

Southern California Gas Company Seminar May 2008

Maximizing Boiler Heat Recovery With ConDex Condensing Economizers

Combustion & Energy Systems Ltd.
www.combustionandenergy.com



ABOUT THE COMPANY

- Established in 1978
- Specializing in Design, Engineering & Fabrication for Heat Recovery Equipment
- Specialists in Condensing Heat Recovery
- Over 25 Billion Btu/hr of installed recovery capacity



Indirect Contact Condensing Heat Recovery

Standard Feedwater Economizers can reduce boiler stack temperatures to about 250 F, and are designed to avoid condensation of the flue gas.

An indirect contact condensing economizer improves heat recovery by recovering energy well below the dew point of the flue gas.



Recovers the maximum amount of usable heat possible from the flue gas – you paid for it, you might as well use it!

FLUE GAS BASICS – FOR NATURAL GAS

- Specific heat (Cp) of flue gas = 0.27 Btu/lb °F
- For combustion, typical excess air = 15%
- Typical efficiency = 80%
- Flue gas dew point = 135°F
- Flue gas is 11.5% water (by wt.)
- Typical exit flue gas is 150°F above saturated steam temperature (for boilers, without superheaters).

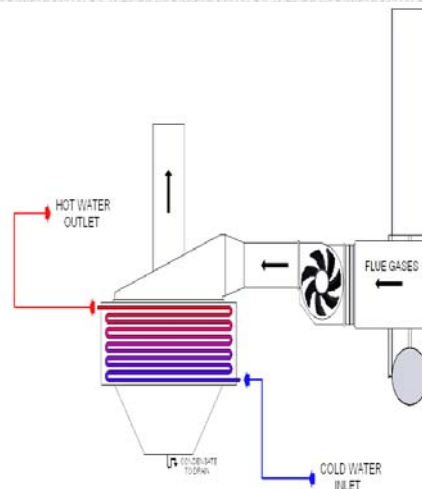
ConDex – Condensing Heat Recovery Systems: The Energy Bonus!

- The normal combustion process of natural gas combines hydrogen and oxygen chemically to form water, which is instantly vaporized by the heat of combustion.
- This process absorbs approximately 11.5% of the total heat released by the fuel and it is normally lost to the atmosphere with the boiler exhaust gases.

The ConDex System Ends This Loss!

HOW CONDEX WORKS

- Incoming cold fluid enters the ConDex exchanger
- Some of the tube and fin temperatures are below gas dew point and cause the vapors to condense out.
- The flue gas and heated liquid are not in contact (indirect contact heat exchange) with each other and the water remains pure.



CONDEX – CONDENSING HEAT RECOVERY SYSTEMS

- By heating cold process liquids with hot boiler exhaust gases, the ConDex system recovers both sensible and latent heat energy.
- As the hot exhaust passes over the proprietary designed ConDex finned tubes, so much energy is exchanged that the gases are cooled beyond the point where the water vapor condenses out, releasing the heat it took to vaporize it initially.
- The phase change from vapor to liquid recovers approximately 1000 Btu's of energy for every pound of water condensed.

