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Energising Businesses and Communities Worldwide

ENERGY EFFICIENCY BENCHMARKING AND SUSTAINABLE SOLUTIONS FOR THERMAL UTILITIES IN TYRE INDUSTRY

Date 07-08-2024

Presenter- Forbes Marshall

TYRE CURING

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TYRE CURING – ENERGY INTENSE PROCESS

High Intensity , less Consumption Process requirement

Curing quality – Tolerance Limit of Parameters are very narrow

UTILITIES

Steam – High , Medium and Low Pressures

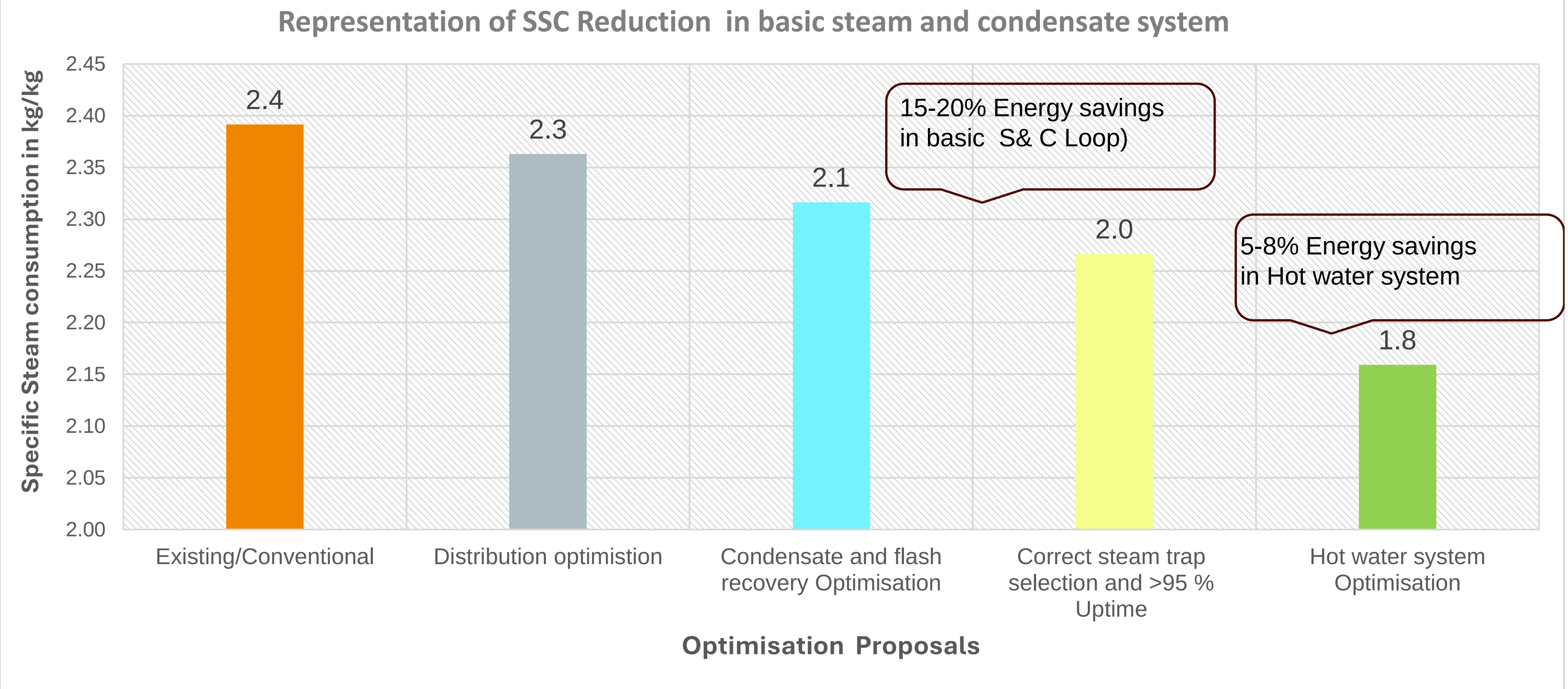
Hot water supply

Nitrogen Supply

Cooling water

Vacuum

SSC OPTIMISATION OPPURTUNITY IN STEAM AND CONDENSATE SYSTEM



CONDENSATE RECOVERY FACTOR OPTIMISATION

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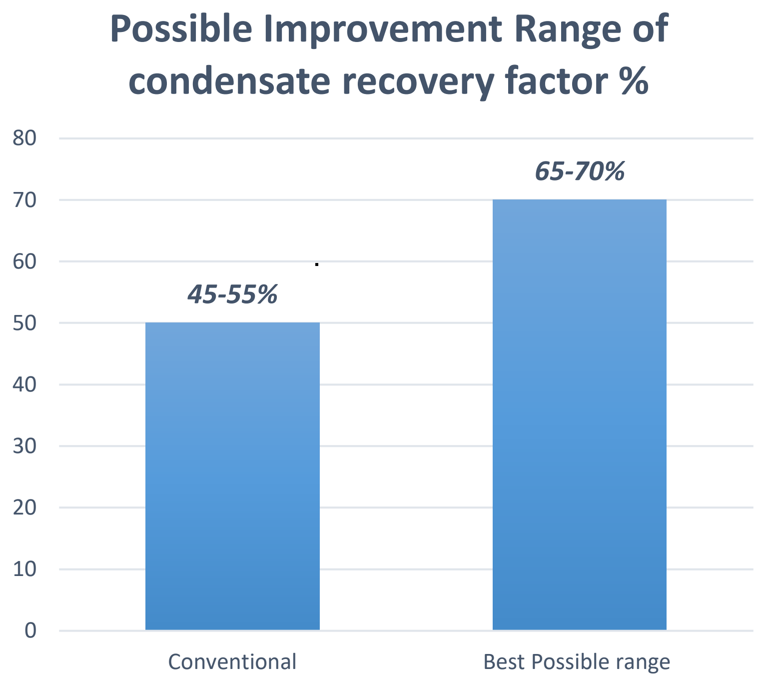

