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## From Experience

### Enhancing Efficiency: Next Generation Stack Economizers

Economizers have long been used in steam boiler facilities to recover energy in the form of heat from boilers and re-use the heat for some other purpose, such as heating feed water. Two common types of economizers are in use today:

- **Direct contact stack economizers** are condensing, free-standing units with flue gas ducted through the unit. Water to be heated is circulated directly in the flue gas stream generally as a counter flow spray. Effluent water is generally between 100°-110°F.
- **Tube-type stack economizers** heat water that is circulated in tubes housed within the flue gas flow stream. These economizers are typically installed at the boiler flue gas outlet and used to extract heat from the flue gas and supply additional heat to the boiler feedwater, typically in the magnitude of a 30°F temperature rise in the feedwater

Two types of tube-type stack economizers are available today. Single-stage economizers, the most commonly used of the two, extract only sensible heat from the flue gas. The second type is a two-stage, condensing, tube-type stack

economizer. With these, the first stage operates the same as a single-stage economizer to extract sensible heat. The second stage then extracts any remaining sensible heat, as well as a significant portion of the latent heat, and transfers the heat to a water source, e.g., makeup water to the deaerator/surge tank system or to other users of heated water. Despite being in the industry for some time, condensing tube-type stack economizers remain relatively expensive, with the payback not competing with single-stage economizers. Therefore, they are not commonly used in practice.

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#### EXPERIENCE IN BRIEF

To gauge the potential benefits of economizers, the Boiler Efficiency table on the following page, provides general guidelines for estimating energy savings in boiler plants.

## Boiler Efficiency of Condensing Economizers

| System                                    | Combustion Efficiency<br>@5% Excess O <sub>2</sub> (%) | Stack Gas Temperature °F |
|---|--|--------------------------|
| Boiler                                    | 78% - 83%  | 350° - 550°              |
| -with feedwater economizer                | 84% - 86%  | 250° - 300°              |
| -with feedwater and condensing economizer | 92% - 95%  | 75° - 150°               |

Table Source: Tip Sheet #26A, Department of Energy

As always, the choice of which type of economizer to use depends on the application and needs of your facility. At a minimum, Hixson recommends that single-stage stack economizers be used on all high-pressure, fire-tube steam boilers (regardless of boiler size) and be used to heat boiler feedwater. When used in this way, single-stage stack economizers typically return a payback within three years.

Direct contact economizers are good for those applications in which there is a high demand for hot water and floor space is available to house the equipment. Because of efficiency gains possible with the two-stage condensing stack economizers (see Experience in Brief), they are a good alternative to single-stage stack and direct contact economizers for those applications requiring additional hot water. Note that intermittent hot water demand requires the availability of insulated storage tanks (hot water sink). In those cases, payback for the two-stage economizer is anticipated to be like that of a single-stage economizer.

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