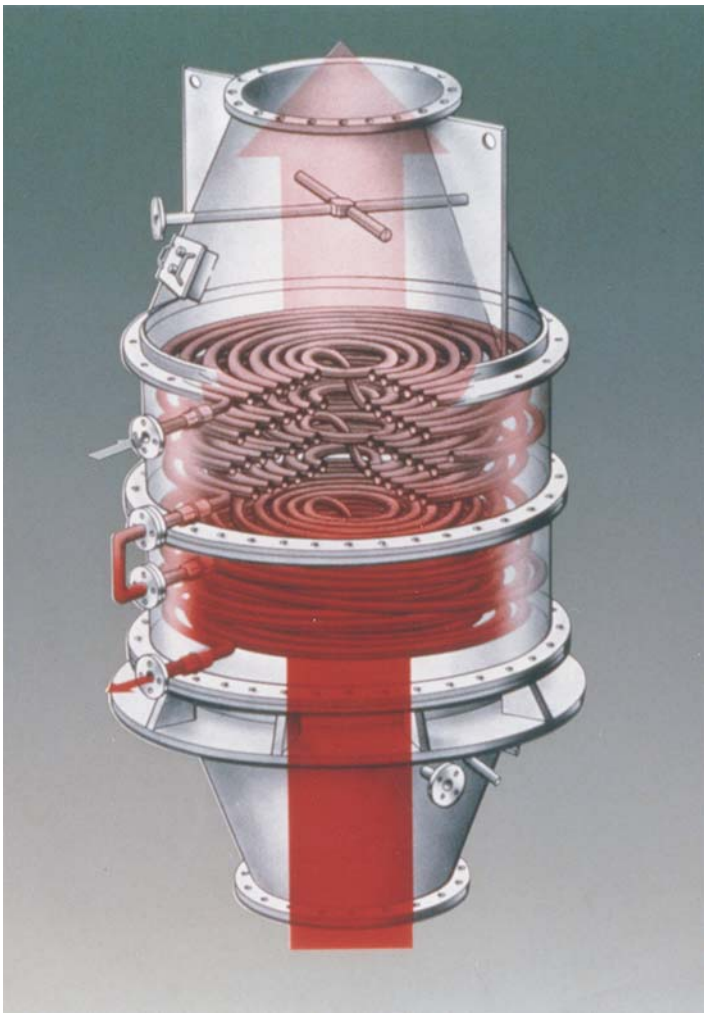
Clayton INDUSTRIES

Your Single Worldwide Source For Steam Technology

Heat Recovery Steam Generators



The Inside Story On Energy Savings

По всем вопросам обращайтесь в наш офис ООО "ТИ-Системс":
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Profit From Heat Recovery

Many industries and their processes utilize large quantities of fuel and electricity that ultimately produce heat for a process and generate large amounts of exhaust heat, much of which is wasted and simply passes out the stacks into the atmosphere or into local rivers and streams. Industrial processors need to focus on these losses and implement strategies to utilize the waste heat and reduce their energy consumption.

The basic technique of waste heat recovery is to capture the waste heat streams and transfer the heat into useful energy. The advantages to the industrial processor are that waste heat recovery can reduce a facility's annual fuel bills, reduce plant emissions and improve productivity. In process heating, using waste heat saves fuel or electricity that would otherwise be purchased.

Waste heat and exhaust gas boilers/steam generators are similar to fired boilers except that they are heated by the waste heat stream from the process or prime mover rather than from their own burner. Waste heat boilers are of most value to process industries that require hot water or steam in their process. The steam generated from a waste heat boiler will not generally replace existing boilers but will supplement the steam they produce, thereby reducing the energy cost to operate the direct-fired boilers. As the steam from a waste heat stream is available only when the process is running, waste heat boilers are generally designed to operate with existing boilers or with steam generators in a combination system.

Clayton Advantages

Clayton's unique equipment and system design results in many significant advantages compared to other types. A variety of steam/water systems can be tailored to best fit each application. All of the systems, however, are based on the use of the same design elements that are used in all of our steam and hot water products. Namely: counterflow of feedwater and exhaust gas; controlled feedwater circulation; spirally wound, smooth-tube heat exchanger design; and mechanical separation of the saturated steam and water. ***Advantages include:***

Compact and Light Weight – resulting from the fact that there is relatively low water volume in the system. Vertical or horizontal installations available.

High Thermal Efficiency – resulting from the inherent design of the equipment and system. Provides more value in equipment and installation costs.

Rapid Start-up – results from the low water content and heat exchanger design.

Easy To Clean – results from the smooth tube design that makes soot removal relatively easy. Soot blowing can be accomplished while operating, using our integral soot blowing system.

Soot Control – Soot can provide a serious safety hazard that is minimized with the use of the smooth tube heat exchanger design and operation of the integral soot blowing system.

Operate Dry Up To 840°F – our system can run dry (without feedwater), continuously, with exhaust gas temperatures up to 840°F (450°C) and with even higher temperatures for limited periods of time. This eliminates the need for exhaust gas bypass dampers in applications that do not have continuous need for steam or hot water.

