



**Technical Bulletin:
Clean Hot Water Systems – Good for the Planet and Your Health**

Michael Schmeida, MSc, LEED™ Fellow
Corporate Manager, Stewardship
The Oatey Company – Cleveland, Ohio

Hot water systems are an essential mechanical system in modern buildings. Whether they are delivering hot water for showers and other potable uses, used in radiant heating or in one of many processes, hot water has become a valuable asset in the built environment. And much like other systems, hot water systems need maintained if they are going to perform as expected.

However, hot water systems have their own unique issues and additional complexities other systems do not. Because of the warmth, in addition to being wet, hot water systems are very susceptible to issues that can make these systems less efficient, more prone to failure and even contribute to human health risks.

But, these systems can operate best if properly maintained. This means, among other things, preventative maintenance through proper cleaning. As we will see, a clean system that is running efficiently (using less energy), will be reliable and less likely to be hazardous to human health (not promoting pathogenic growth).

Many people, even many engineers, don't always understand or remember the full complexity of the water-energy nexus. Most of us understand that a water heater uses fuels such as gas, propane or electricity to heat the water, but we don't always connect that as being energy; we often think of energy in a more sizable scale such as power plants or maybe something we see more tangibly, such as the gas we pump into our cars. Regardless, energy is a significant cultural issue because of factors such as climate change and geo-politics. One only needs to check their favorite newspaper, news channel or news site on the internet to see evidence of this¹.

So how can one clean running hot water system save the world? Well, one system cannot, but if everyone started doing this we could have a significant impact. And even on the individual

¹ <http://www.resilience.org/stories/2014-02-11/the-purposely-confusing-world-of-energy-politics>

level, one can save something else – money. Removing build up through routine cleaning of the system allows it to return to the optimal condition, meaning less heat loss and therefore less energy used. Studies in the United Kingdom suggest up to a 15% loss of efficiency or over \$200/year due to inefficient operation from build-up².

Build-up in hot water systems changes the characteristics of that system. It is designed assuming certain flow rates, retention rates, thermal losses due to contact with pipe surfaces, and many other factors beyond the basic scope here. However the build-up of deposits in the system disrupts the intended design conditions by increasing surface area and restricting flow rate. This means there is more opportunity for heat loss³.

Health:

Many of us in the modernized world take our clean water for granted. And we believe it is “pure”. But, the word “pure” is a relative term. The fact is that even the cleanest water direct from a well or water treatment facility has pathogens (viruses, bacteria, protozoa, amoebae, etc.), minerals and other content at or below levels dictated by law as safe levels. This basically means that for a healthy person the levels are low enough not to cause illness, and the body can easily fend off infections from them⁴.

But, pathogens can grow to unhealthy levels in your home, industrial water system, etc. One such pathogen, *legionella*, is believed to be in detectable levels in as many as one-half of all residential hot water systems⁵. Studies vary widely, but it is estimated that perhaps 18,000 cases of this disease occur in the United States each year, and out-breaks in apartment buildings, hotels, nursing homes or hospitals can impact tens of victims, if not hundreds⁶. This genus of bacteria can live in a whole ecosystem in hot water pipes and even drains and traps, where the temperature is perfect for living and breeding and where nutrients abound. And once this or other pathogens become respirable via atomized water droplets (think your showerhead, kitchen sprayer or a pipe being opened for repair), illness can occur. And unfortunately, even if the incoming water is *legionella* free, it only takes one contaminated plumber’s tool to introduce this or any other pathogen into a system⁷.

The nutrients *legionella* and other pathogens need are in one major place in piping systems; the biofilm. Biofilm is a slimy amalgamation of microbes, organic matter, scale and minerals that builds-up over time in any system. These ingredients can come from naturally turbid water, pipe decay, organic components in the system such as rubber washers/seals and the o-rings in components such as hammer arrestors and/or a whole array of other sources. Removal of the

² <http://www.sentinelprotects.com/us/products/the-sentinel-system>

³ http://www1.eere.energy.gov/femp/pdfs/om_9.pdf

⁴ <https://www.osha.gov/dts/osta/otm/legionnaires/faq.html>

⁵ http://wwwnc.cdc.gov/eid/article/10/3/02-0707_article

⁶ <http://www.cdc.gov/legionella/clinicians.html>

⁷ ASHRAE Guideline 12 – *Minimizing the Risk of Legionellosis Associated with Building Water Systems*. American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc., 2000.

biofilm via regular cleaning as part of system maintenance can inherently reduce pathogenic levels⁸ and therefore reduce the likelihood of infections, especially in sensitive sub-populations.

Resiliency/Long-Life:

Let's think about our cars. We know if we change the oil regularly, flush and fill the transmission and cooling systems, check all the wearing parts and systems and fix items as needed, our cars will last longer.

Your hot water system is the same way. Certainly the mechanical parts such as the burners, the blower and the like need routinely inspected per most manufacturers guidelines. But the pipes/coils, where the water flows, is heated and the water may sit, meaning these need routinely maintained as well or they will "break-down". As corrosion, scale, biofilm and deposits build-up in the system, they change the dynamics, much as discussed with the energy section. Pressures may change, walls may be compromised and eventually catastrophic failure can occur. And even if those burners and other components are maintained well, if they are forced to work harder than intended because of an inefficient, dirty system, they can fall victim to premature failure. Pumps and valves can also be destroyed by these materials, meaning premature replacement⁹.

Close:

A hot water system is like any other mechanical system; proper maintenance is key to the efficient performance and long-life. In hot water systems, it also means a healthy system for human use. By cleaning these systems regularly, all three objectives can be achieved.

⁸ <https://www.osha.gov/dts/osta/otm/legionnaires/hotwater.html>

⁹ <http://energy.gov/energysaver/articles/solar-water-heating-system-maintenance-and-repair>.