Water Treatment for the Condensing Boiler

Introduction

Today, the high efficiency domestic condensing boiler is now the first choice of consumer and installer. Not only are these boiler units smaller, lighter and aesthetically pleasing to the eye, they are much more efficient in using costly fuel to heat domestic water. The advantage for the consumer is not only reduction of fuel bills but burning less fuel releases less carbon dioxide into the environment and in turn slows greenhouse global warming. The 'green' credentials of high efficiency boilers have been recognized by many Governments who have introduced legislation to encourage their installation. However, to realize the enhanced efficiency of a condensing boiler it is important to avoid any waterside problems.

Installation and design

Put simply, a condensing boiler is a small standard boiler with a secondary heat exchanger bolted on to it. The secondary heat exchanger enables otherwise wasted heat to be reclaimed from the exhaust gases in the flue. The physical process involved requires the return temperature of the circulating water to be low enough to cause water vapor entrained in the gases to condense. This extracts the latent heat from the gases, which is then transferred into the system water. This results in a net gain in energy, so improving the efficiency of operation.

The key to a well designed system is that the boiler should be well matched to the heat load required. This means that extra care must be taken when a condensing boiler is fitted as a replacement to an existing system.

If the return temperature of the circulating water is too high, greater than approximately 136°F, condensation will not take place and the energy associated with the latent heat of the water vapor in the gases will not be recovered.

Any condensing boiler will always be more efficient than a non-condensing boiler of the same type, as the secondary heat exchange will always result in sensible heat being drawn from the exhaust gases regardless of whether or not the boiler is condensing.

Nature of condensate

Condensate is invariably corrosive. This is because it contains dissolved gases and contaminants and is acidic. The combustion exhaust generated by a boiler regardless of the fuel used, always contains acidic gases such as nitrogen oxides and sulfur dioxide.

When dissolved in water these gases form mineral acids. Dependent on the percentages of the acid gases present in the exhaust, the pH of the resultant condensate can be as low as 4.0. It can be just as aggressive as lemon juice.

The condensate produced by the boiler must be handled and disposed of safely. In some commercial and industrial sized installations, neutralization plant is sometimes used. The condensate from a domestic boiler can easily be neutralized by fitting a simple neutralizing unit in the condensate discharge line.

The problem of collecting the condensate and transferring it to waste is easily resolved with plastic components. Also it is clear that as the condensate forms on the heat exchanger, the heat exchanger itself must be manufactured not only from a material with a high thermal conductivity, but one which is also resistant to acid attack.

The material most commonly used, although not invariably, is aluminum, which has good heat transfer properties and is particularly resistant to corrosion under such conditions.

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Need for water treatment

Aluminum is often considered to be a ready source of system problems, as it sometimes thought to be easily corroded. This is far from the truth. Aluminum is sufficiently resistant to corrosion for use in atomic reactors, where conditions are somewhat more severe than the average hydronic heating system!

The corrosion behavior of aluminum and its alloys depends on the metallurgical condition, the impurities and alloying elements present, the nature of the dissolved salts in the water and the water's pH. Its ability to form a tightly adherent oxide film on its surface makes the metal highly resistant to corrosion. The formation of the oxide film takes place not only by reaction of the metal with oxygen in the air, but by reaction with water itself.

The primary cause of waterside problems with condensing (and any other kind of) boiler is debris remaining in the system after installation. Foulants can take a variety of forms. In the case of new systems, it is usually stamping oil, swarf, flux residues and other installation debris, which can form the basis of an insulating paste in the heat exchanger and the circulating pump.

Boilers fitted as replacements on older systems can be similarly fouled or even blocked by any loose debris, such as magnetite sludge from radiators, and microbiological growths.

Avoidance of debris related problems

Before fitting a new boiler all debris should be removed by cleaning and flushing the system thoroughly.

It is not possible to fully clean a system without the application of a chemical cleaner; many of the drain down facilities fitted to systems are unsuitable for flushing by gravity alone, therefore the preferred method of cleaning most systems is powerflushing in conjunction with a suitable chemical cleaner (Note: Powerflushing is not suitable for systems containing microbore or non-barrier plastic piping).

There are many cleaners available to installers, and it is important that selection of a product is made on the basis of the foulants expected in the system. It is also important to choose the safest and most effective product. Products are available, such as Sentinel X300 for new systems and Sentinel X400 for older systems - including those where problems have been experienced previously.

Application of inhibitors

Application of chemical scale and corrosion inhibitors is always desirable. Such protection is especially important for high efficiency Aluminum boilers; in some geographical areas, the quality of the make up water is not wholly suitable for aluminum components. Any potential problem can be prevented by the application of a suitable water treatment product. Neutral products, such as Sentinel X100, are excellent not only for preventing general corrosion, but also for preventing pitting attack.

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