Wide Equipment Selection – Clayton's modular design, combined with the large number of module sizes results in a large equipment selection that allows tailoring the equipment and system to meet a broad variety of specific applications. This results in the ability to meet the optimum performance criteria for each application, whether it be maximum heat recovery, minimum capital cost, or somewhere in between.

Safety – The unique Clayton design is inherently safe with no possibility of a hazardous steam explosion.

The Clayton Exhaust Gas Boiler (EGB)

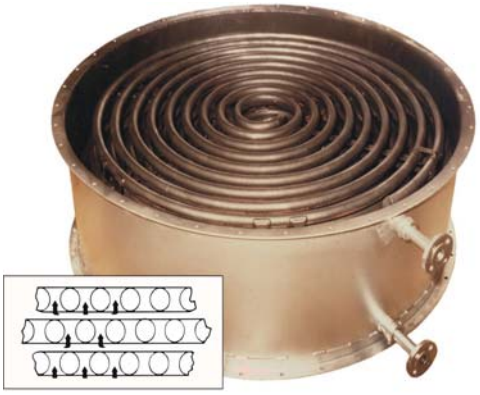
The Clayton Waste Heat Recovery System can be used to generate steam or high temperature hot water. Typical combinations of an exhaust gas or waste heat unit with a direct fired steam generator are shown on page 5. A principal feature of the Clayton Waste Heat Recovery System is its unique coil design. The coil tube is wound in a spiral pattern with closely controlled spacing between turns. This provides the desired area to control the velocities of the boiler gases. This highly efficient heating surface arrangement minimizes size and weight requirements.

The Clayton Exhaust Gas Boiler (EGB) is primarily used in conjunction with a Prime Mover, such as a Turbine or Internal Combustion Engine (100 kW to 15 mW), as part of a Distributed Generation installation producing electricity or in marine/shipboard applications. The typical Clayton EGB is constructed of individual coil modules, with each module containing spirally wound layers. The number of modules used depends upon the exhaust gas flows, allowable back pressure and on the boiler heat output requirements in steam or hot water.

The Clayton EGB module is available in various sizes and configurations to meet individual requirements.

Clayton EGB modules can operate at temperatures up to 1,200°F (650 °C) and can run dry (without circulating water in the tubes) at temperatures up to 840°F (450°C).

Once assembled with the appropriate coil modules, the completed Clayton EGB includes inlet and outlet cones that permit vertical or horizontal units with exhaust gas flows in any direction.



Individual EGB Coil Module

Four Module EGB

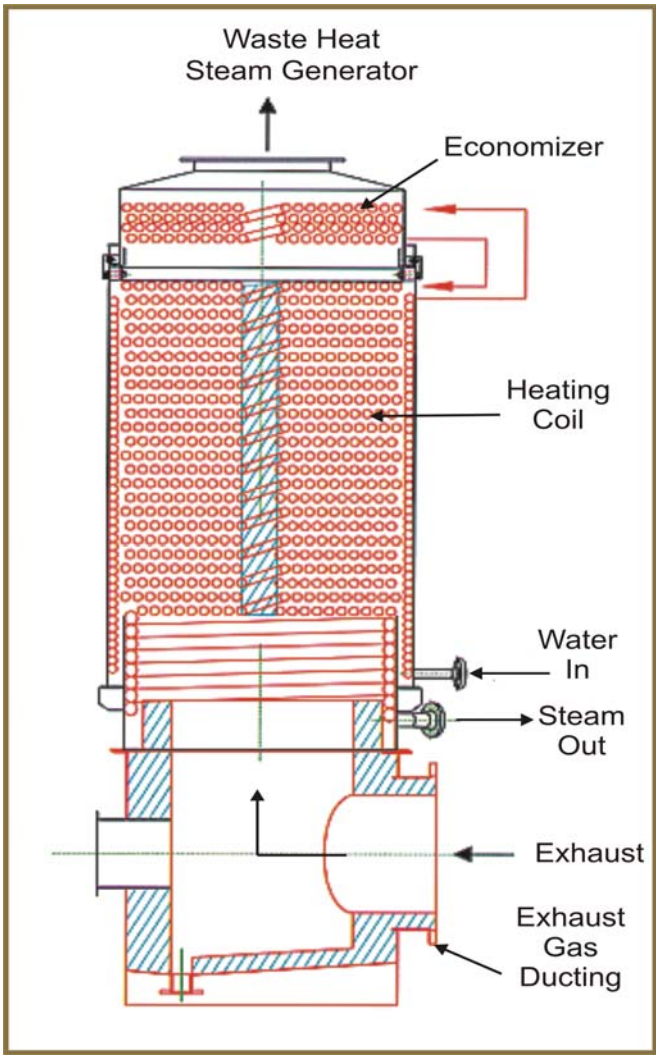
Example Exhaust Gas Boiler Performance
Natural Gas Internal Combustion Engine

