



The Basics of a Boiler Stack Economizer

By S.F. Connor, Revised July 2010

Boiler stack economizers have been around for years; using round, finned coils (normally 7 fins per inch), encased in an insulated metal housing which is either cylindrical or square in shape, and mounted on or near the boiler's vent outlet. The finned coils are normally made from copper or stainless steel, and vary in diameter based on the mass flow of the water within them. Normally the ID of the finned tubes is approximately one (1) inch or less; suitable for accommodating fireside and waterside fluid flow while mitigating excessive pressure drop and erosion of the tubes' waterside surfaces.

The purpose of the boiler stack economizer is to reclaim Btu's from the combustion process, normally wasted out of the boilers' vent; transferring them to the boilers' feed water, thereby reducing the amount of heat energy required from the burner to raise the temperature of this fluid to the respective boiling point within the pressure vessel proper.

This boiling point increases with the operating pressure of the boiler. For instance, at atmosphere and sea level, water boils at 212 deg. F. At 100 pounds, and sea level, the boiling point increases to 338 deg. F. Therefore, as the pressure increases above 14.7 pounds (atmosphere and/or zero gauge pressure), and at sea level, the boiling point continues to increase along with the amount of sensible energy required. Thus, the more energy (Btu's) we can put back into the feed water as reclaim, the less energy has to be taken from the burner. It's all about saving energy which would have normally been wasted.

To be effective, the stack economizer needs to be applied to the right application which usually involves a high pressure steam boiler operating at or above 100 psig (338 deg. F). It should also be over 150 HP in size in order to achieve a favorable payback.

In the case of employing a standard (non-condensing) economizer wherein the feedwater is coming from a vented feedwater tank at approximately 180 degrees F or from a pressurized deaerator supplying incoming water to the economizer at approximately 230 degrees F, the efficiency gain will vary. The variation is based on the approach temperature. The lower the approach temperature (incoming water temperature to the economizer), the higher the efficiency. Normally in the 2.0 – 4.0% range.

In the case where there is a cold water makeup stream (50-55 deg. F) of at least 25% of the boilers' evaporation rate, the efficiency gain can be more. To figure this, you begin by calculating the flow to the economizer. Use 34.5 pounds of steam per boiler horsepower and a gallon of water weighs 8.3 pounds. A 200 HP boiler will then develop approximately 6900#/hr and at 25% makeup is 1726#/hr divided by 8.3#/gallon or 208 gallons per hour needs to be heated.

Next, you may consider a two stage economizer with the first stage (noncondensing) heating water from the feed system before entering the boiler. The second stage is then used for the cold makeup water, heating it before it enters either the vented feedwater tank or the deaerator. This second stage must be



constructed of stainless steel as the products of combustion will reach (corrosive) dew point when they give up their latent energy. The result is another 3-5% efficiency gain depending on the cold water temperature and mass flow. The lower the temperature, and the more the flow means higher efficiency gains approximating another 3-5%; additive to the 2-4% gained in the first or non-condensing stage.

The rule of thumb to keep in mind is that based on a consistent firing rate, operating pressure and constant ambient temperature, for every 40 degrees the stack temperature is reduced, it's a full percentage point of fuel savings. A stack economizer can be a very effective way of putting this money back in your pocket. If the application is right, the savings are a sure bet, often increasing the boiler's efficiency by 5-9% depending on feedwater conditions. This can equate to significant fuel dollar savings during the course of the year.

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