1. *Pressure wise condensate segregations*
2. *Flash and condensate recovery (closed loop) to feed water tank*
3. *Condensate contamination detection, segregation and heat recovery*
4. *HP Internal condensate recovery (Incase of Nitrogen step – condensate carryover to Nitrogen cycle which is loss of water and air)*
5. *Practically complete flash steam and condensate recovery can* ***achieve feed water temp of 100-105 deg.c – cutdown to Zero Live steam***

SP.STEAM CONS AND STEAM CYCLE IN CURING

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HP Blow-through steam contributes to

10-15% of Plant Average steam load

40-50% Higher Steam system design /Boiler capacity

5-10% Loss /vent in the Plant

Key Parameters to Optimised

step time of Blow-through

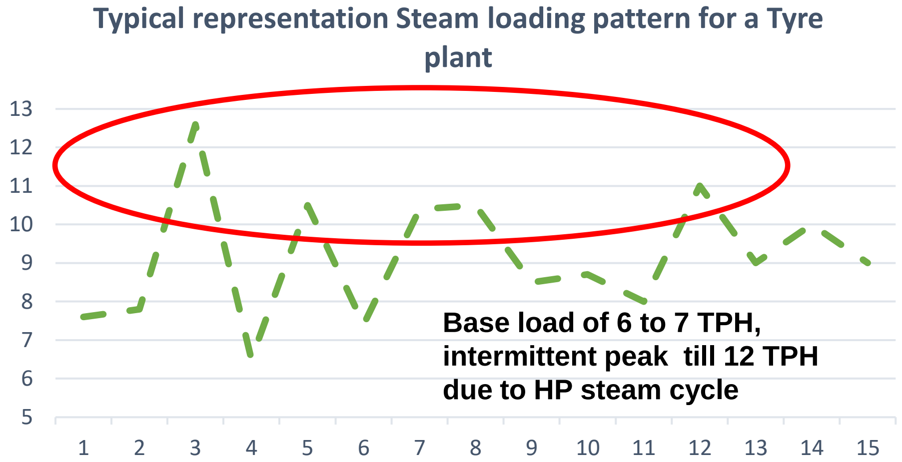
Pipe /Orifice Opening size

Improvement in plant

Optimised Boiler capacity/ Improved Boiler efficiency

Improved Steam pressure controls

Reduced steam consumption and No vent steam in Plant/Reduction in Excess air & CO_2 Emissions



SP.STEAM CONS AND PRODUCTIVITY

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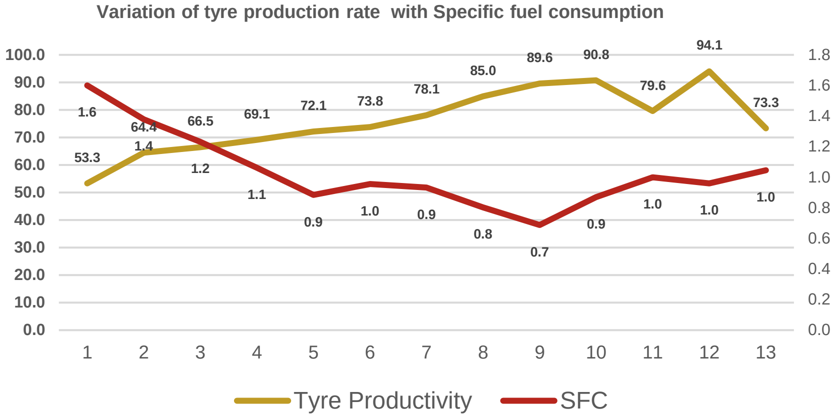
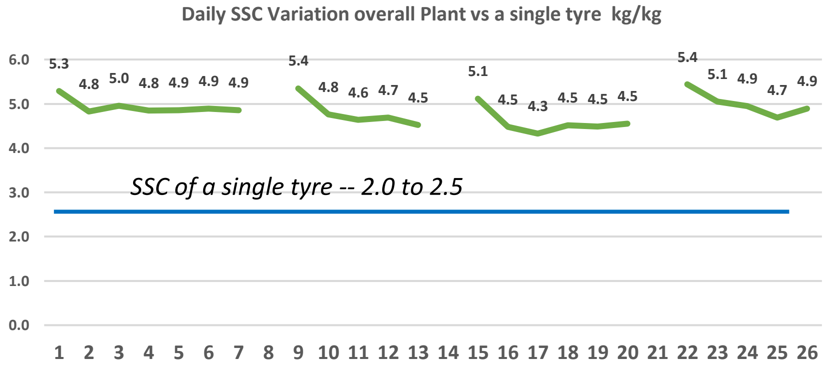
1. **Reasons /areas of productivity or production Planning**

- Regular shut down and start-ups- Press Heatup
- Idle Presses
- Breakdowns and bladder change in presses
- Delay in Loading and unloading
- Daily Press Planning
- Right selection of press size corresponding to the tyre /Mould size

Key Parameters
Platen surface temperature
Platen surface Area
Heatup Time /Idle time





