



Armstrong[®]

Intelligent System Solutions[®]

STEAM • AIR • HOT WATER

Armstrong International

Armstrong International, Inc.



Founded in 1900

Five Generations of Family Ownership and Leadership

Adam Elliott Armstrong
Lawrence F. "Army" Armstrong
Merrill H. "Gus" Armstrong
David M. Armstrong
Kurt Armstrong



Global leader in energy
and environmental
management



Specialists in utility optimization for process,
industrial, and institutional facilities



Operate 12
manufacturing
facilities located in
North America,
China, Europe,
Japan, India, Mexico
and Korea



Global network of sales
engineers and energy training
facilities located in 60 countries



Armstrong Promise

We provide intelligent system solutions that improve utility performance, lower energy consumption, and reduce environmental emissions . . . while providing an “enjoyable experience”!



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“Expect many enjoyable experiences!”

David M. Armstrong

Promise Kept....every second...

- Since 2004, when we authored the UN recognized methodology for steam system carbon trading....
 - Armstrong saves 1 ton of CO₂ every 13 seconds
 - Armstrong saves 1 ton of energy every 40 seconds
 - Armstrong saves 10 tons of water every 3 seconds

....globally....



Energy Audits – System wide

Have conducted *thousands of system audits* that have recognized upgrade ideas saving millions of \$'s in energy at customer sites



Operations and Maintenance

Operate, maintain, and/or service multiple facilities globally that have lowered operational costs at each facility. Terms: 3-25 years

Service Solutions



Financed Optimization (specific projects)

Have *financed millions of \$'s of energy projects*



Turnkey Construction and Project Management

Have implemented *hundreds of turnkey energy conservation projects* where Armstrong provided the talent and manpower to install project ideas and mitigate cost overruns



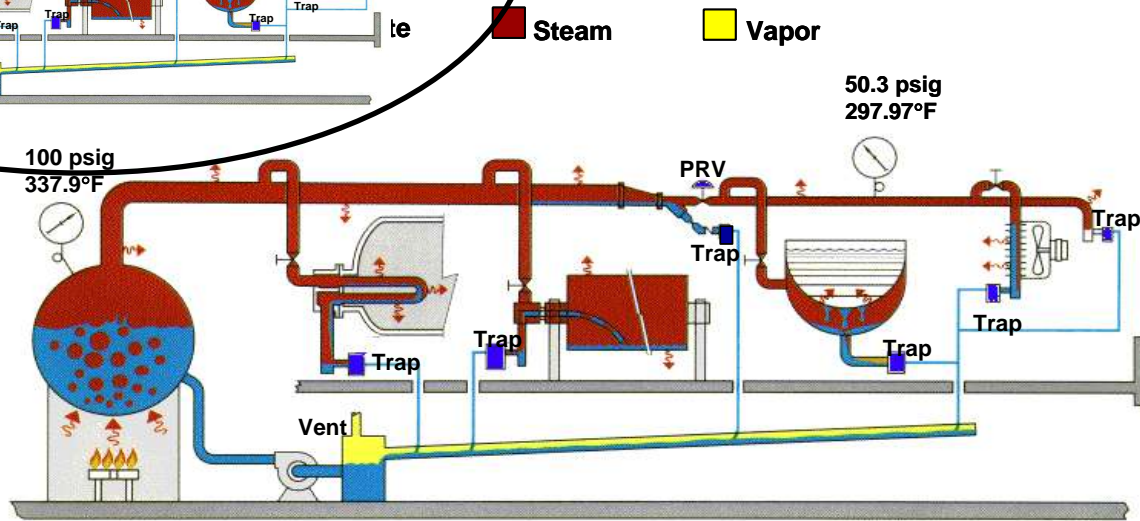
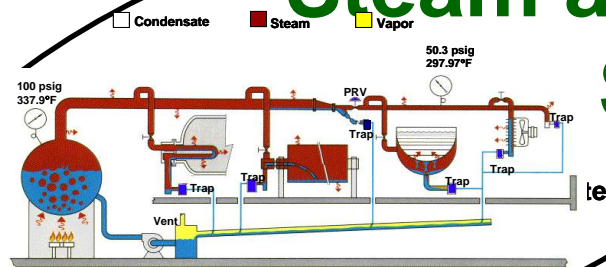
Utility Monetization (utility asset ownership)

