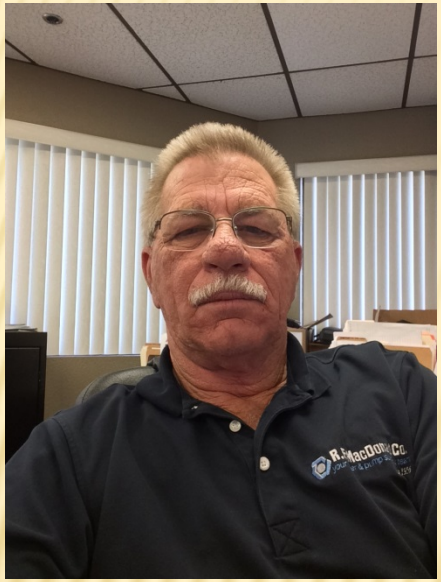
HOW IMPORTANT IS STEAM TO *YOUR* PROCESS?



Don Williams

RF MacDonald Company Corporate Trainer

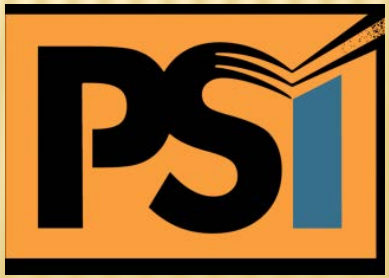
BACKGROUND

- U.S. Navy 1973 to 1988 (Active Duty and Reserves) – Machinist Mate 1st Class
- Westinghouse Marine Division 1984 to 1991 – Lead Turbine Tester - Propulsion Turbines and Reduction Gears

Westinghouse

BACKGROUND

- COEN Burner Company 1991 to 2000 – Product Line Manager, R&D Low NOx burners and controls
- Proctor Sales 2000 to 2008 – Industrial Boiler Systems Sales and Design Engineer



BACKGROUND

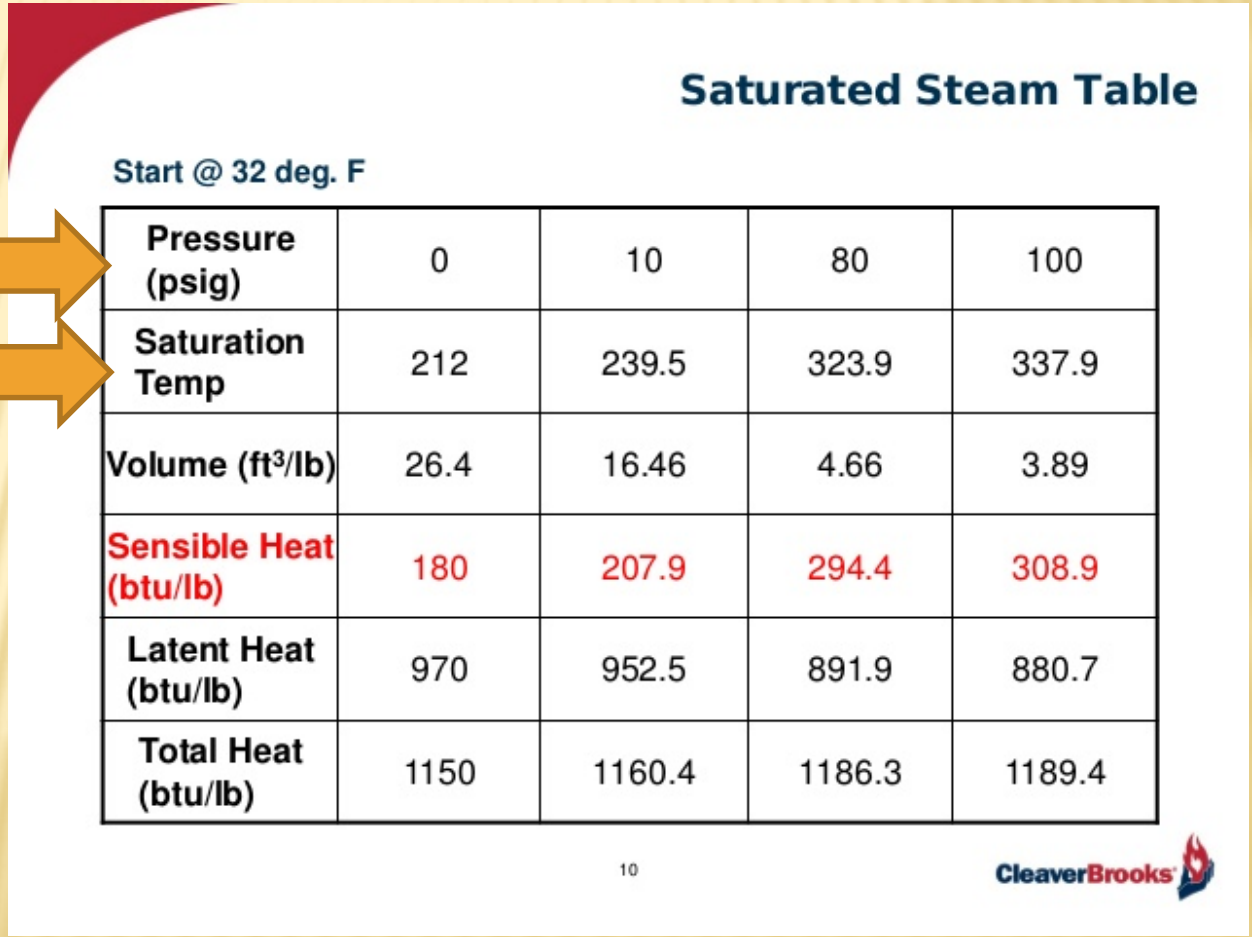
- R. F. MacDonald Company 2008 to present:
- Modesto Service Manager 2008 to 2010
- Corporate Trainer 2010 to present

TOPICS

- What is steam and its benefits?
- How do we generate steam?
- Why do you need to maintain your boiler?
- What will be the result of not maintaining your boiler?

STEAM

- Temperature is consistent based on pressure
- Sterile



Saturated Steam Table

Start @ 32 deg. F

Pressure (psig)	0	10	80	100
Saturation Temp	212	239.5	323.9	337.9
Volume (ft^3/lb)	26.4	16.46	4.66	3.89
Sensible Heat (btu/lb)	180	207.9	294.4	308.9
Latent Heat (btu/lb)	970	952.5	891.9	880.7
Total Heat (btu/lb)	1150	1160.4	1186.3	1189.4

10

CleaverBrooks

STEAM

- Steam is used for various applications
- Pasteurizing
- Comfort heating
- Humidification
- Cooking processes
- Feed preparation