SPECIFIC ENERGY CONS. OPTIMISATION

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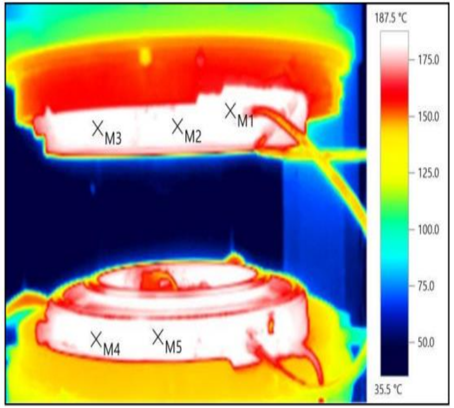
1. **Temperature control of platens** separately ***(set the temperature specifically for each tire type)***
2. Insulation of Curing Headers and Press Insulation
3. **Flush steam/Depressurization steam recovery** to feed water tank /Hot water make up tank & Increasing the **Hot water Make up temperature**
4. **Hot water recovery** based on the temperature to enable maximum recovery
5. **Nitrogen recovery** to be used in Compressed air system Reduces compressed air consumption
6. **Heat recovery** from Curing cooling water return tower
7. **VFD Based electrical Pumps** for Hot water/cooling water system



- **RIGHT DESIGN – NOT OVERSIZED /UNDERSIZED**
- **UNDERSTANDING THE HEAT AND MASS BALANCE OF PLANT (SOURCE /SINK MAPPING)**

KPI MONITORING AND SUSTENANCE

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SPECIFIC STEAM CONSUMPTION

SPECIFIC FUEL CONSUMPTION

CONDENSATE RECOVERY FACTOR %

SPECIFIC ENERGY CONS(HOT WATER)

SPECIFIC ENERGY CONS(COOLING WATER)

SPECIFIC NITROGEN/ COMP. AIR CONS.

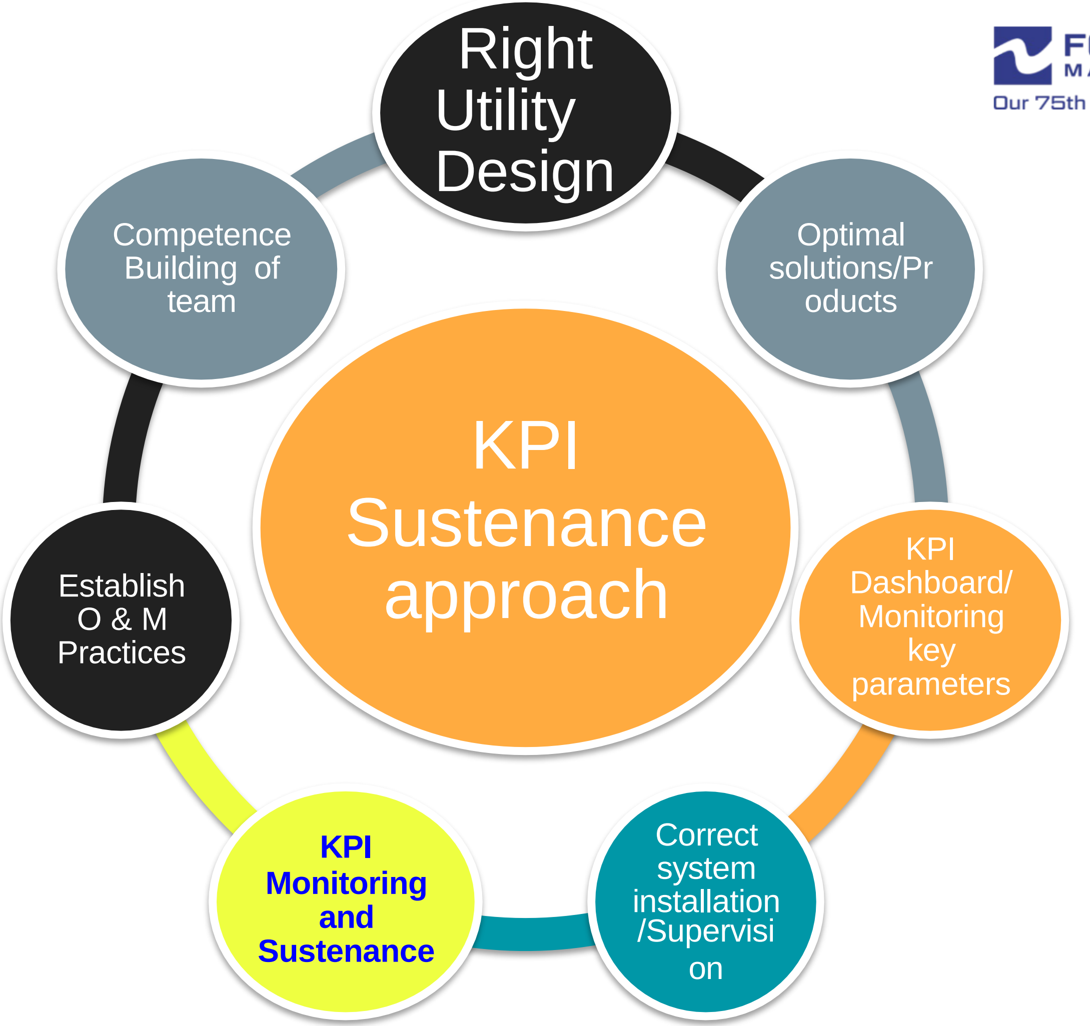
SPECIFIC CO2 EMMISSION

STEAM TO FUEL RATIO

SPECIFIC WATER CONSUMPTION

How I overcome controllable Variations?