20 Global facilities owned and/or operated by Armstrong

Steam and Condensate Solutions

Solutions

Steam and Condensate Solutions



and Air Drainers



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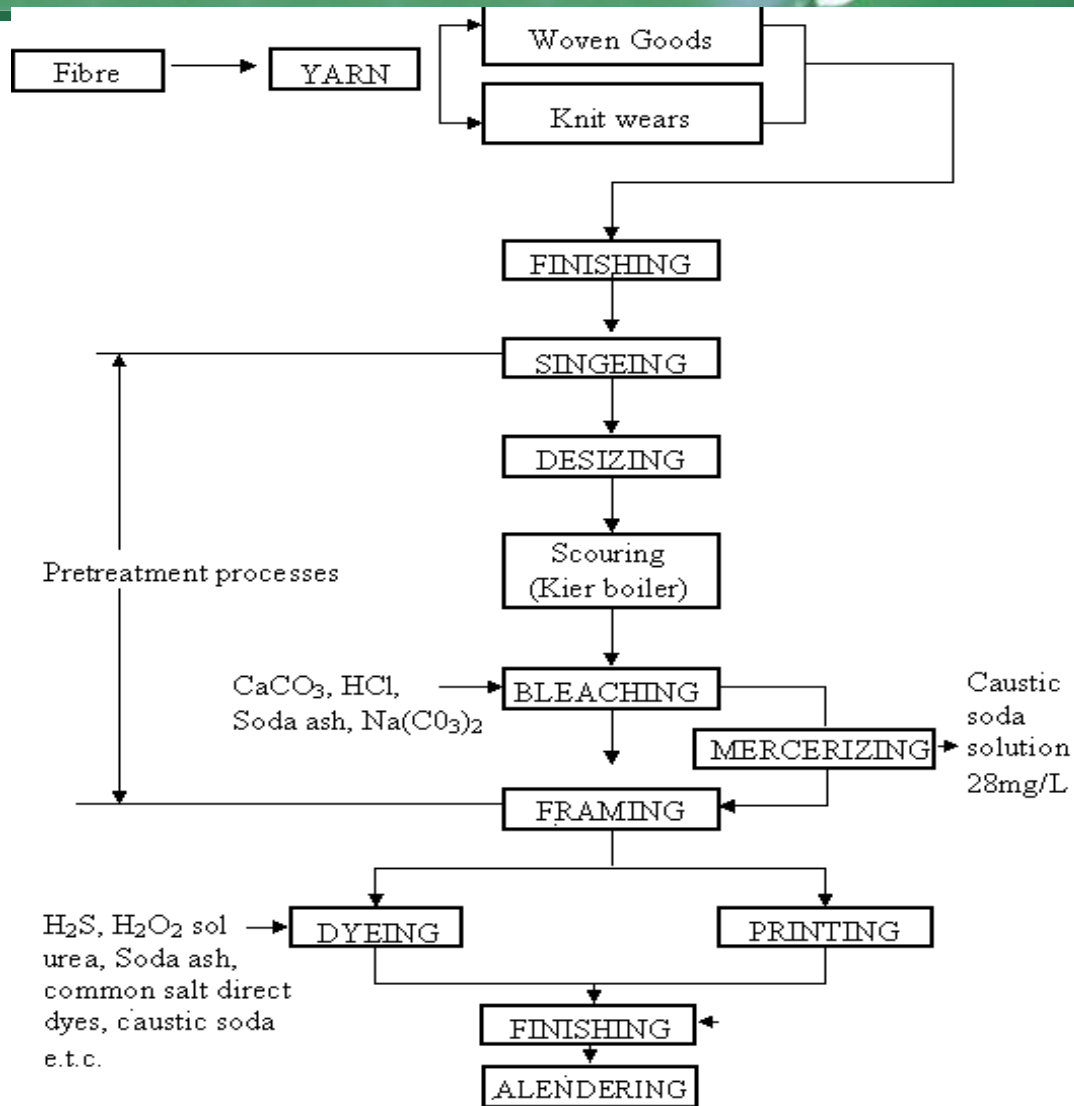
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Energy Conservation by improving Steam System Efficiency