STEAM

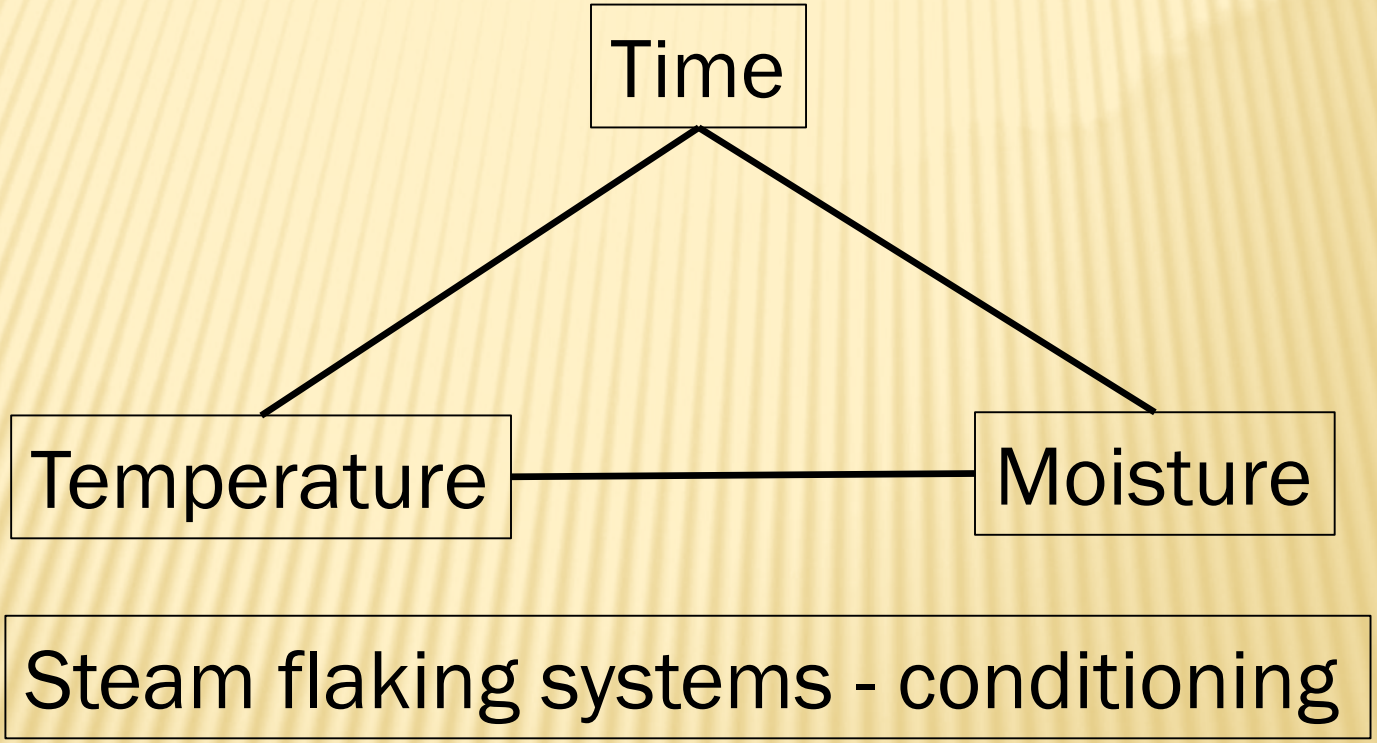

BLUEBERRIES
OAT FLAKES
RASPBERRIES
SPINACH
PUMPKIN FLAKES
APPLE FLAKES

STEAM


What do cattle eat?
Steam-flaked Corn
Feedyard Learning Center

STEAM

STEAM


Time
Temperature
Moisture
Steam flaking systems - conditioning

STEAM

Calculating Steam Consumption
100% Quality Steam, 100% Efficiency

Assume: 10 Tons/Hour on Corn
Incoming temperature 60° F
Incoming moisture 14%
Condition to 212° F

10 Ton x 2,000#/Ton x .33 x (212-60) = 1,003,200 BTU Req

Saturated steam @ 212°F and ATM Pressure = 1150 BTU/#

1,000,000 BTU / 1150 BTU/# = 872# Steam Required

872# Steam (Water) / 20,872# Corn = Addition of 4.2% Moisture

Calculating Steam Consumption
80% Quality Steam, 80% Efficiency

Assume: 10 Tons/Hour on Corn
Incoming temperature 60° F
Incoming moisture 14%
Condition to 212° F

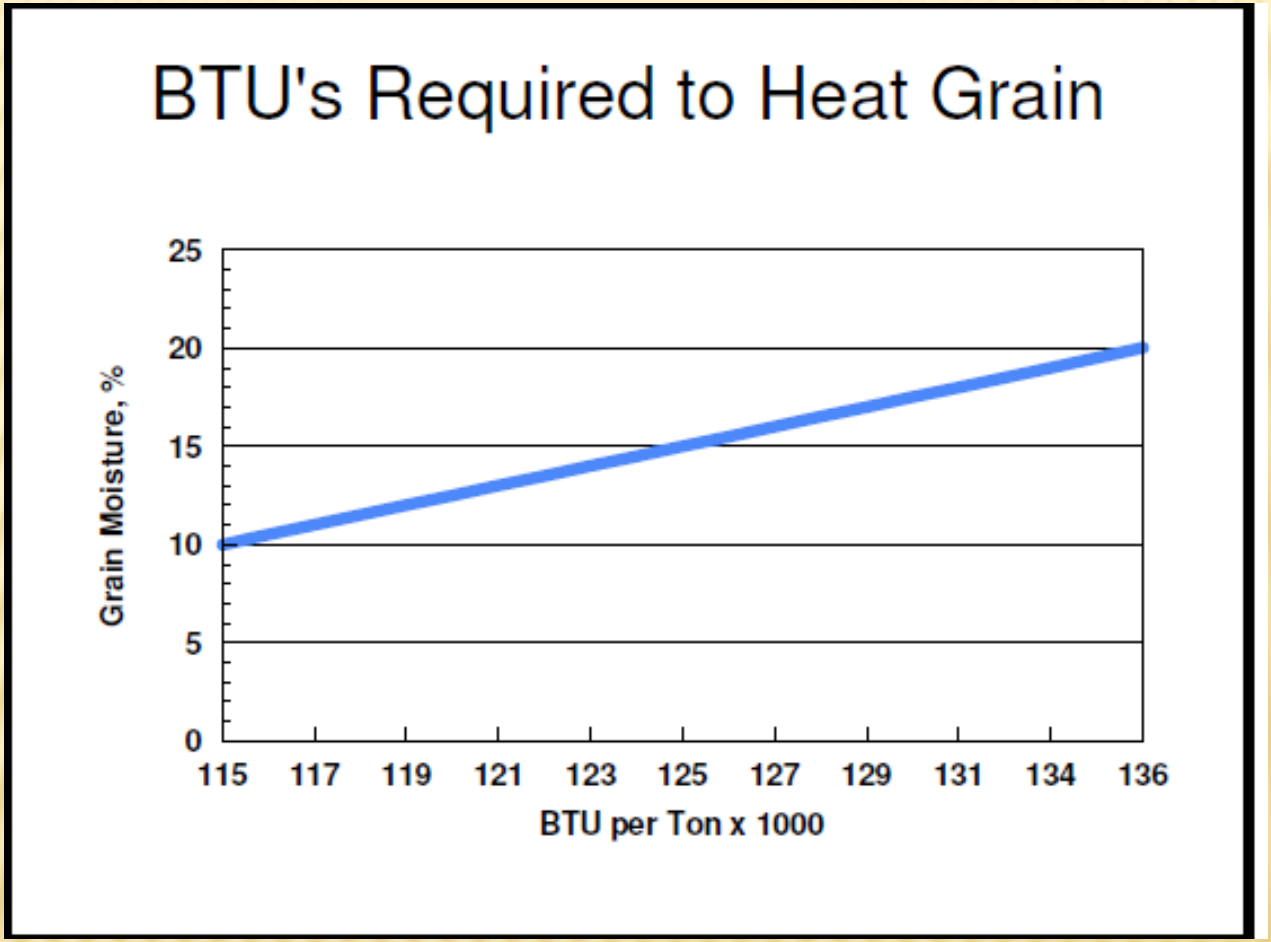
10 Ton x 2,000#/Ton x .33 x (212-60) / .8 = 1,254,000 BTU Req