- Plant as per Design
- Monitor KPIs
- Sustain KPIs



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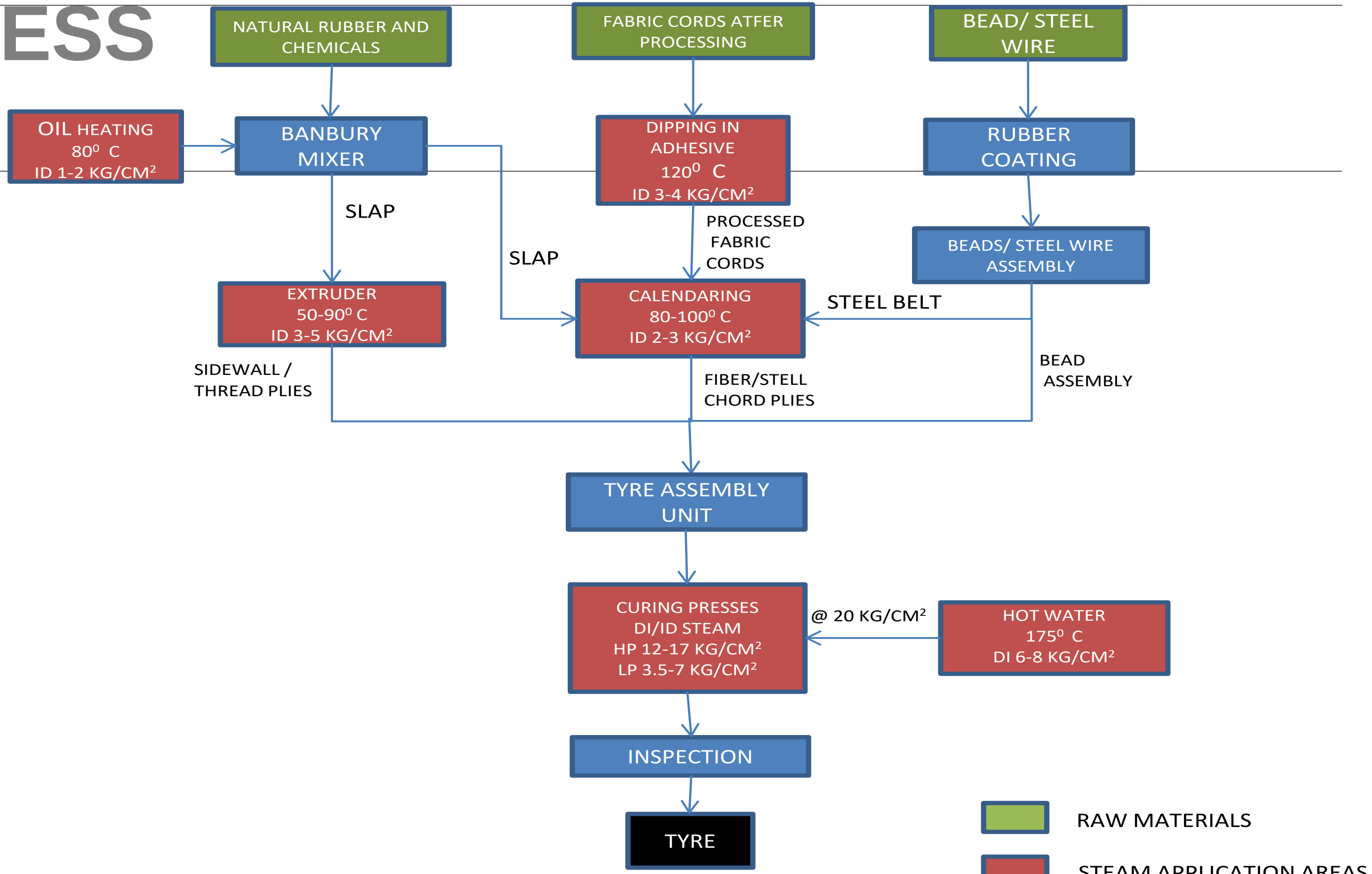
TYRE INDUSTRY

Presentation
By

FORBES MARSHALL

TYRE PROCESS



TYPICAL LOADS

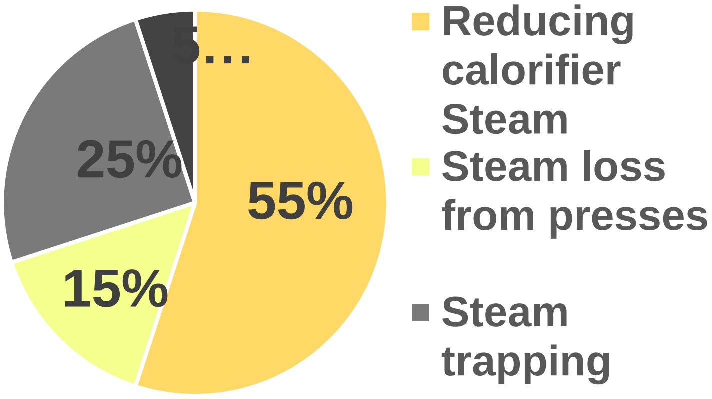
EQUIPMENTS	DIRECT CONSUMPTION Kg/hr	INDIRECT CONSUMPTION Kg/hr	PRESSURE USED kg/cm2	HOURS OF OPERATION	TOTAL STEAM CONSUMPTION TPD	% STEAM CONSUMED	% DIRECT CONSUMED	% INDIRECT CONSUMED	PRODUCTS
BANBURY OIL HEATING	NA	170.63	2	24	4.10	0.98	NA	0.98	Proper Trapping, CRS, PRS, TCM
CALENDER-1	NA	400	3	16	6.4	1.53	NA	1.53	
CALENDER-2	NA	218	3	16	3.49	0.83	NA	0.83	
CALENDER-3	NA	495	3	8	3.96	0.94	NA	0.94	
EXTRUDER	NA	57.14	6	14	0.8	0.19	NA	0.19	
VAM	NA	990	6	24	23.76	5.66	NA	5.66	
DIP ZONE-1	NA	759	6	16	12.14	2.90	NA	2.9	
DIP ZONE-2	NA	762.56	6	16	12.20	2.91	NA	2.91	
TOTAL		**3852.33**			**66.85**	**15.94**		**15.94**	