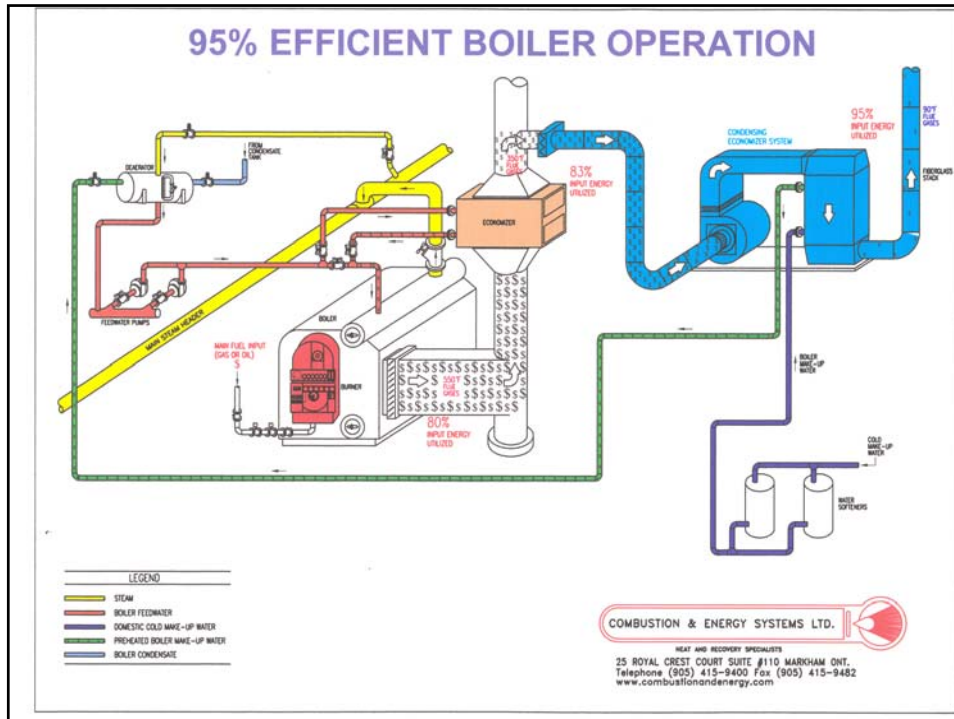
When can you benefit from indirect contact condensing heat recovery?



ConDex Systems can offset the use of “purchased” energy by using recovered energy to heat cold boiler make up or plant process water.



By using recovered energy to heat process fluids, you are more efficiently using the energy you have already paid for!



ConDex

Less Exhaust Gas • Less Pollution • More Dollar Savings

Home • Contact Us

In-Stack Cylindrical ConDex

- For individual boiler applications.
- Patented “Reverse Flow” condensing economizer maximizes condensing heat recovery and keeps the condensing section completely separate from boiler stack while maintaining extremely low pressure drop.
- Sized for boilers from 100 HP to 500 HP

In-Stack Cylindrical ConDex

- Maximize Energy Efficiency Even on small commercial and light industrial boilers with the ConDex Cylindrical In-Stack condensing Economizer.

Part No.	Part Name	Material	Notes
1	Shell	304 SS	1. In this case it is optional.
2	Coil	304 SS	2. In this case it is optional.
3	Flange	304 SS	3. In this case it is optional.
4	Support	304 SS	4. In this case it is optional.
5	Bracket	304 SS	5. In this case it is optional.
6	Weld	304 SS	6. In this case it is optional.
7	Weld	304 SS	7. In this case it is optional.
8	Weld	304 SS	8. In this case it is optional.
9	Weld	304 SS	9. In this case it is optional.
10	Weld	304 SS	10. In this case it is optional.
11	Weld	304 SS	11. In this case it is optional.
12	Weld	304 SS	12. In this case it is optional.
13	Weld	304 SS	13. In this case it is optional.
14	Weld	304 SS	14. In this case it is optional.
15	Weld	304 SS	15. In this case it is optional.
16	Weld	304 SS	16. In this case it is optional.
17	Weld	304 SS	17. In this case it is optional.
18	Weld	304 SS	18. In this case it is optional.
19	Weld	304 SS	19. In this case it is optional.
20	Weld	304 SS	20. In this case it is optional.

ConDex System Energy Efficiency

ConDex Indirect contact condensing economizers can cool the boiler exhaust gas down to within 5 °F of the incoming water.

Boiler efficiency results are typically 93% - 99% based on HHV

No supervision required with ConDex system operation
– Does not operate as a pressure vessel



CONDEX ADVANTAGES OVER DIRECT CONTACT SYSTEMS:

- ConDex Systems are much more efficient energy recovery systems because they can heat water to much higher temperatures than direct contact heat recovery systems, thereby recovering more energy when heating the same given volume of water, such as boiler make up water.
- Once the water being heated in a direct contact spray tower reaches the flue gas dew point (~ 135 F), most of the water begins to re-evaporate and thus limits the energy recovery.
- For heating fluids such as boiler make up or process water, the ConDex System recovers much more energy than a spray tower (by heating make up water from 50F up to 180 – 200 F, vs. a spray tower heating the same volume of water from 50F up to 130-140F).
- ConDex Systems are scalable – from 100 HP up to multiple boiler / gas turbine combined cycle applications.