80% Quality steam @ 212°F and ATM Pressure = 956 BTU/#

1,254,000 BTU / 956 BTU/# = 1312# Steam Required

1312# Steam (Water) / 21,312# Corn = Addition of 6.2% Moisture

STEAM


BTU's Required to Heat Grain
Grain Moisture, %
25
20
15
10
5
0
115
117
119
121
123
125
127
129
131
134
136
BTU per Ton x 1000

STEAM

Steam Flaking - Conditioning Costs

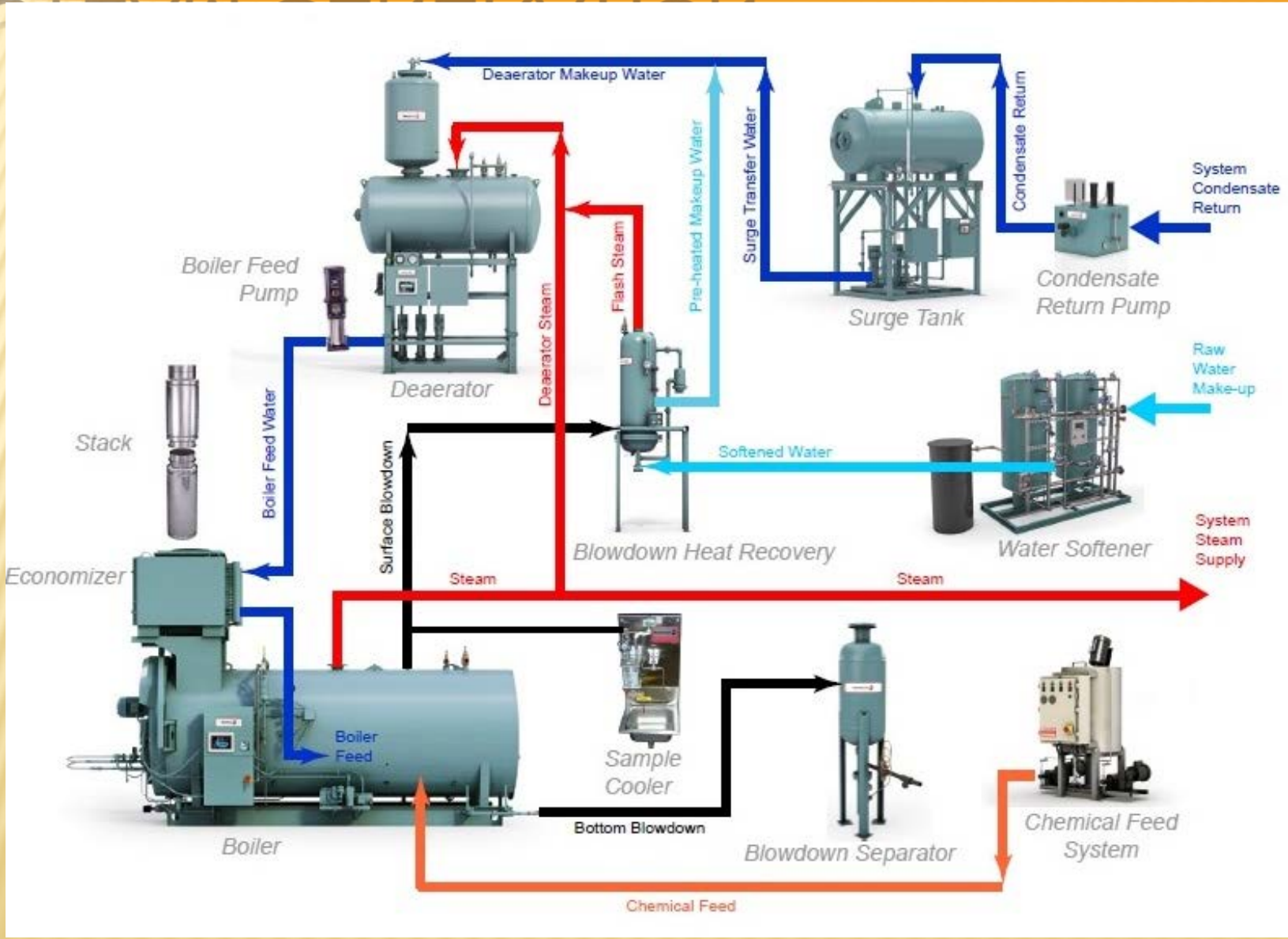
Assumptions: 100% make up water @ 50° F
Boiler pressure @ 120 PSI (350°F)
Boiler efficiency = 85%
Natural gas @ $0.27 / 100,000 BTU (Therm)

1% moisture addition per ton = 20# steam

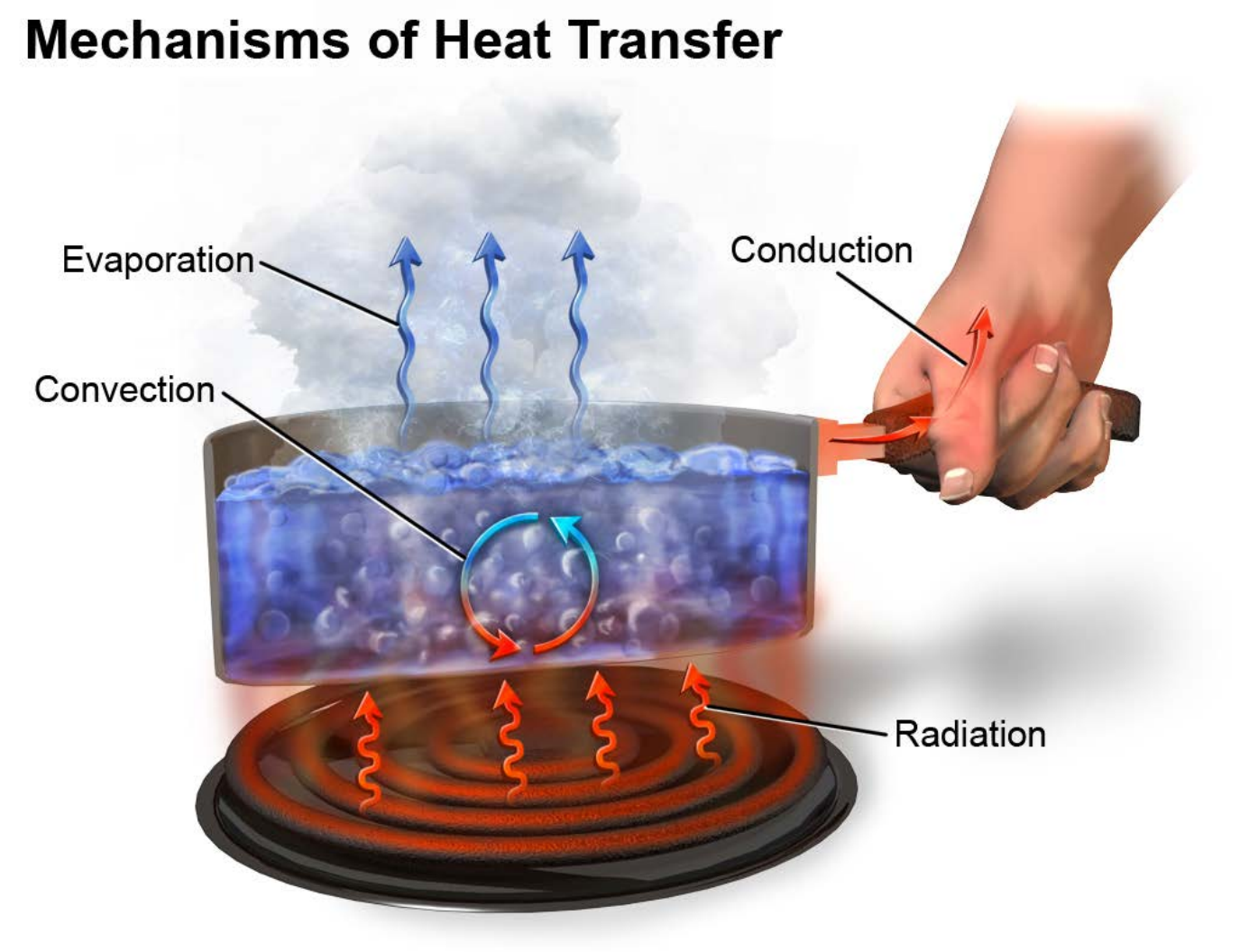
$$\frac{20 \times ((350-50) + 970)}{85\%} = 29{,}882 \text{ BTU's required}$$