EQUIPMENTS	DIRECT CONSUMPTION TPD	INDIRECT CONSUMPTION TPD	PRESSURE USED kg/cm2	HOURS OF OPERATION	TOTAL STEAM CONSUMPTION TPD	% STEAM CONSUMED	% DIRECT CONSUMED	% INDIRECT CONSUMED	PRODUCTS
RADIAL CURING PRESSES	76.7	69.5	17	24	146.2	34.86	18.29	16.57	CHRS, CCDS, Proper Trapping, PRS
BIAS CURING PRESSES	51.1	78.3	17/12	24	129.4	30.85	12.18	18.67	
HOT WATER GENERATOR	77	NA	12	24	77	18.36	18.36	NA	
TOTAL	**204.8**	**147.80**			**352.60**	**84.06**	**48.83**	**35.24**	

TOTAL STEAM DEMAND OF THE PLANT IN TPD	**419.45**
TOTAL % OF DIRECT STEAM CONSUMPTION	**48.83**
TOTAL % OF INDIRECT STEAM CONSUMPTION	**51.17**

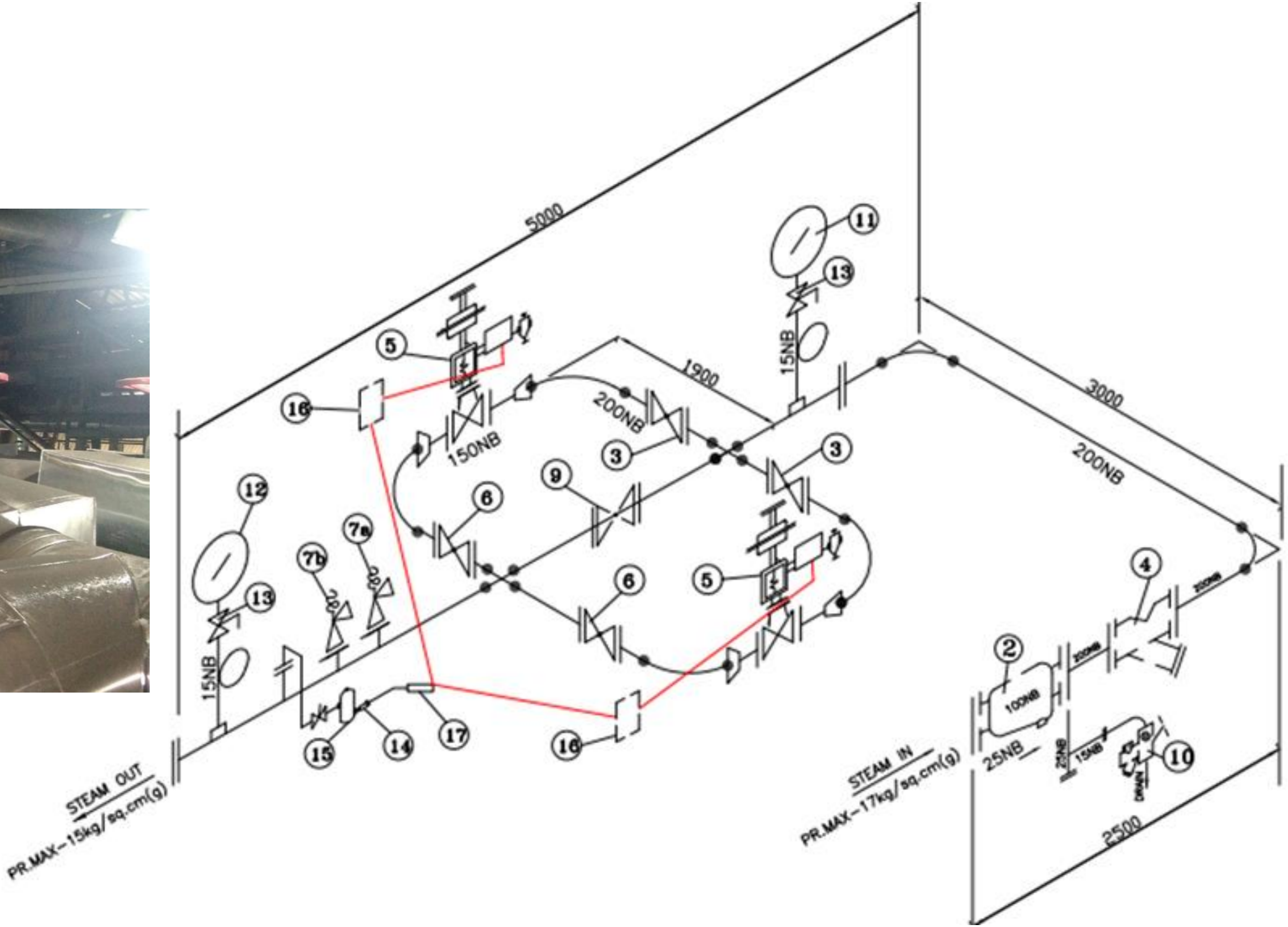
IMPROVING SSC

✓ ***Improving SSC by addressing***
- Steam distribution
- Steam trapping system
- Standing losses of presses
- Reducing calorifier steam