Broad Textile Process

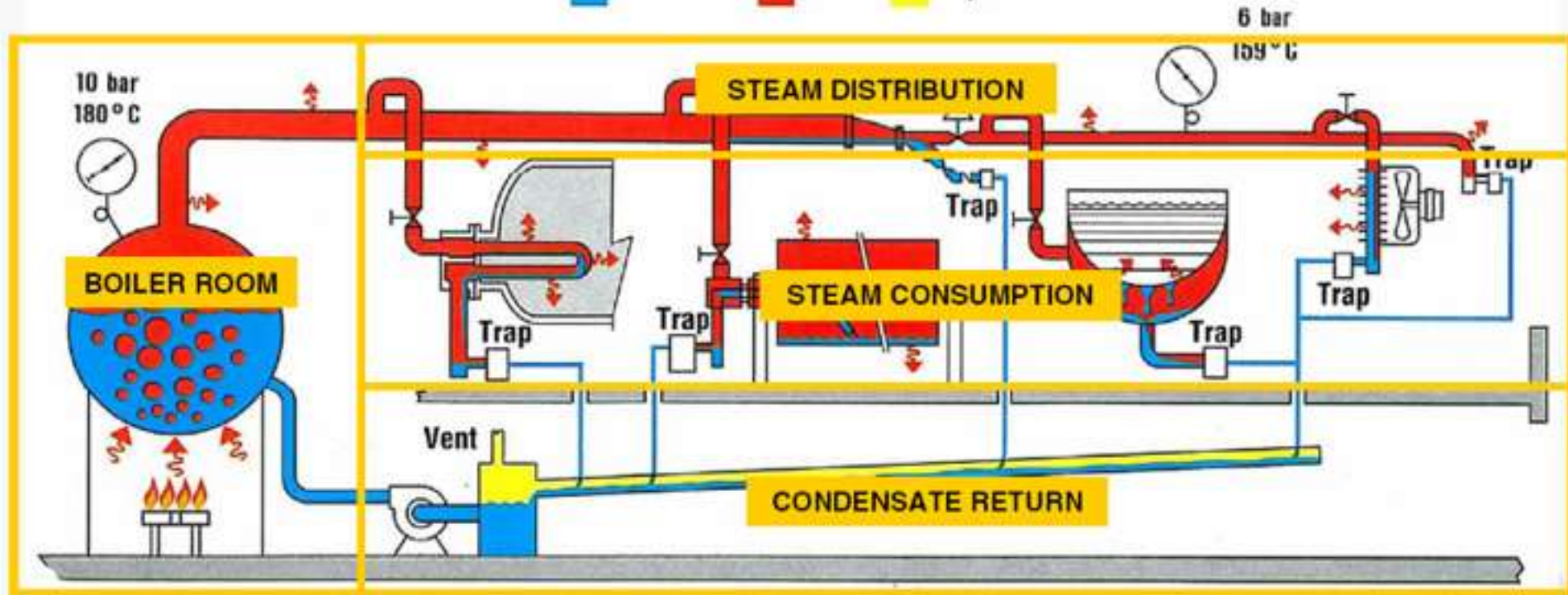
Process Flow



The 4 Parts of a Steam System



Condensate Steam Vapor

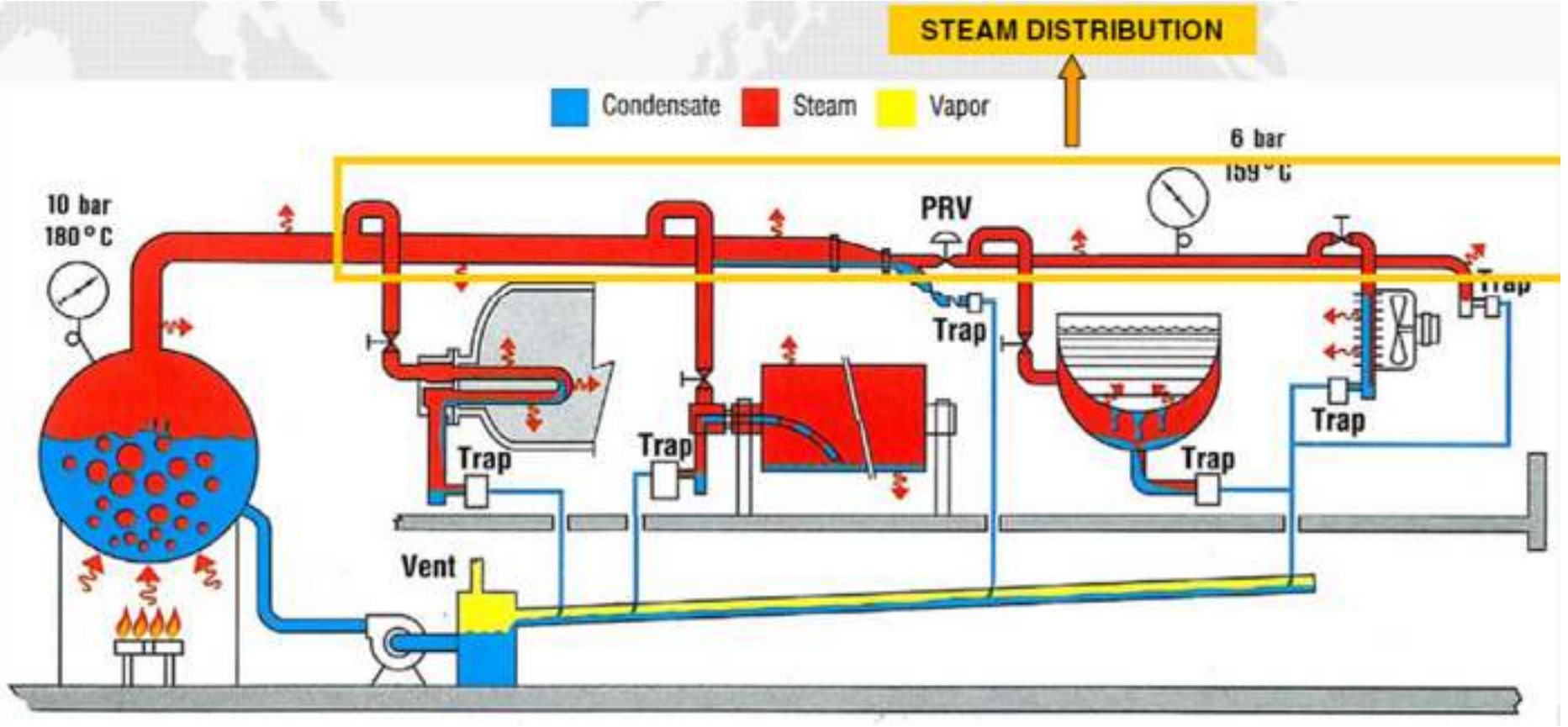


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Steam Distribution



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Steam Distribution



Factors affecting steam distribution system efficiency:

- Pipe Size
- Pressure Drop
- Velocity
- Heat loss & Condensation
- Effects of air & other gases
- Removal of Condensate

Flow / Velocity / Pressure Drop

- Velocity is proportional to flow rate.
- Pressure Drop is proportional to the square of the flow rate.
- Example: 2" Line, XXXX kg/hr at 7 bar(g)