		Design Flow
Percent of Maximum Exhaust Gas Flow	100 %	100 %
Exhaust Gas Flow	14,059 Lbs./Hr.	6,377 Kgs./Hr.
Exhaust Gas Specific Heat	0.27 BTU/Lb. °F	0.27 KCAL/Kg. °C
Exhaust Gas Temperature In	885 °F	473 °C
Exhaust Gas Temperature Out	281 °F	138 °C
Exhaust Gas Pressure Dop	5 inch WC	127 mm WC
Heat Output (+/- 5%) -	69 BHP	676 kW
Heat Output (+/- 5%)	2,293,747 BTU/Hr.	577,795 KCAL/Hr.
Steam Capacity - (+/- 5%)	1,981 Lbs./Hr.	898 Kgs./Hr.
Operating Steam Pressure	125 PSIG	8.5 Bar
Design Steam Pressure	150 PSIG	10.3 Bar
Feedwater Temperature	203 °F	95 °C

Completed EGB with inlet/outlet cones

The Clayton Waste Heat Steam Generator (WHSG)

For exhaust temperatures over 1,200°F (650°C), the Clayton Waste Heat Steam Generator (WHSG) is applied. The Clayton WHSG is primarily used on incinerators, furnaces and thermal oxidizers with exhaust temperatures up to 3,500°F (1,925°C). The Clayton WHSG is designed much like the standard Clayton direct-fired Steam Generator with water-walls and air-cooled shells. Inlet and outlet casing and connection pieces complete the unit for installation in the client's ductwork.



Example Waste Heat Steam Generator Performance

	Design Flow	
Percent of Maximum Exhaust Gas Flow	100 %	100 %
Exhaust Gas Flow	19,000 Lbs./Hr.	8,618 Kgs./Hr.
Exhaust Gas Specific Heat	0.27 BTU/Lb. °F	0.27 KCAL/Kg. °C
Exhaust Gas Temperature In	1,350 °F	732 °C
Exhaust Gas Temperature Out	451 °F	232 °C
Exhaust Gas Pressure Dop	2 inch WC	51 mm WC
Heat Output (+/- 5%)	140 BHP	1,373 kW
Heat Output (+/- 5%)	4,693,977 BTU/Hr.	1,182,413 KCAL/Hr.
Steam Capacity - (+/- 5%)	4,705 Lbs./Hr.	Kgs./Hr.
Operating Steam Pressure	125 PSIG	8.5 Bar
Design Steam Pressure	150 PSIG	10.3 Bar
Feedwater Temperature	227 °F	108 °C

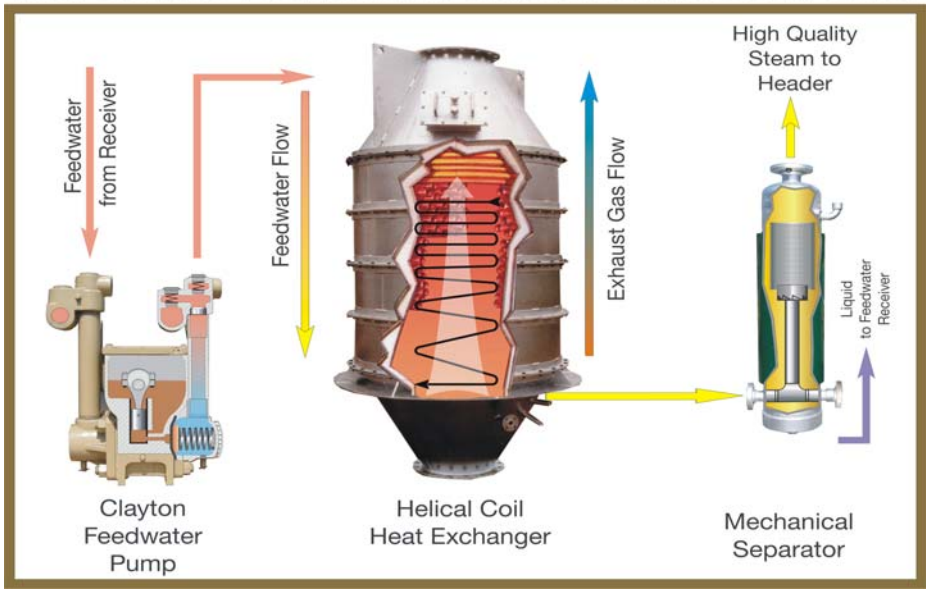
Typical Heat Recovery Installations

Another unique feature of both the Clayton EGB and WHSG is the Clayton designed and manufactured main feedwater positive displacement diaphragm pump. The pump requires minimum maintenance since there are no packings or mechanical seals to leak or require replacement. Pistons are not exposed to feedwater being pumped but run on lubrication oil so wear and tear due to the presence of grit is eliminated.

As with the standard Clayton Steam Generator, all the ancillary components such as the separator/steam drum, feedwater tank, softeners, blowdown tank and chemical pumps can be packaged on a common skid. All piping and electrical work is completed by Clayton.

Clayton Feedwater Pump & Separator Skid

How Steam Is Produced In A Clayton Heat Recovery Boiler



Typical System Combinations