- ***Steam Distribution***
  - PRS for each trench -
  - Quality of steam - Moisture separators on steam line of all trenches
  - Line traps, air vents
  - Monitoring steam consumption
- ***Steam Trapping – Health, selection and group to individual***
  - Selection of Float Traps on presses with correct delta P of trap
  - Group to individual trapping on platens
    - Proper condensate evacuation
    - Reduction in pressure,
    - Proper curing,
    - Reduction in cycle time
      - Individual tapping to each platen
      - Air vents on dome presses
- Trap monitoring – health (impact on savings / curing)
- ***Reducing calorifier steam***
  - Recovering hot blowdown water at maximum temperature to calorifier
  - Blow through steam recovery i.e. bladder HP flushing steam
  - Recovering main drain steam at end of dome steam cycle
  - Recovering shaping steam
- Steam loss from presses – press insulation, dome lip gasket leaks, safety valve
- Insulation on steam, condensate, hot water supply and return lines

TYRE PRS



5000
1900
3000
200NB
200NB
150NB
15NB
15NB
100NB
25NB
2500
STEAM OUT
PR.MAX–15kg/sq.cm(g)
STEAM IN
PR.MAX–17kg/sq.cm(g)

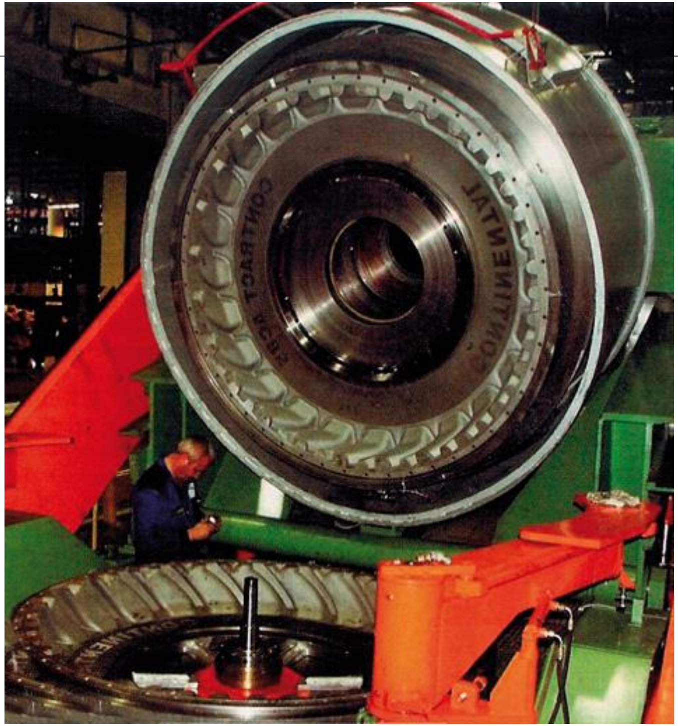
Compact Module – Thermodynamic Trap with replaceable seat

CMTD42M-S

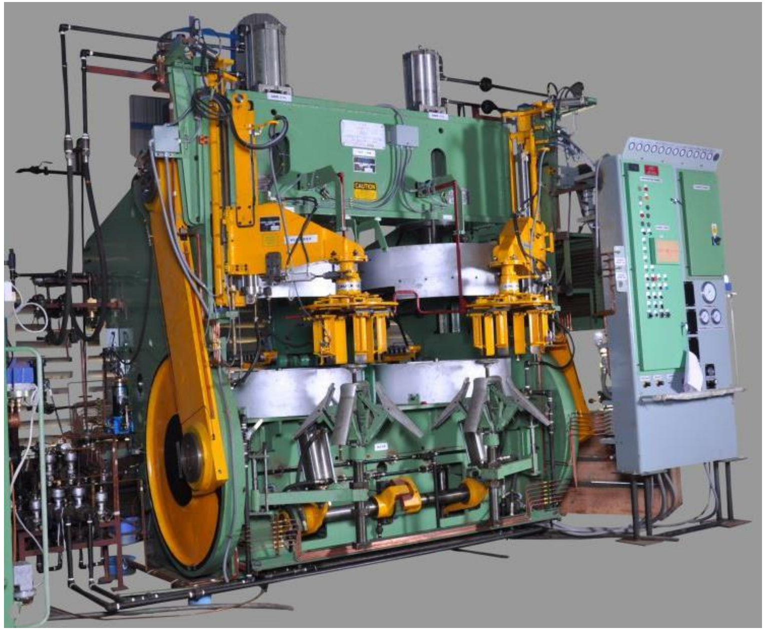
CMTD42M-F

“Quick to Install Easy to Maintain”