$$\frac{29{,}882}{100{,}000} \times \$0.27 = \$0.081 \text{ per 1\% moisture addition per ton}$$

STEAM GENERATION

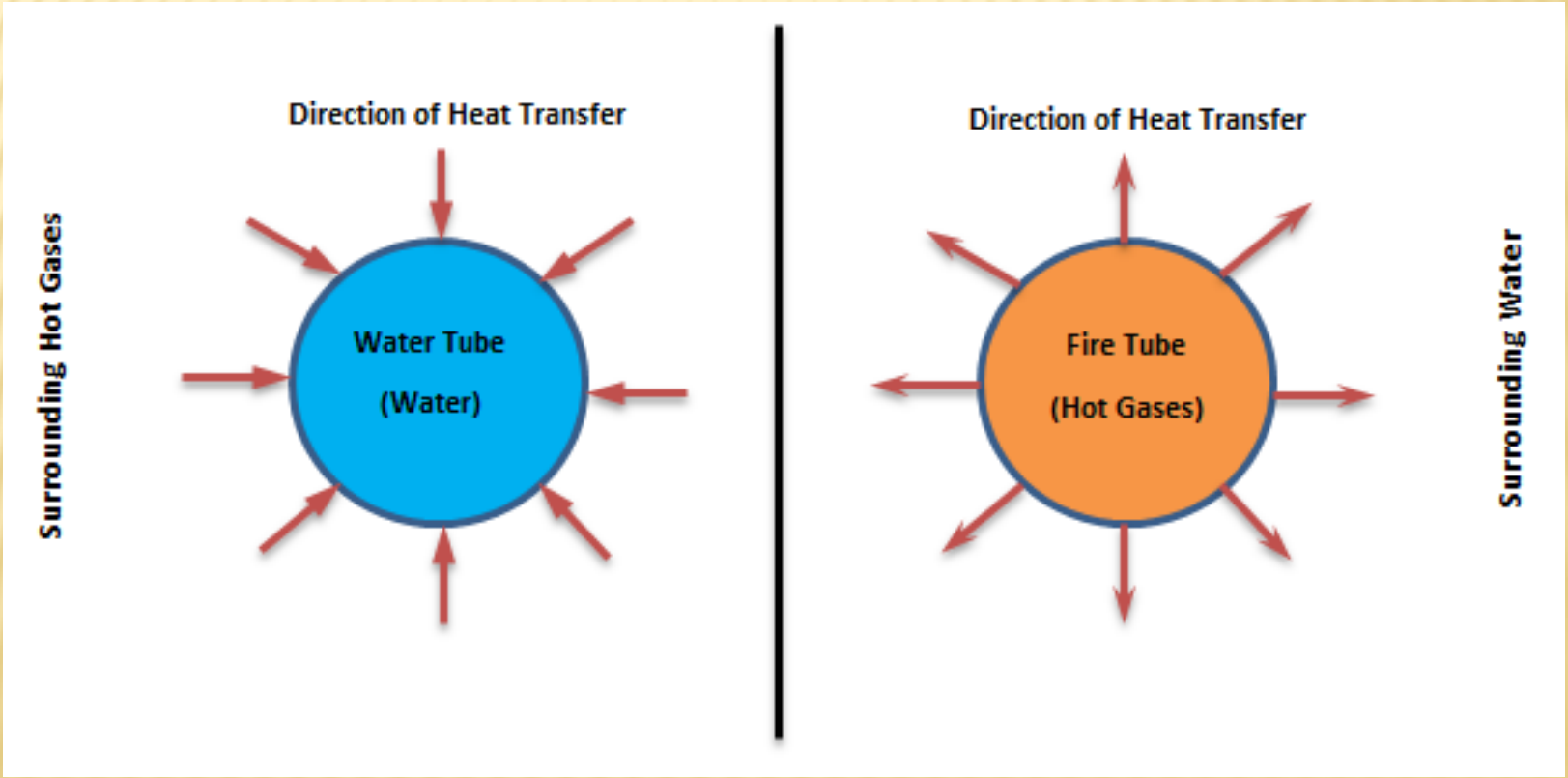


STEAM GENERATION

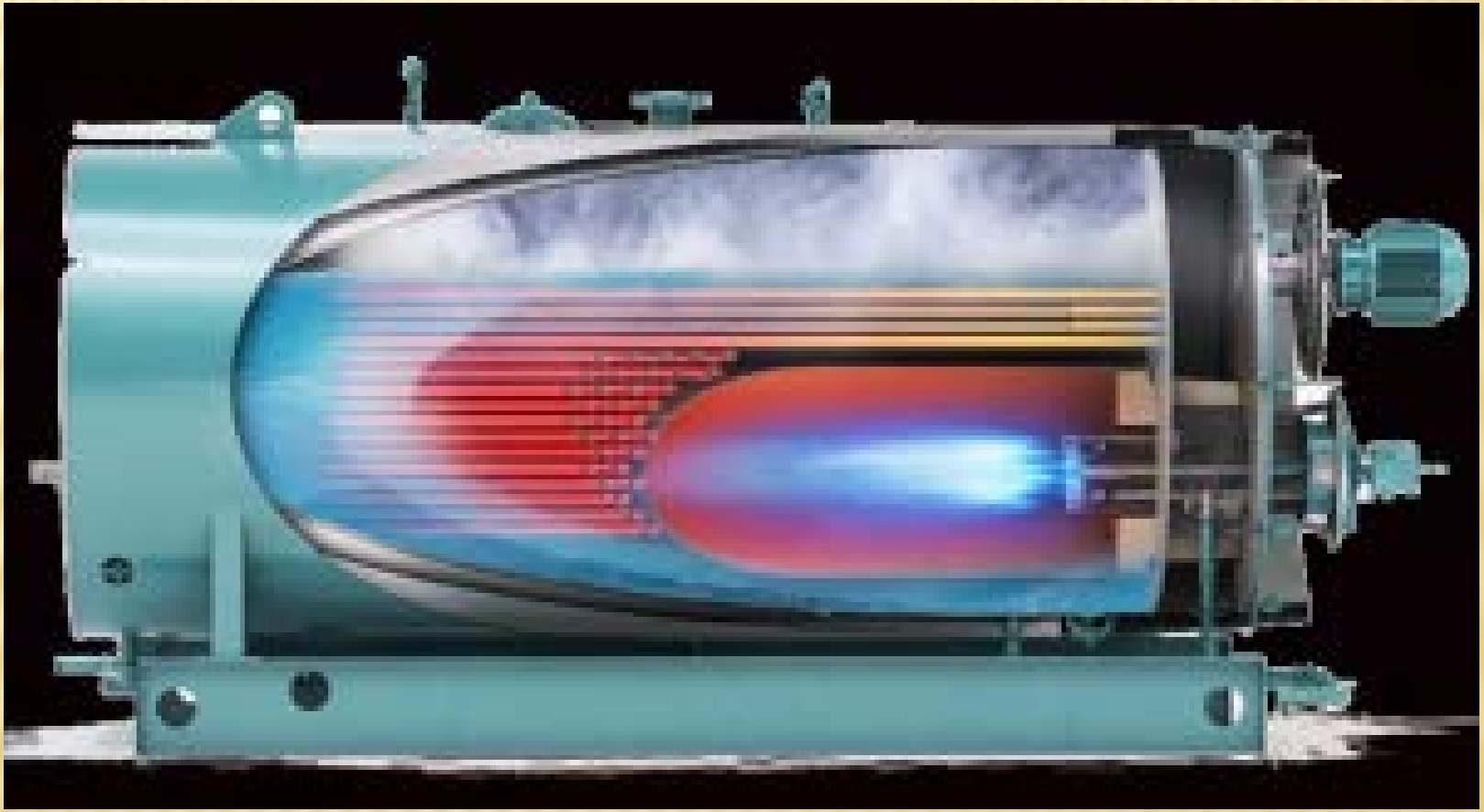