Flow

Velocity

Pressure Drop

450 kg/hr

14 m/sec

0.04 bar(g)/ 30 mtr

900 kg/hr

28 m/sec

0.18 bar(g)/ 30 mtr

1350 kg/hr

42 m/sec

0.4 bar(g) / 30 mtr

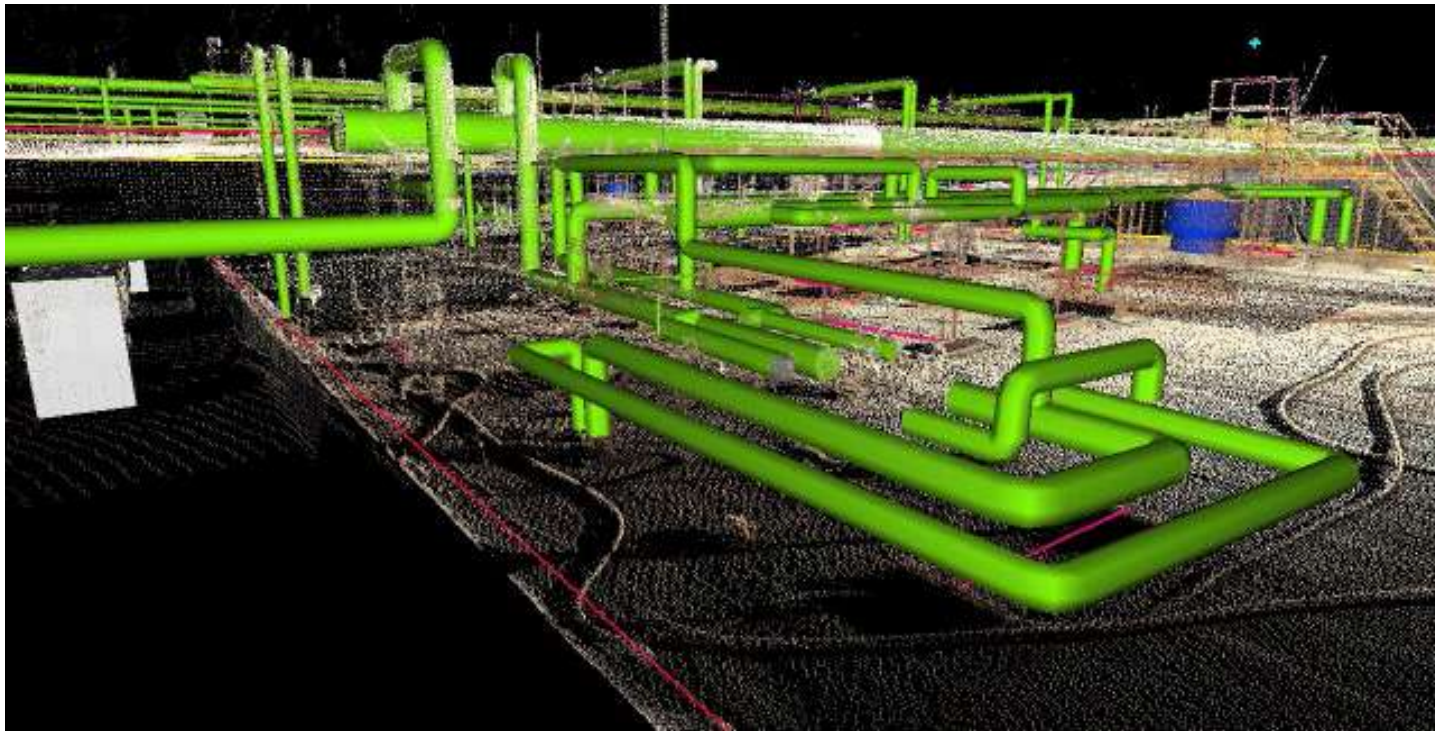
Pressure Drop in Steam Distribution Piping: 450 kg/hr steam

Pipe Size Sch 40	P= 7 bar bar / 30 mtr	P= 3.5 bar bar / 30 mtr	P= 1 bar bar / 30 mtr
3/4"	6	10	21
1"	1.72	3.5	6
1-1/4"	.41	0.68	1.4
1-1/2"	0.18	0.31	.6
2"	0.04	0.08	.18



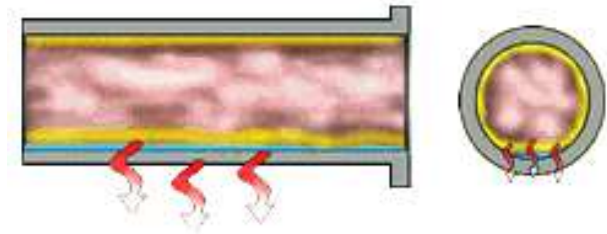
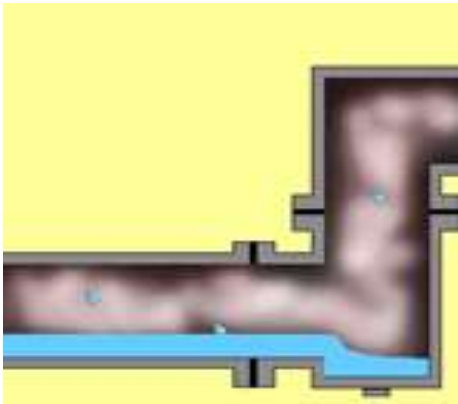
Steam System Pressure Drops

- Steam Pipes Should be sized for a Speed of 20-25 m/s
- Pressure drops should not be higher than 10% of Boiler Pressure



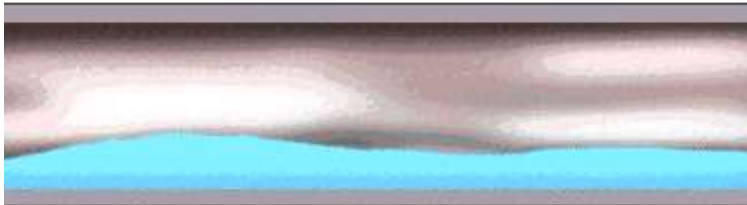
Heat loss & condensation effects

The Piping is Constantly Being Filled With Water (Condensate)