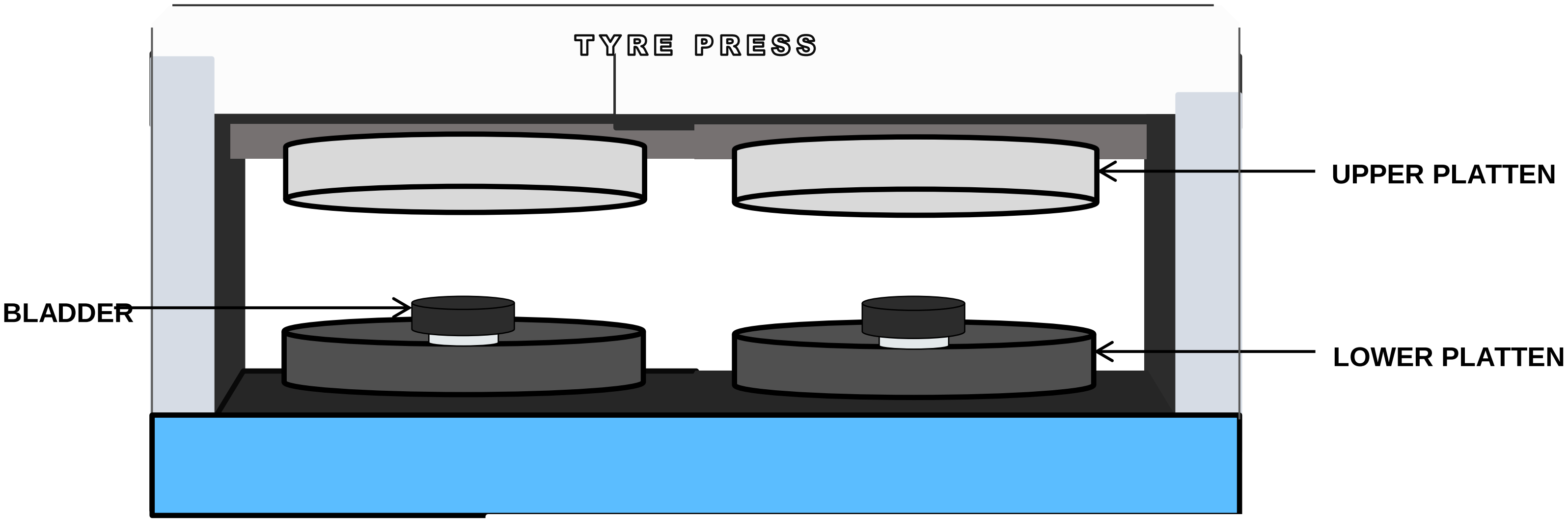
DOME PRESS



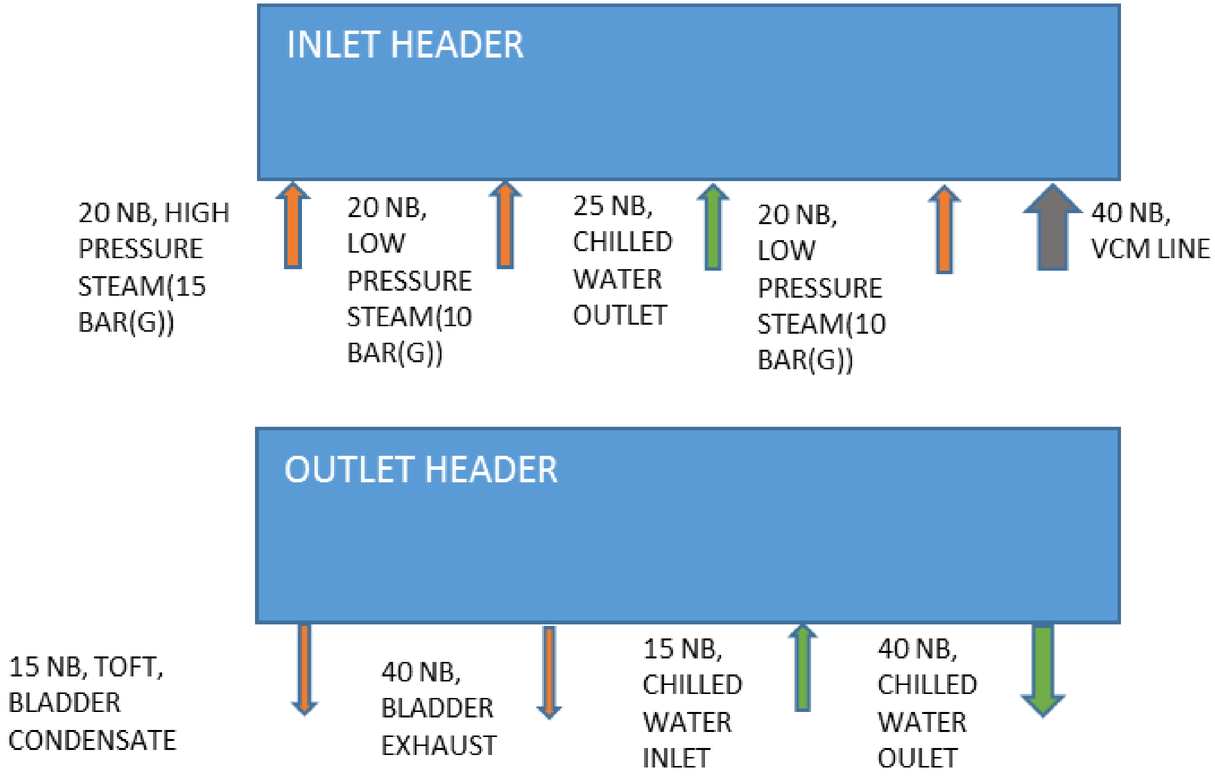
PLATEN PRESS



TYRE Press

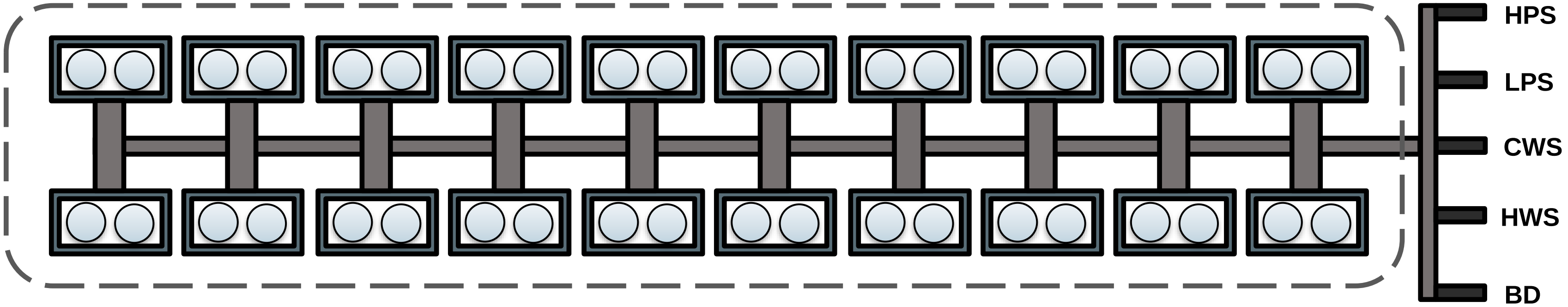


Auxiliary header - bladder



TYRE Press

SCHEMATIC OF TRENCH



LPS (Platen) - Low Pressure steam
HPS (Bladder) - High Pressure steam
CWS (Bladder) - Cold water circulation
BD - Blowdown (Bladder)

CURING CYCLE | BIAS TYRE

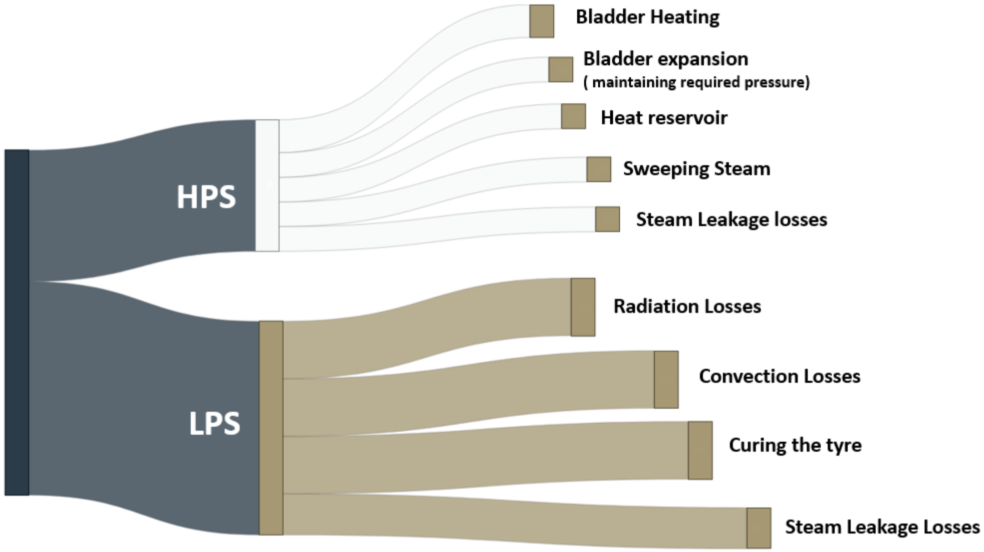
Press		75"	Dome	Single Dome
Size		Shaping steam	10+/-2 psi	
Sr. No.	Step	min	sec	Time
1	200+/- PSI HPS ON	0	0	2
2	Open circulation drain	2	0	0.5
3	Close circulation drain	2	30	2.5
4	Dome steam ON	5	0	5
5	Open circulation drain	10	0	0.5
6	Close circulation drain	10	30	6.5
7	HP steam OFF/270 PSI Hot water circulation ON	17	0	37
8	Dome steam OFF	54	0	1
9	Circulation of HW OFF/ CW circulation ON	55	0	3
10	CW circulation OFF/Open all drain	58	0	1
11	Apply Vacuum	59	0	1
12	Open Press	60	0	
Utility requirement		kg/cm2	Deg C	
	HPS	14+/-.4	198+/-1	
	HW	19+/-1.8	168+5-0	
	CCW	14+/-4	Atm. Temp	
	Dome		155+/-1	

CURING CYCLE | RADIAL TYRE

Press	Segment mould	45"	Platen	