STEAM GENERATION

- Firetube Boilers
- Watertube Boilers

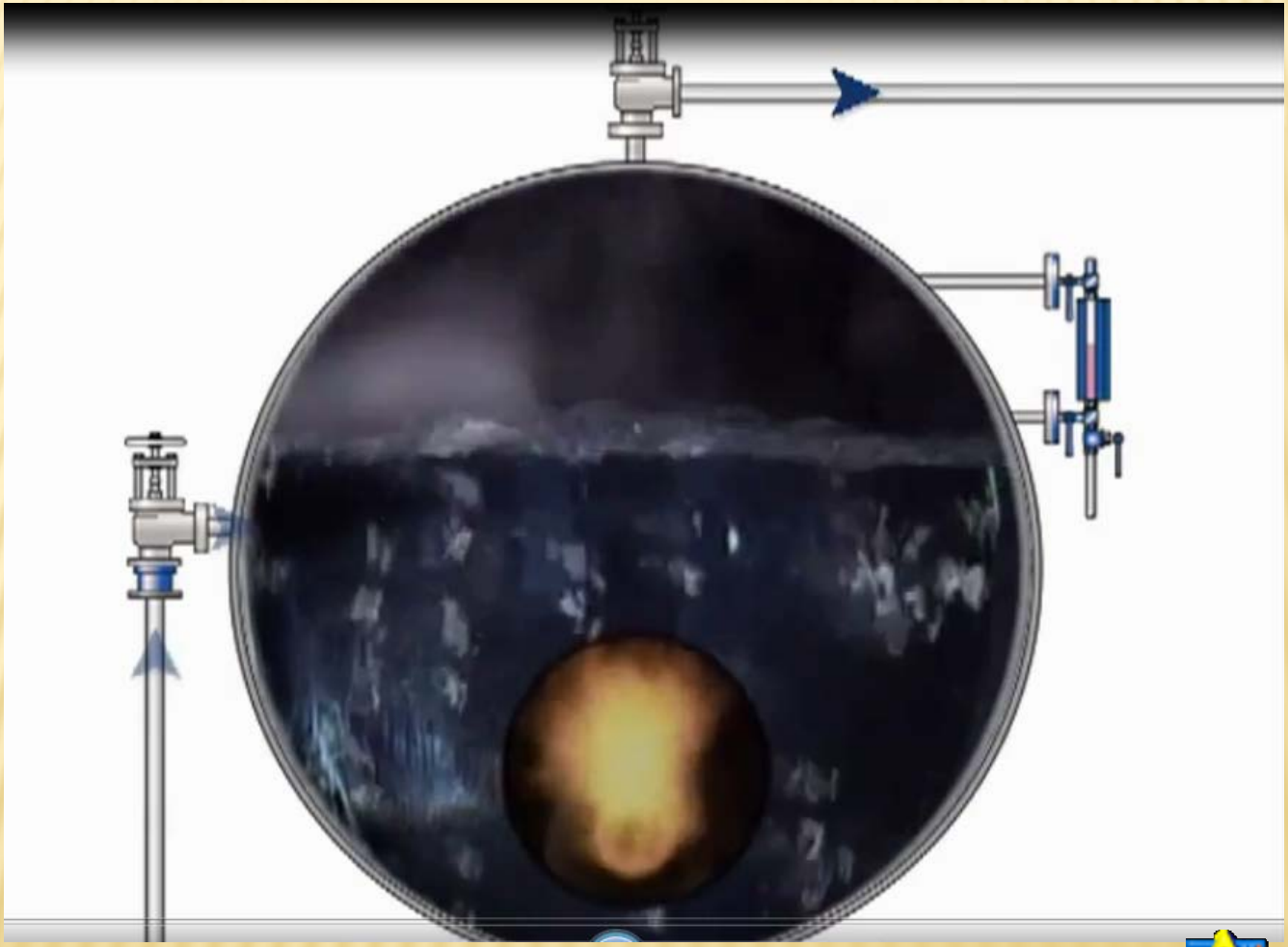


STEAM GENERATION



Cleaver Brooks CBEX Boiler

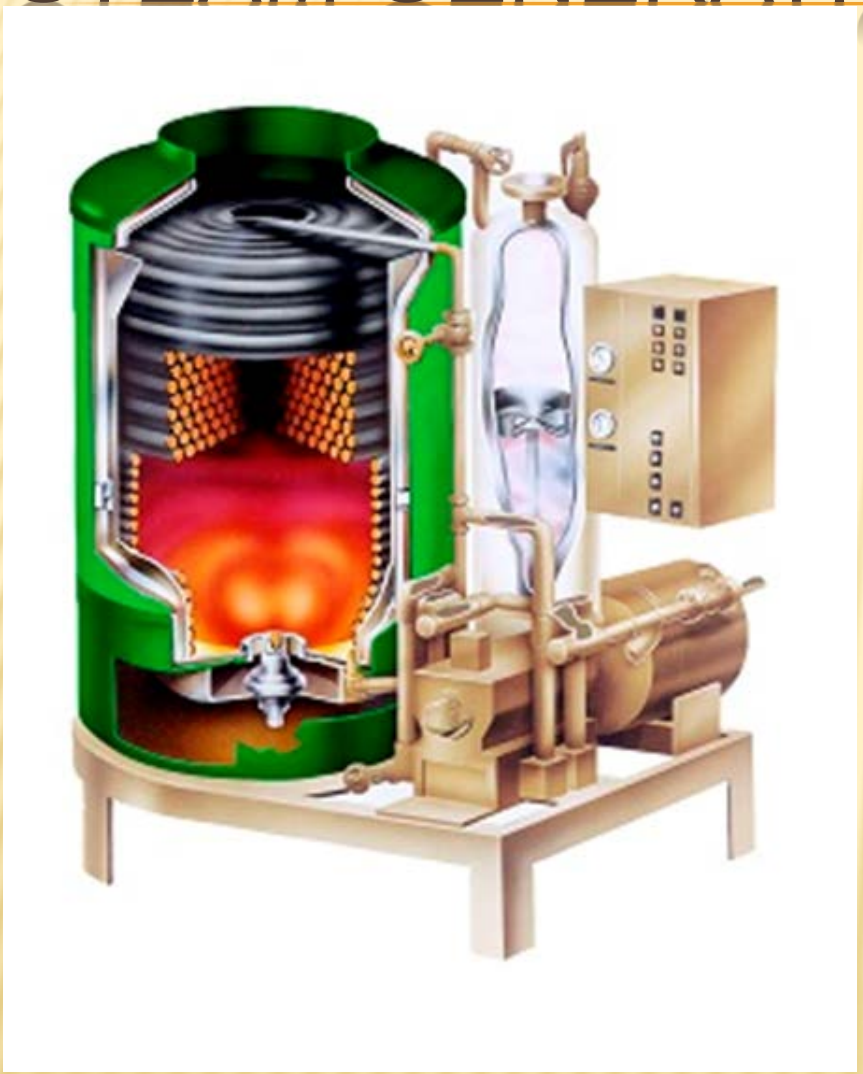