Sub cooled Condensate + CO₂
Forms Carbonic Acid

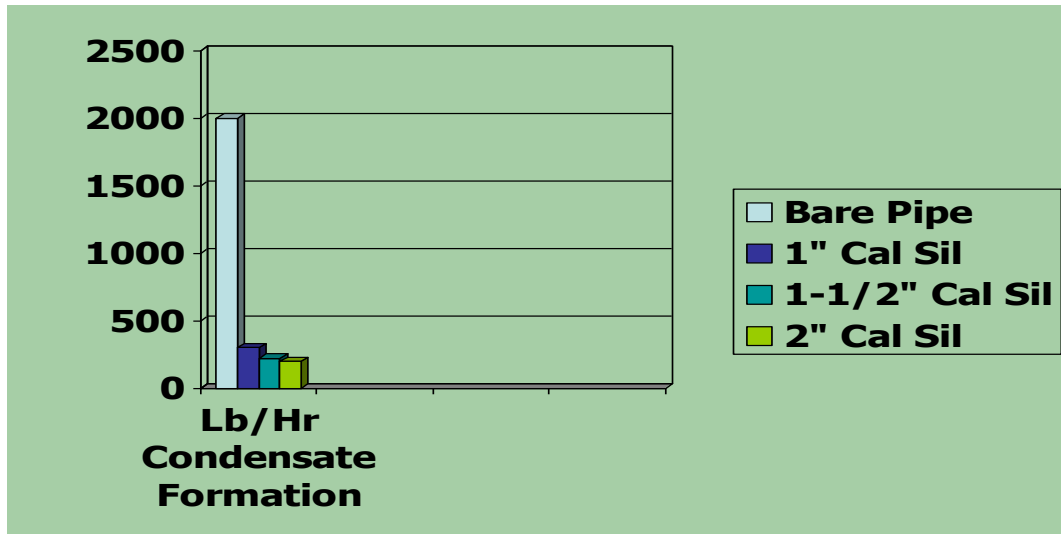
The Piping is Subject to Water Hammer



Insulation is the Answer



**The effects of insulation on a steam distribution line:
300' of 8" line at 20 °F, 20 mph wind, 100 psig steam.**



ECM: Repair /Install Insulation

- Description :
 - Insulate Bare Piping, Valves, fittings.
 - Repair Damaged Insulation
- Typical Payback Time:
 - 6 – 9 months
- Advantages:
 - Safety Improvement
 - Better Steam Quality,
 - Energy Savings
 - Minimize Water hammer
 - Avoid corrosion due to damaged insulation



Effect of Air on Steam Temperature

Heat exchanger designed for maximum capacity at 60 psig, when supplied with a 30% steam air mixture must raise pressure to 90 psig to regain temperature.

Latent heat at 60 psig = 502.2 kcal/kg

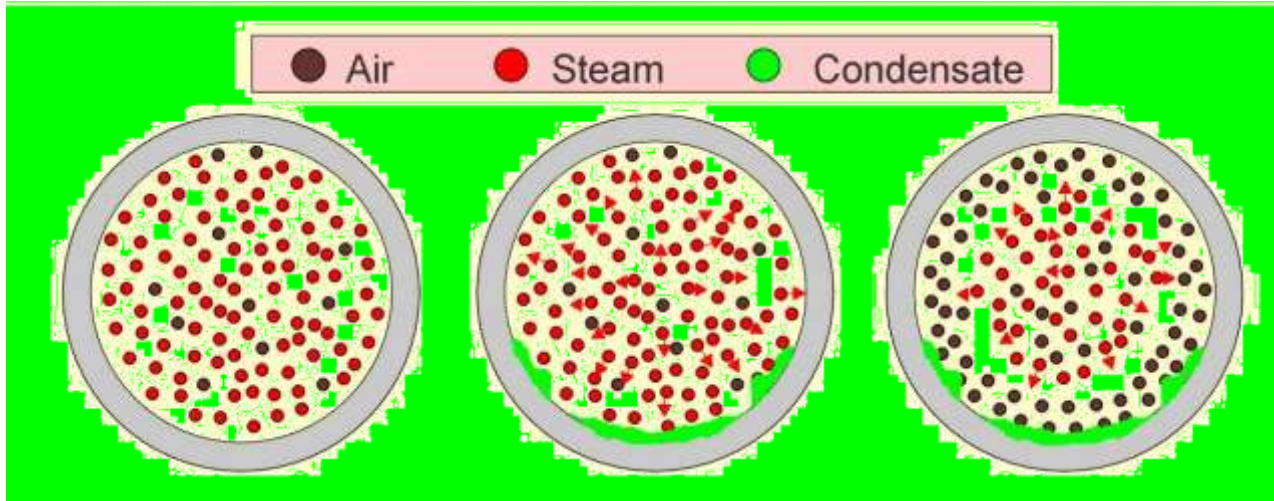
Latent heat at 90 psig = 492.2 kcal/kg = 2% less heat energy available

Heat exchanger designed for maximum capacity at 60 psig, when supplied with a 30% steam air mixture must raise pressure to 90 psig to regain temperature.

