure refrigerant (R-12) centrifugal chillers located at Harbor Group Management Company's PNC Center in order to regain system capacity that was lost to oil entrained in the chillers refrigerant charge (these OAM-Purgers removed 9.5 gallons of excess oil in Chiller 1, 6 gallons of excess oil in Chiller 2, and 22 gallons of excess oil in Chiller 3).