STEAM GENERATION



Cleaver Brooks CBEX Boiler

Inside Story - Shortcut.lnk

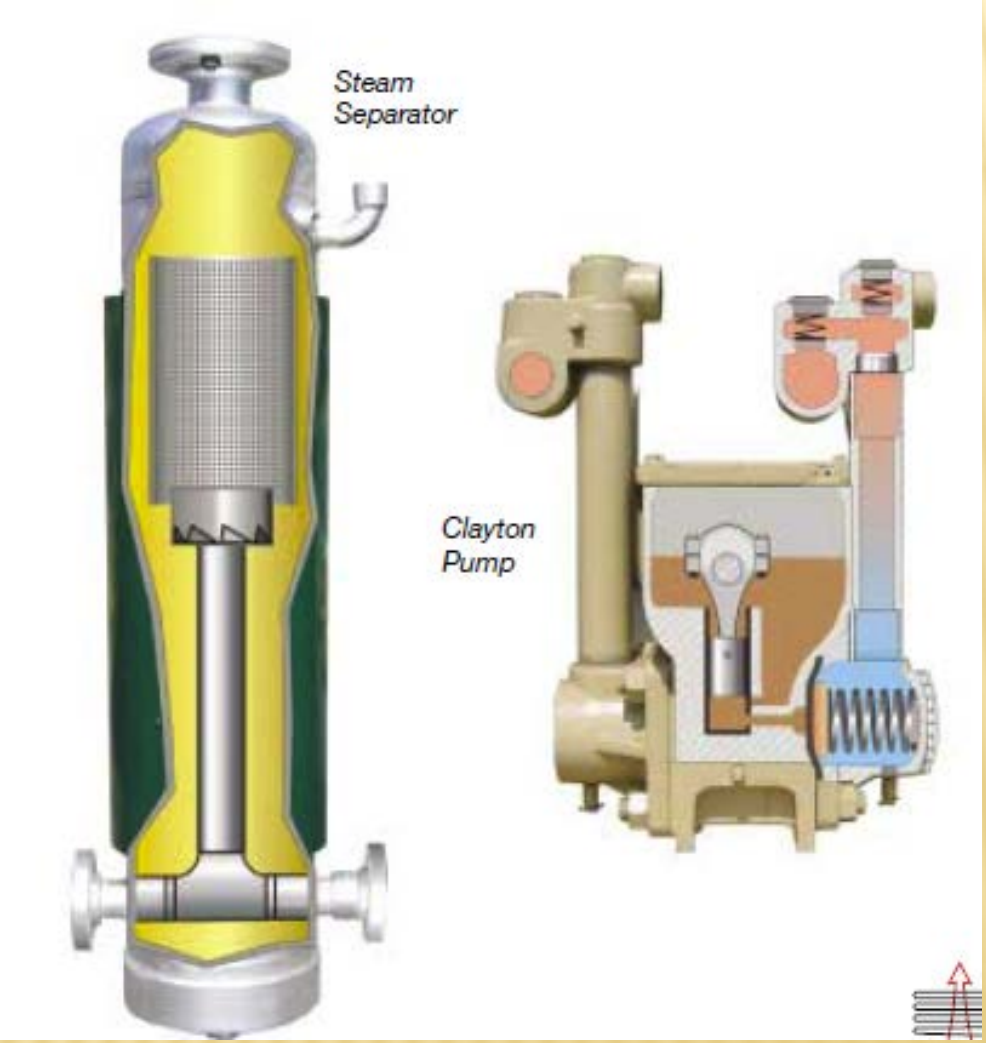
STEAM GENERATION



Spiral Spring Coil Construction allows rapid start-up without thermal stress.