CONDEX ADVANTAGES OVER DIRECT CONTACT SPRAY TOWER SYSTEMS:

- Another efficiency advantage to the indirect contact ConDex System is that no secondary heat exchangers are required with a ConDex System.
- Because the water being heated inside the ConDex tubes is not contaminated by flue gas properties as it is in a direct contact unit, secondary exchangers are not required with a ConDex System eliminating this loss in heat and efficiency associated with spray towers.
- The condensate water that is collected and drained separately in a ConDex system is a free source of water and can be re-used in the plant – another big advantage – facilities do not have to treat the combined flow of water.
- Because Indirect Contact ConDex Systems do not require secondary heat exchangers or water treatment systems for operation, the overall plant footprint requirement is typically smaller than direct contact systems.

ConDex Materials of Construction

Because each ConDex installation is custom engineered, we establish the required materials of construction based on the site specific installation requirements.

Standard material of construction is 304L stainless steel. Specialized metallurgy such as titanium, Incoloy or Hastelloy are available.



Reduce Greenhouse Gas Emissions Through Energy Recovery

- For every 1 million Btu of natural gas burned there is approximately 118 pounds of CO₂*
- Energy recovery allows for less fuel to be burned – for every million Btu's of energy recovered, we save the emission of 118 lbs of CO₂.
- Over an 8700 hour operating year, that is 1,026,600 lbs (or 513 tons) of CO₂ not emitted to our environment per million Btu recovered!
- In addition to CO₂ emissions reductions, ConDex system also recover a substantial amount of water that would otherwise be lost to atmosphere

*Source: Union Gas Ltd.

Case Study

Altivity Packaging – Santa Clara, CA

- ConDex System Recovers waste heat from gas turbine / HRSG exhaust.
- Heats 1,300 GPM of process water to 180 deg F
- Recovers 58,178,000 btu/hr at peak load.
- Yearly savings: \$3,263,000
- At peak load, ConDex System recovers up to 48 GPM of water from the exhaust gas!



Case History

Toyota Motor Manufacturing

ConDex System installed to recover energy from 3 boilers with existing economizers

System heats boiler feed water from 80 deg F up to 180 deg F

Energy efficiency incentive financing provided by local gas utility

Installed payback of less than 1.5 years



CASE HISTORY

Heinz Inc – Stockton, CA

- Patented ConDex Cylindrical In-Stack Condensing Economizer Installed on a 350 HP boiler.
- Recovers 1,264,000 Btu/hr.
- Yearly savings \$105,900.00
- Annual CO2 Emissions reduction: 732 Tons/year
- Annual Water Recovery: 544,530 Gallons per year



Case History

Menu Foods Inc. – Toronto, ON

- ConDex System installed to recover heat from exhaust gas from 2 -450 HP boilers
- ConDex System heats make up water from 50 deg F to 180 deg F
- Recovers 1,734,000 btu/hr Avg.
- Yearly savings \$164,400.00
- Installed payback: 19 Months
- Annual CO2 emissions reduction: 1,040 Tons



Case History

Dow Corning, Carrollton, KY

- Large volume of boiler make up and process water.
- ConDex System heats treated fresh make up water from 55 deg F to 180 deg F
- Recovers 6,300,000 btu/hr Avg. Peaks to 8,000,000
- Yearly savings \$358,100.00 (U.S.)



Del Monte Foods – Wisconsin & Minnesota



Multiple ConDex Systems installed in 2006-2008.

Systems heat boiler make up water. The initial system heats boiler make up water from 55 F up to 180 F, cools exhaust gas from 315 F down to 105 F

Recovers 9,500,000 Btu/hr

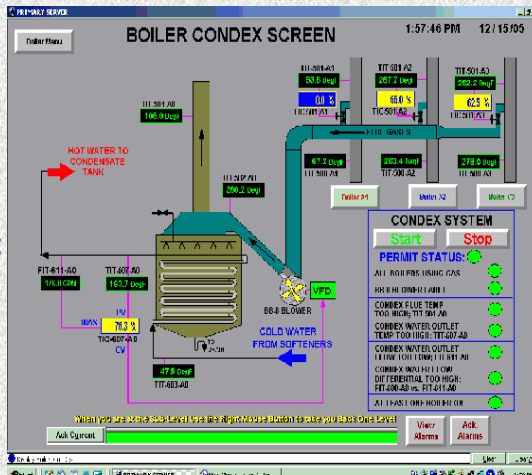
Also recovers 8.1 GPM of water at average load.

