The Dirt on Modern Hydronics

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Dirt in a hydronic system is not a new problem. Until recently, it generally exposed itself in the form of system inefficiency and failures in pump seals, bearings, valve seats and packing. Y-strainers are great at picking up the larger dirt chunks but the smaller particulate passes through. If the dirt is that small, why is it so important to remove it?

Some of the dirt is from the ferrous components such as pumps, boilers, radiators, pipe, air separators, – pretty much anything made of steel or iron. This dirt is called magnetite and looks like a dark gray sludge. The dirt particles are so small they pass right through a traditional strainer. So, we live with leaks dripping from handles, replacing seals, and so on. We are only forced to deal with it when the system isn't working or there is water on the floor.

Now we are firmly into the 21st century, modern hydronic heating and cooling systems are less tolerant of dirt in the water. In addition to the failures previously mentioned, we are now experiencing failures that go beyond merely annoying and have advanced to catastrophic.

The energy efficient Electronically Commutated Motor (ECM) or "Permanent Magnet Motor" contains very powerful magnets that can suck up any magnetite in the water, reducing performance and ultimately causing the pump to fail (figure 1). A few manufacturers have installed seals or filters into the pump. Sometimes this is enough, but typically it only delays the inevitable. I have seen failures in less than three weeks.

Figure 1 - from 2 yr old radiant system

In a boiler, the high heat from the flame can cause the magnetite to come out of solution where it will then adhere itself to the heat exchanger wall. In watertube style boilers, the narrow water passageways can easily become clogged (figure 2) or stress-crack because the heat can't be transferred efficiently. Some boiler manufacturers recommend maintaining an increased water velocity inside the exchanger to reduce the chance of particulate sticking to the tube walls. This has been met with varying success.

Figure 2 - watertube failure after one year of service

Lower velocity firetube boilers will suffer a similar fate. The magnetite will adhere itself to the underside of the tubesheet acting as a layer of insulation (figure 3). Once the heat can't easily move into the water stream, the exchanger stress-cracks and fails. Newer, lighter weight cast-iron boilers are not immune. Some have failed inside of a few years because they were loaded with magnetite.

Figure 3 - less than one year old firetube exchanger (courtesy of NTI Boilers)

This sludge will adhere itself to the walls of the pipe, restricting flow. It will also coat the inside of baseboards, fan coils, and radiators, where it acts like insulation, reducing their ability to release heat into the space.

To combat these failures, it is important to clean and treat the system. Prior to removing the old boiler, install a quality system cleaner. The cleaner can dramatically reduce limescale and iron oxides. Best practices would include the use of a test strip to ensure enough cleaner has been introduced.

Next, install a quality magnetic filter. This will capture all the iron oxides that the cleaner is loosening up. On an existing system, it is best to install it on the return side. The boiler and pump will receive a nice clean water stream.

Once the system has been cleaned, thoroughly flush it, replace the boiler, and install a corrosion inhibitor. A quality inhibitor will help balance the pH, act as a biocide, and coat the metal surfaces inside the system, reducing corrosion. Verify that enough inhibitor has been used with a test strip.

Here's the part where I get the most resistance. Once the job is finished, the system is purged of air and you are loading up your truck, close the cold-water supply to the system. I usually hear "I leave it open in case the system pressure drops." The system pressure will not drop unless water is leaking. It won't evaporate. Close the valve. It's a PRV (Pressure Reducing Valve), not an AFV (Automatic Fill Valve). You will almost always know if the system pressure drops long before the low-water-cut-off shuts the system down. The owner will call and complain that one of the rooms is not heating correctly. You have a leak. Go find it. Leaving the valve open will flush out all the chemical you installed, introduce more lime in the system, and put you back to square one.

In summation, best practice for starting up a modern hydronic system are:

1) Clean the system
2) Install a magnetic filter
3) Use corrosion inhibitor
4) Close the cold-water supply

R. D. Bitzer Company represents BoilerMag, which produce a full line of magnetic filters from 1" through 12", as well as corrosion inhibitors, cleaning chemicals, test strips, and more. BoilerMag is the most efficient line of magnetic filters available on the market. Contact your salesman for more information.