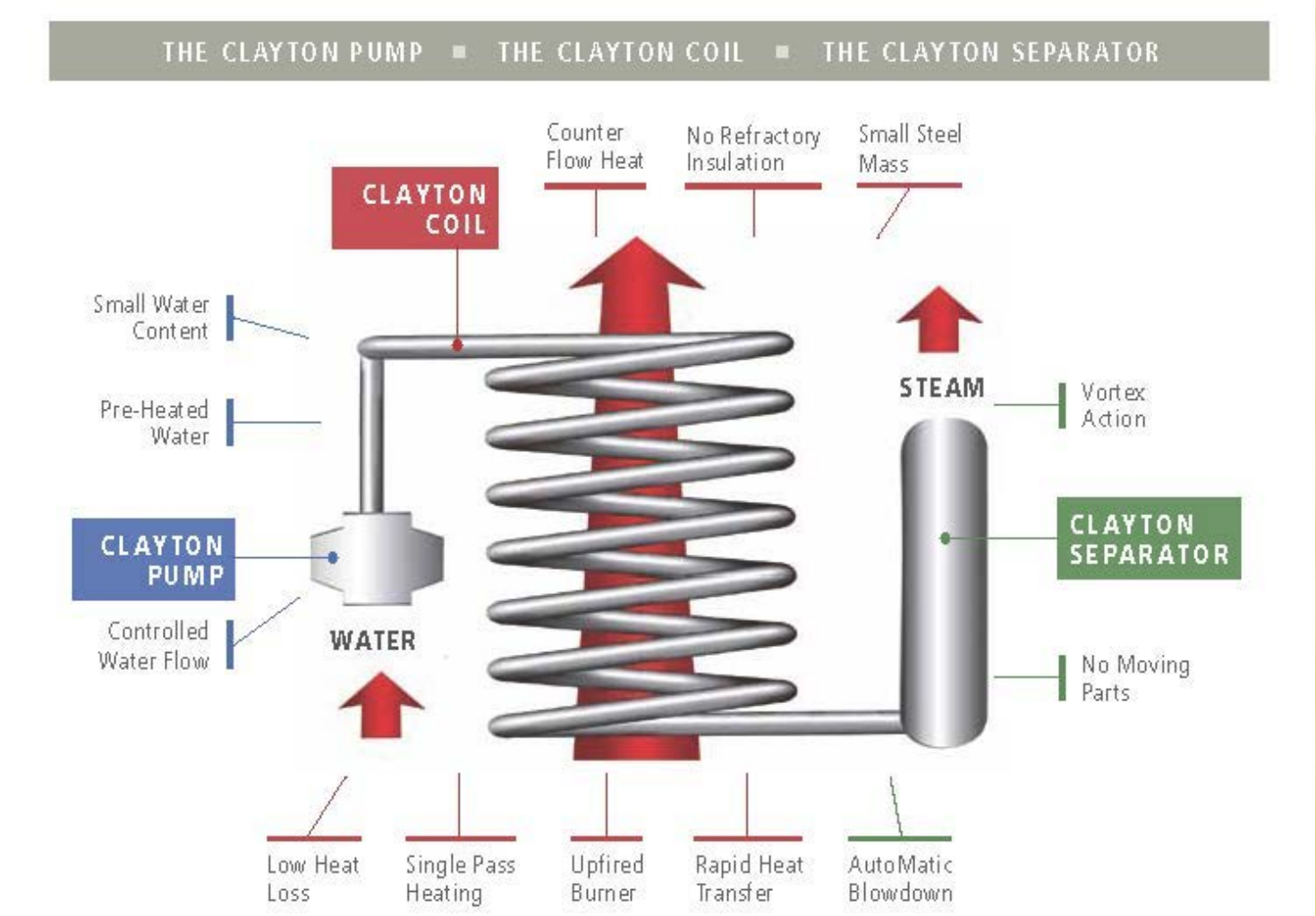
Clayton Steam Generator

STEAM GENERATION



Clayton Steam Generator

STEAM GENERATION



Clayton Steam Generator

BOILER MAINTENANCE

- Annual inspections required all boilers operating at > 15 PSIG
- Hourly inspections required per California Title 8 Section 781 “Boiler Attendance”
- Water chemistry testing – should be completed daily at a minimum
- Testing Primary Low Water Cutout each shift

BOILER MAINTENANCE

- Excerpt from Travelers Insurance Risk control maintenance guidelines for boilers

Low pressure steam (pumped and gravity condensate return)	Two LWCOs , the lower equipped with a manual reset	Daily Annual	Rapid drain Slow drain
		Annual	Inspect
	High pressure limit cutoff with manual reset	Annual	Operational
	Safety valve	Every 3 Months	Manual
High pressure steam (automatically fired and unattended)	Two LWCOs , the lower equipped with a manual reset	Daily Annual	Rapid drain Slow drain
		Annual	Inspect
	High pressure limit cutoff with manual reset	Annual	Operational
	Safety valve	Every 6 months Annual	Manual Pressure
High pressure steam (operator attended)	One LWCO	Each shift Annual	Rapid drain Slow drain
		Annual	Inspect
	High and low water level alarms	Each shift	Manual
	Safety valve (400 psi or less)	Every 6 months Annual	Manual Pressure
	Safety valve (over 400 psi)	Every 3 years	Pressure

BOILER MAINTENANCE

- Clayton Boiler water chemistry requirements

COIL FEEDWATER AT SAMPLE VALVE	
Limit Values:	Typical Values:
Hardness – 4 ppm maximum	0 ppm
pH	10.5 – 12.5
Residual Sulfite	50 – 100 ppm (during operation) > 100 ppm (during wet lay-up)
Limit dissolved solids – 8,550 ppm maximum	*3,000 – 6,000 ppm
Free of suspended solids (mud, rust particles, etc.)	0

BOILER MAINTENANCE

- Typical Firetube water chemistry requirements

Water Constituent Tolerance: 0-300 operating psig

Feed Water		Boiler Water	
Oxygen	.007 ppm	Silica	150 ppm
Iron & copper	0.1 & 0.05 ppm	Total Alkalinity	700 ppm
Total Hardness	0.3 ppm	Free OH Alkalinity	200-400 ppm
pH	8.3 – 10.0	Specific Conductance	7000 umhos
Non-Volatile TOC (Total Organic Carbon)	1 ppm		
Oily Matter	1 ppm		

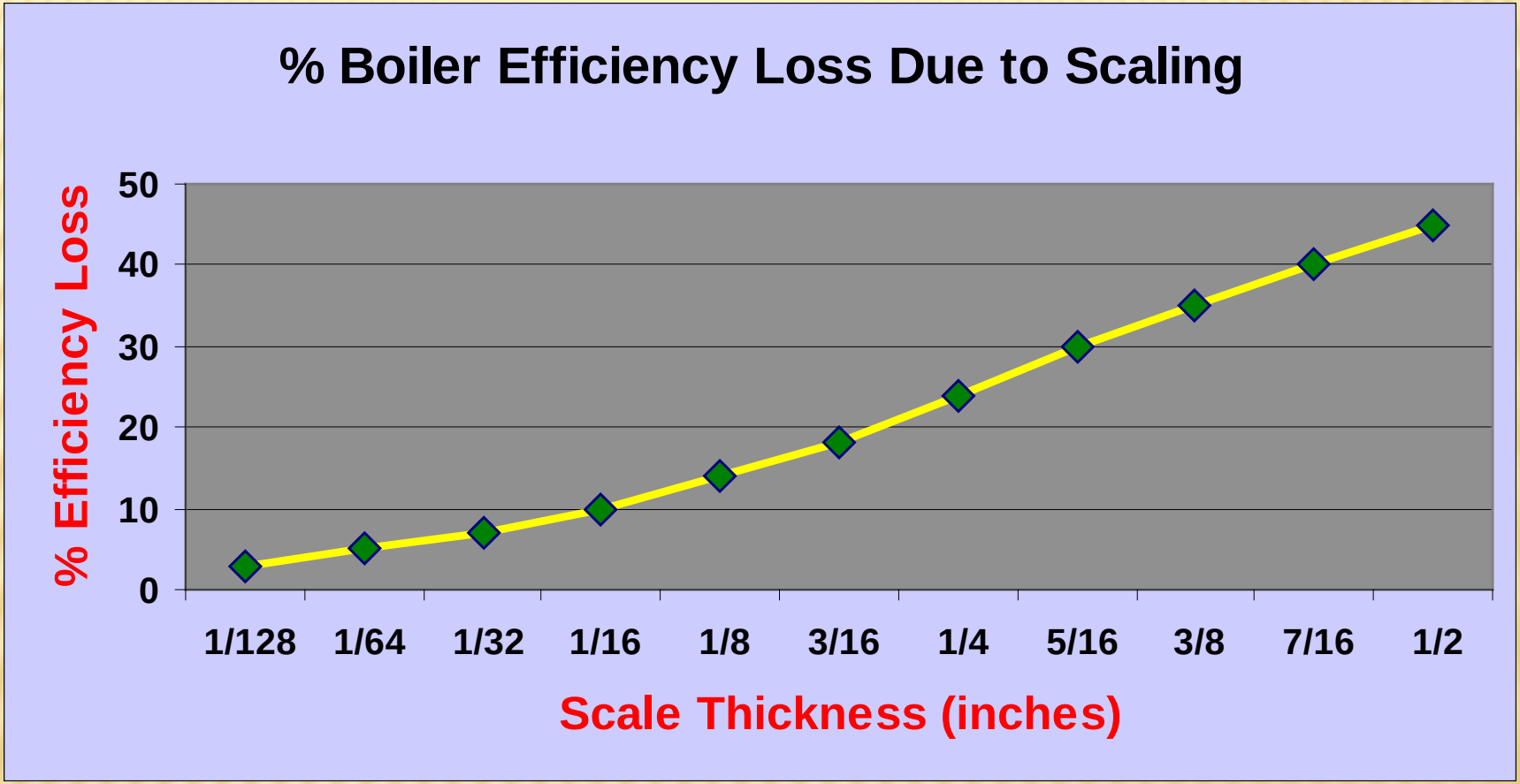
BOILER MAINTENANCE

- When making hourly rounds complete boiler log sheet
- Note boiler water level
- Note Feed water tank/DA Tank water level and pressure/temperature
- Inspect burner flame
- Note any leaks