Total heat at 60 psig = 656.6 kcal/kg

Total heat at 90 psig = 660kcal/kg = 1% more heat energy used

Insulating Effects of Air



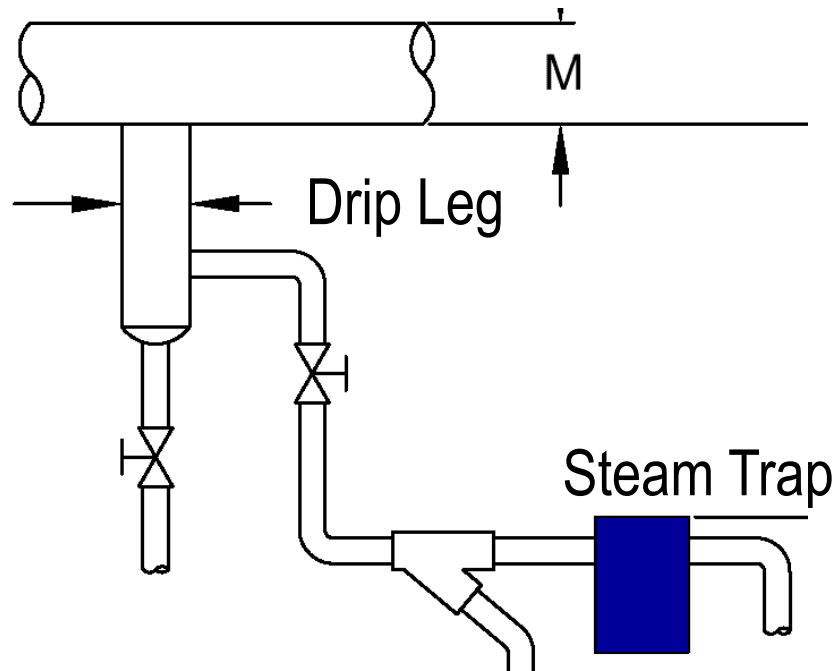
As steam condenses it flows toward the tube walls

Air flows with the steam to the tube walls and forms an insulating film on the tube walls

1 mm air = 1.5 mm steel = 13 mm copper in insulating value

Piping and Trapping for Condensate Removal

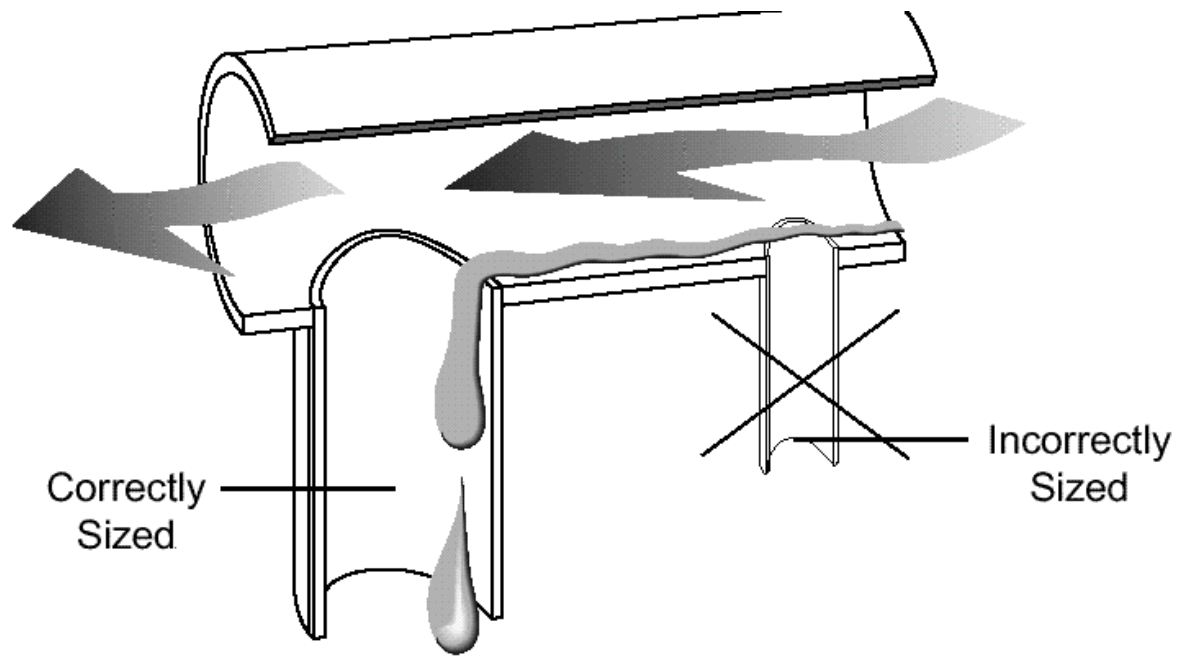
Drip Legs Allow a Space for Condensate and Dirt to Collect, and Direct the Condensate to the Steam Trap



Drip Leg Sizing



Condensate Can be Pulled Across an Undersized Drip Leg



Piping and Trapping for Condensate Removal

Provide Drip Legs and Traps:

