

Preheat Combustion Air to Improve Efficiency

For fuel-fired industrial heating processes, one of the most potent ways to improve efficiency and productivity is to preheat the combustion air going to the burners. The source of this heat energy is the exhaust gas stream, which leaves the process at elevated temperatures. A heat exchanger, placed in the exhaust stack or ductwork, can extract a large portion of the thermal energy in the flue gases and transfer it to the incoming combustion air. Recycling heat this way will reduce the amount of purchased fuel needed by the furnace.

Many processes produce dirty or corrosive exhaust gases that will plug or attack heat exchangers. Some exchangers are more resistant to these conditions than others, so if your process is not a clean one, do not give up without investigating all the options. When discussing it with potential vendors, be sure to have a detailed analysis of the troublesome materials in your exhaust gas stream.

Fuel savings for different process temperatures can be found in the table below and can be used to estimate reductions in energy costs.

Percent Fuel Savings Gained from Using Preheated Combustion Air						
Furnace Exhaust Temperature, °F	Preheated Air Temperature, °F					
	600	800	1,000	1,200	1,400	1,600
1,000	13	18	-	-	-	-
1,200	14	19	23	-	-	-
1,400	15	20	24	28	-	-
1,600	17	22	26	30	34	-
1,800	18	24	28	33	37	40
2,000	20	26	31	35	39	43
2,200	23	29	34	39	43	47
2,400	26	32	38	43	47	51

Fuel: Natural Gas at 10% Excess Air
Source: IHEA Combustion Technology Manual

There are two types of air preheaters: recuperators and regenerators. Recuperators are gas-to-gas heat exchangers placed on the furnace stack. Internal tubes or plates transfer heat from the outgoing exhaust gas to the incoming combustion air while keeping the two streams from mixing. Recuperators are available in a wide variety of styles, flow capacities, and temperature ranges. Regenerators include two or more separate heat storage sections. Flue gases and combustion air take turns flowing through each regenerator, alternately heating the storage medium and then withdrawing heat from it. For uninterrupted operation, at least two regenerators and their associated burners are required: one regenerator is needed to fire the furnace while the other is recharging.

Payback Guidelines

Process temperature is customarily used as a rough indication of where air preheating will be



cost effective. Processes operating above 1,600° F are generally good candidates, while preheated air is difficult to justify on processes operating below 1,000° F. Those in the 1,000 to 1,600° F range may still be good candidates but must be evaluated on a case-by-case basis.

These guidelines are not ironclad. Financial justification is based on energy (or Btu) saved, rather than on temperature differential. If a low temperature process has a high enough exhaust gas flow, energy savings may still exist, even though the exhaust gas temperature is lower than 1,000° F.

Suggested Actions

Using current or projected energy costs, estimate preheated air savings with this example or the Process Heating Assessment and Survey Tool (PHAST) available from the Department of Energy's Office of Industrial Technologies.

Contact furnace or combustion system suppliers to calculate payback period or ROI.

Contact us at EnergySC to help evaluate your needs.