BOILER FAILURES

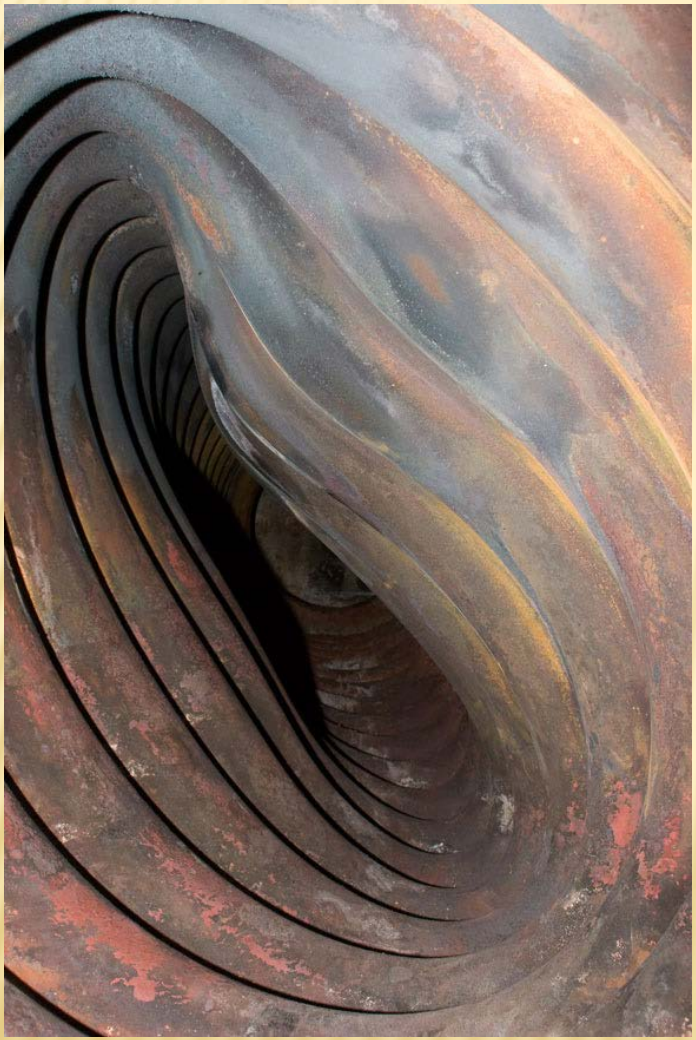
- Typical boiler failures:
- Flame failure during run or pilot
- Low water shutdown
- Control faults
- Water chemistry out of compliance with established parameters
- Lack of maintenance
- ***Don’t ignore the problem, find the cause and resolve it!***

BOILER FAILURES



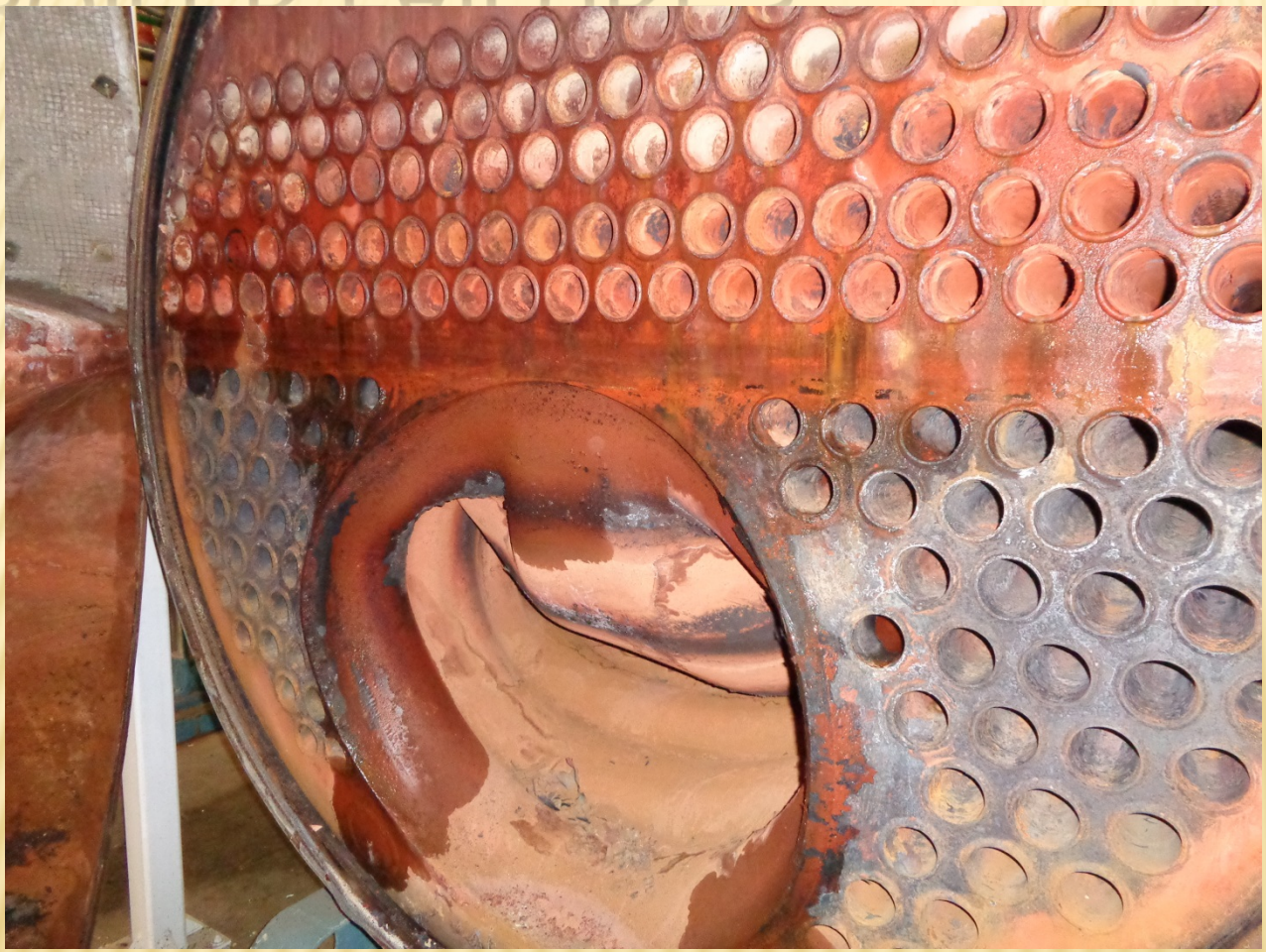
Scale increases operating costs - $$$ lost

BOILER FAILURES



Poor water chemistry resulting in tube failure

BOILER FAILURES



Lack of maintenance

BOILER FAILURES

Auxiliary Low Water Cutout not tested correctly and had failed

OVERVIEW

- How important is steam to your process?
- Without steam, no or limited production
- No or limited production costs you $$$$ in potential feed sales
- Customers will go to another supplier who can meet their immediate needs
- By the way, those customers may not come back

OVERVIEW