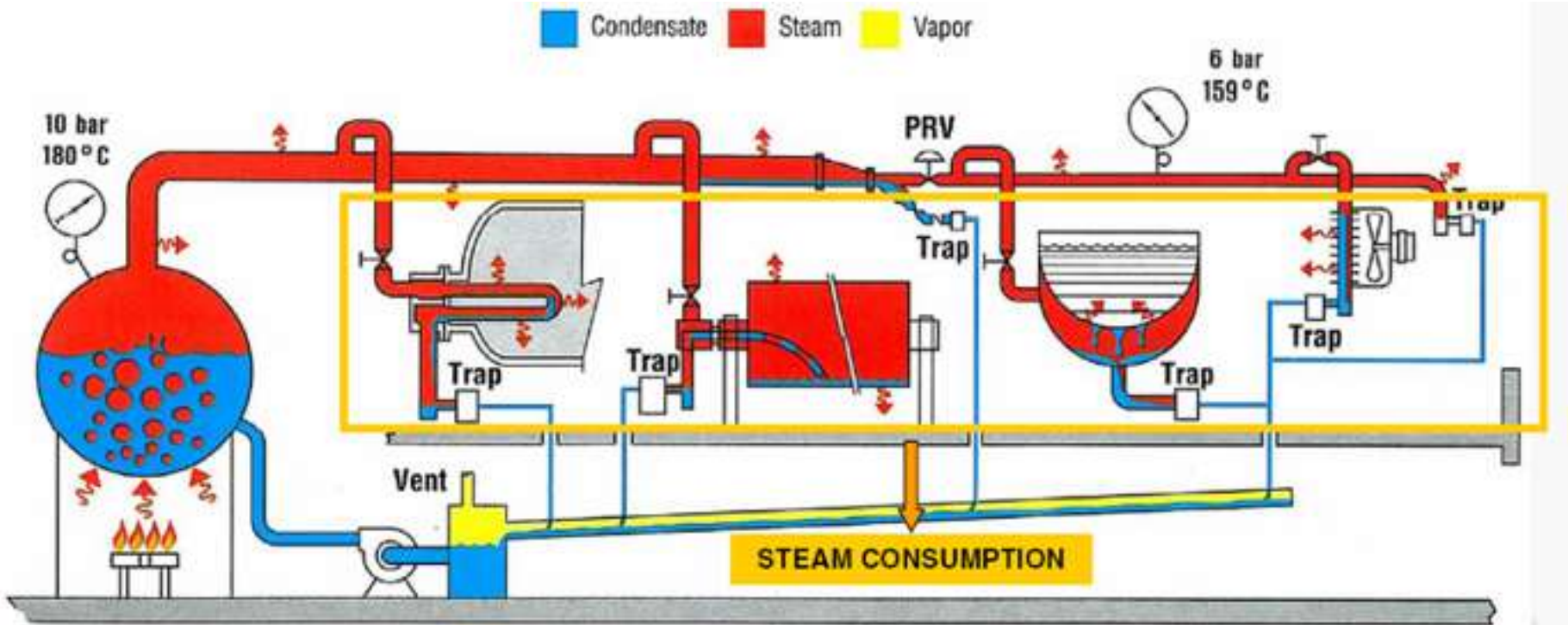
- At Boiler Headers
- On Mains and Branch Lines at Natural Drainage Spots and Low Points
- On Long Pipe Runs, With or Without Natural Drainage Points
- ALWAYS Prior to Valves

ECM: Install Appropriate Traps on Main Headers on Main Headers



- Description:
 - Avoid Disc Traps outside as it will cause useless Steam Leaks during Raining Season and high Back Pressure and Condensate Return
 - Avoid Bi-Metallic Traps on Main Steam Lines . They do not drain condensate as soon as created. This will have as consequence higher water hammer Risks.

Steam Users



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Steam users in the Textile Industry

Different types of process in textile industry

- Wet processing under pressure – batch type
Eg: Soft Flow machines, Yarn dyeing machines
- Wet processing at atmospheric pressure – batch type
Eg: Jiggers, winches
- Continuous processing
Eg: Drying cylinders

Energy Saving Opportunities

- Wet processing – Batch type under pressure
 - Proper temperature controls
 - Use steam at lowest possible pressure for latent heat savings
 - Proper condensate removal
 - Proper steam trapping
 - Heat recovery from dye liquor and cooling water

Energy Saving Opportunities



- Wet processing – Batch type at atmospheric pressure
 - Avoid temperature overshoot by using proper temperature controls
 - Steam supply at the right pressure
 - Proper steam injection in direct heating

