

High-rise retrofit

Updating 40-year-old boiler system proves a challenge

By Simon Blake

Changing out a heating system in a 40-year-old residential high-rise building will always offer a number of challenges – some anticipated and some not. Old pipes and new equipment can be a difficult mix. When abrasive black sludge started destroying pump seals at two recently retrofitted apartment buildings in downtown Toronto, Fred Weinstein, P.Eng. (Weinstein, Taylor & Associates) knew he had to find a solution. It wasn't easy.

"There was nothing available (in North America) that would take out the magnetic sludge," he reports. So he looked to Europe for a solution.

But we're getting ahead of ourselves. When Weinstein was asked to submit a proposal for retrofitting the two buildings, he quickly established that significant energy efficiencies and reduced equipment and maintenance costs could be achieved by combining the heating plants for both buildings in one mechanical room.

This was relatively straightforward because they shared a common underground parking garage, allowing easy routing of hot water piping from one building to the other. The first building is 22 storeys high with 287 suites; the second is 20 storeys high with 291 suites.

Last year the mechanical contractor, Superior Boiler Works and Welding Ltd., Hamilton, Ont., installed three new Unilux water-tube boilers with a combined output of 14.4 million Btu/h. Weinstein spent considerable effort



A much-needed boiler upgrade revealed other problems.



This European-made magnetic sludge separator provided a cure.

"right-sizing" the boilers for the buildings, making them about half the capacity of the old ones.

The boilers supply water to the main header at 160 to 180°F. Condensing boilers would have been impractical in this application, noted Dave De Faveri, P.Eng., vice-president of sales for Superior. "In a building like this, the water temperature never gets low enough to condense."

The retrofit

When Weinstein re-designed the heating system, it proved an ideal application for injection mixing. A large custom-built header in each building supplies five zones, each an individual closed loop system. There are 33 pumps in the system, ranging from fractional to 15 horsepower. Each is controlled by a variable speed drive, making field adjustment easy. Return piping enters the manifolds at 45 degrees to ensure water goes smoothly into the header rather than bouncing off the back wall of the header and re-circulating to other zones, explained Weinstein.

Each building has four Lochinvar 250-gallon indirect DHW tanks, ganged in pairs and zoned so that one pair serves the lower floors and the second pair serves the upper storeys. These are also equipped with variable speed pumps and drives, something that proved beneficial when the recirculation volume had to be cranked up, noted Weinstein.

The retrofit also included the installation of a full building automation system operating on a LonWorks protocol with outdoor reset on every heating zone.

The project took about five months with from six to 30 tradesmen on the job site, depending on what state it was at. However, the crew started the project only three weeks before the fall heating season, reported De Faveri. "We were really scrambling." About 60 percent of the piping was prefabricated in the company shop. The first boiler was commissioned in September, 2006.

And that's when the problems began. Abrasive black sludge from the existing iron piping was destroying pump seals. The installation of particle filters did little to alleviate the issue because the particles were so fine that they flowed right through, reported De Faveri. Seals in just about every pump had to be replaced, something that technicians from Superior were still working on during P&HVAC's visit.

The solution

The engineers worked out a solution that involves a 10-micron particle filter, a special sludge trap along with chemical treatment to stop the corrosion.



From left, mechanical contractor Dave De Faveri, engineer Fred Weinstein, filter supplier John Priolo, Nick Campbell of Allied Technical Services and building superintendent Paul Nelson discuss the project.

"We've got a belt and braces system," quipped Weinstein.

The key piece of equipment turned out to be the sludge separator. Made in Germany by Judo Water Treatment, it is specifically designed to deal with magnetic sludge. The Judo Ferroclean houses four high performance magnets rated for a 50-year lifespan. They attract the iron sludge (or magnetite). Each magnet is housed inside a sleeve. A raw water connection is attached to a valve at the top of the unit and there is a drain on the bottom. To clean, the magnets are pulled down out of the water stream, allowing the sludge to be backwashed away from the sleeves, which remain in place, explained John Priolo, president of Judo Water Treatment Inc., Concord, Ont. An integrated magnesium anode rod provides additional protection by chemically removing unwanted oxygen.

The water is pre-filtered through a 10-micron Judo Heifi-Top backflush filter to remove the larger particles and air bubbles. Backwashing occurs through turning a hand-wheel at the bottom of the filter 180 degrees. This closes the inlet, reverses the flow, and activates stainless steel bristles that dislodge any particulate. Air bubbles are vented through the top.

One advantage of this type of filter compared to a conventional cartridge-type filter is that it prevents oxygen from entering the system during the cleaning process, reducing the chances of corrosion or air locks, explained Priolo.

Both units are mounted on a "side-stream" four-inch piping layout. As a result, no bypass is required and it is not necessary to shut down the system for

maintenance. As well, this allowed smaller and less expensive filtration equipment. The Ferroclean can be used inline, explained Priolo, but in this building an eight-inch unit would have been required.

Backflushing – typically about once a week until the system is clean – would be carried out either through a maintenance contract with the mechanical contractor or by building maintenance personnel.

Typically, both units would be plumbed into the drain for backwashing. However, engineers wanted to monitor the system by backwashing both units into a bucket at first. "It's a very good indication of how clean or dirty your system is," noted Priolo.

In future retrofits of older buildings, Weinstein sees significant cost savings by installing equipment to deal with sludge from the beginning. "I'm not going to wait for problems to arise. It's a small part of the project cost," he added.

"This is going to plague many older buildings in the city, especially if the boiler room is in the basement."



Pipe fitting as fine art – note the variable speed pump drives below.