Additional installations are currently underway.



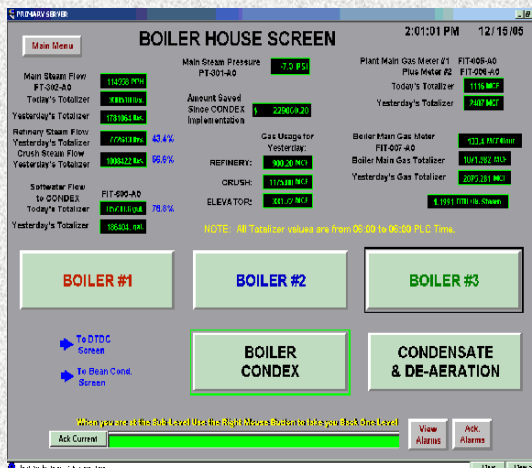
CASE HISTORY BUNGE NORTH AMERICA

- ConDex System heats 183 GPM of boiler make up water from 60 F up to 185 F.
- Exit flue gas temperature cooled to 105 F.
- Annual savings delivered: \$ 1,035,000.00
- System Recovers 7,700,000 gallons per year of reusable water



CASE HISTORY BUNGE NORTH AMERICA

- Snapshot DCS screen:
- "Amount Saved Since CONDEX Installation: \$ 229,860.00"
- System operational Sept. 28th, 2005 – Snapshot taken Dec. 15, 2005 = 78 days.
- System provided an immediate reduction in fuel expenditures.
- Installed payback will be achieved in 5 months!



Case History

Goodyear Tire & Rubber Co. – Beaumont, Texas

- Dual ConDex Systems heat 180,000 lb/hr boiler make up water from 70 deg F to 185 deg F
- Recovers 20,700,000 btu/hr Average, each.
- Yearly savings: \$2,100,000
- Installed payback achieved in 1 year.
- 11.4 million gallons /year water recovery



CASE HISTORY

LiDestri Foods – Rochester, NY

- ConDex system heats process water from 55 F up to 175 F.
- Recovers heat from 2 x 500 HP boilers.
- Greenhouse gas emissions reduced by 2,339 tons/year!
- 2,190,000 gallons per year of recovered water!
- Installed payback achieved in 1 year.



CASE HISTORY

Rock-Tenn Paper Co. – Dallas, TX

- ConDex systems heat boiler make up water and pulper process water.
- ConDex System heats the water from 60 deg F to 180 deg F
- System saves the company \$460,000.00 / year in fuel expenditures.
- CO₂ emission reductions achieved: 2,554 tons per year
- 2,843,000 gallons/year water recovered



CASE HISTORY

William Osler Hospital

- Dual stage ConDex System heats boiler make up water and domestic hot water for the hospital.
- Average energy recovery rate: 5,100,000 Btu/hr
- Capitol payback rate: 4 months
- Greenhouse gas emission reduction: 3,200 tons /year!
- NO_x emissions reduction: 2.11



CASE HISTORY University of Guelph

- Two completely isolated loops in a single system.
- District heating loop water from 170 deg F to 192 deg F
- ConDex System heats boiler make up water from 65 deg F to 200 deg F
- Flue gases from multiple boilers
- Recovers 5,873,035 Btu/hr.
- Yearly savings \$535,000.00



SELECTION CRITERIA FOR CONDENSING ECONOMIZERS

- Any company that is using a boiler or virgin energy to heat a cold process fluid, is a good candidate for indirect contact condensing heat recovery.
- Virtually any process fluid can be heated with a ConDex unit.
- Waste heat sources include boilers, ovens, dryers, incinerators, paper machines.



WHAT'S IN IT FOR OUR CUSTOMERS?

- Fuel savings = Increased profits
- Efficiency gain
- Reduced greenhouse emissions
- Recovery of substantial amounts of water from flue gas
- Reduced thermal emissions
- Positive plant image
- Increased plant capacity



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