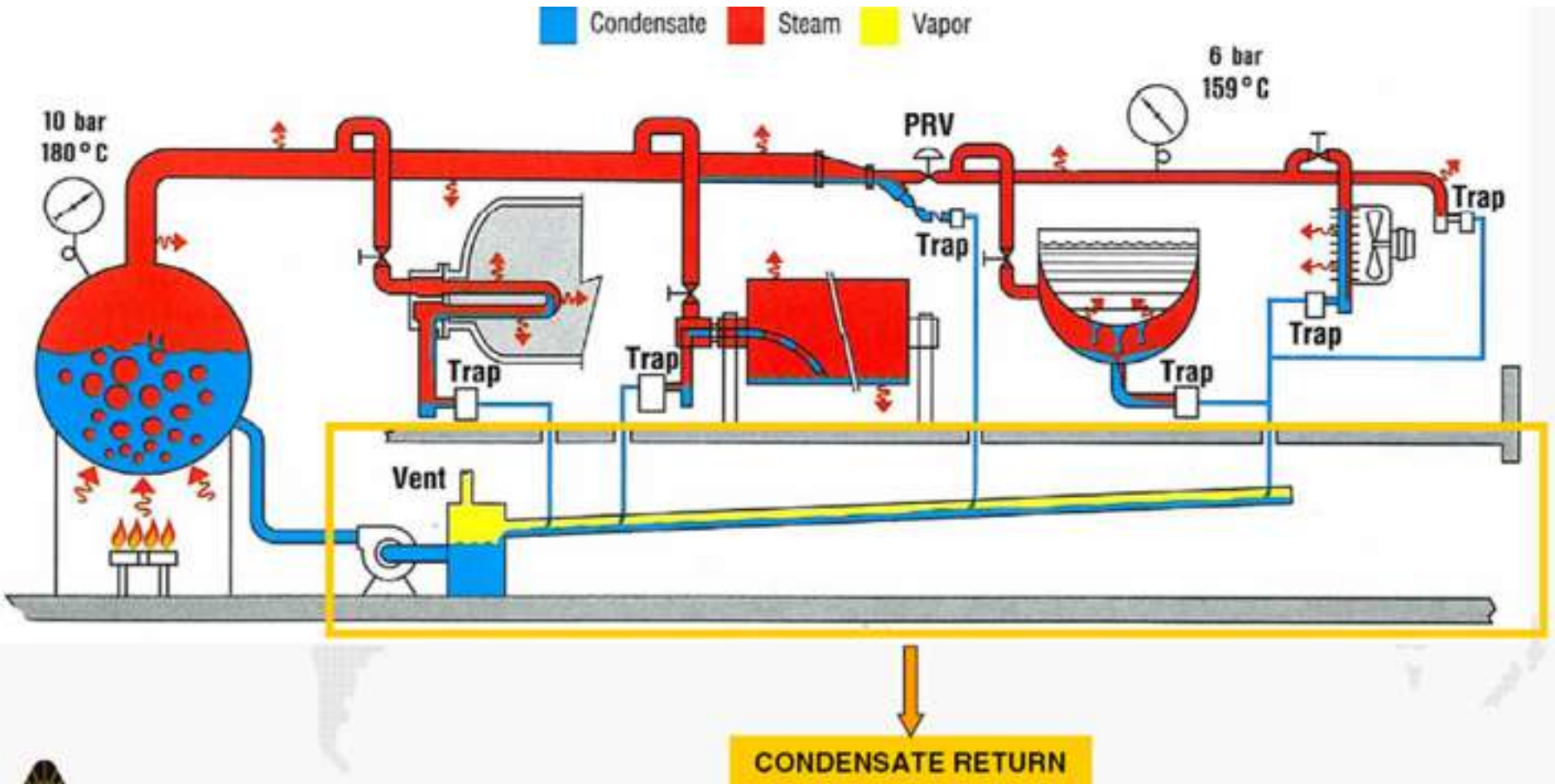
Energy Saving Opportunities



➤ Continuous processing

- Proper temperature controls
- Use steam at lowest possible pressure
- Proper air venting from steam system
- Proper condensate removal
- Avoid group trapping

Condensate Return



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Condensate and Flash Steam Recovery

Recover condensate to boiler feed water tank
Recover Flash Steam

Advantages of Returning Condensate

- Energy Savings
- Water Savings
- Blow Down Reduction
- Chemicals Reduction
- WTP Costs Reductions

Condensate Return Optimisations

- Improving Condensate Return
 - Piping Sizing
 - Recover from low pressure steam users
- Recovering Flash Steam
 - Flash tank
- Avoiding water hammers in condensate return
 - Separating flash/live steam from condensate
 - Mixing cold and hot condensate
- Decreasing Back Pressure
 - Segregating Different Pressure Condensate Return Lines
 - Decreasing Steam Leaks into Condensate Return

ECM : Segregate Condensate Return Lines to avoid Water Hammer

- Description
 - Sending 3 bar & 6 bar pressure condensate in the same pipe will generate high back pressure that will impede correct draining of low pressure users
- Solution
 - Segregate 3 bar and 6 bar Condensate Return Lines
- Benefits
 - Lower Back Pressure
 - Efficient condensate removal on Process Steam Users
 - Better Productivity

Recovering Flash Steam

Description:

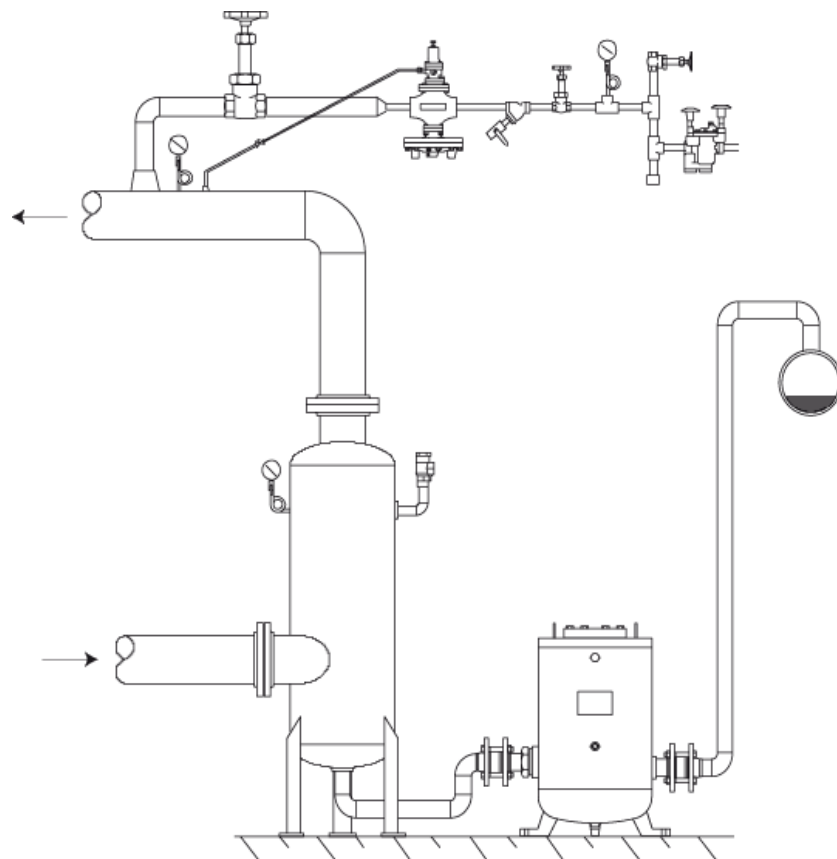
- Recovering Flash steam from Drying, Dyeing etc areas for low pressure use.

Flash steam Recovery

- Savings: 2 – 10 % on fuel
- Return on Investment : 30 – 180 % per year (After deducting depreciations)

Benefits

- Flash steam could be used for other application instead of low pressure live steam = energy and CO2 savings
- No flash steam in the condensate return – no increase in the back-pressure due to steam volume that is much bigger than the one of condensate



“Knowledge not Shared is Energy Wasted.”



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Questions & Answers



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Thank you