Size		12+/-2	12+/-2	14+/-2
Sr. No.	Step	Min	Sec	Time
1	240 +/-5 PSI HPS ON/Open circulation drain	0	0	0.2
2	Close circulation drain	0	12	4.8
3	Open circulation drain	5	0	0.1
4	Close circulation drain	5	6	1.9
5	270 psi HW ON	7	0	0.5
6	HP steam OFF	7	30	4.5
7	HW OFF/ CW circulation ON	12	0	2
8	CW circulation OFF/Open main drain/ Apply Vacuum	14	0	1
9	Open Press	15	0	
	Utility Requirement	kg/cm2	Deg C	
	HPS	17+/-.4	206+/-1	
	MPS	12+/-0.4	191+/-1	
	HW	19+/-1.8	168+5-0	
	CCW	14+/-4	Atm. Temp	
	Platen		174+/-2	

Present SCENARIO

Steam utilization within the process



Losses

- Overshoot
- Steam leakage in distribution lines
- Delay between cycles
- Delay during cycles
- Scaling within the mould channel
- Air trapped inside the mould
- Trap leakage
- Steam loss during blowdown
- Slow controller response
- Steam channels choking

Quality parameters

- Steam pressure
- DOM temperat ure cycle
- Platen temperat ure
- Curing time
- Steam temperat ure
- DOM Pressure cycle
- Bladder Pressure cycle

Problems | Probable CAUSES

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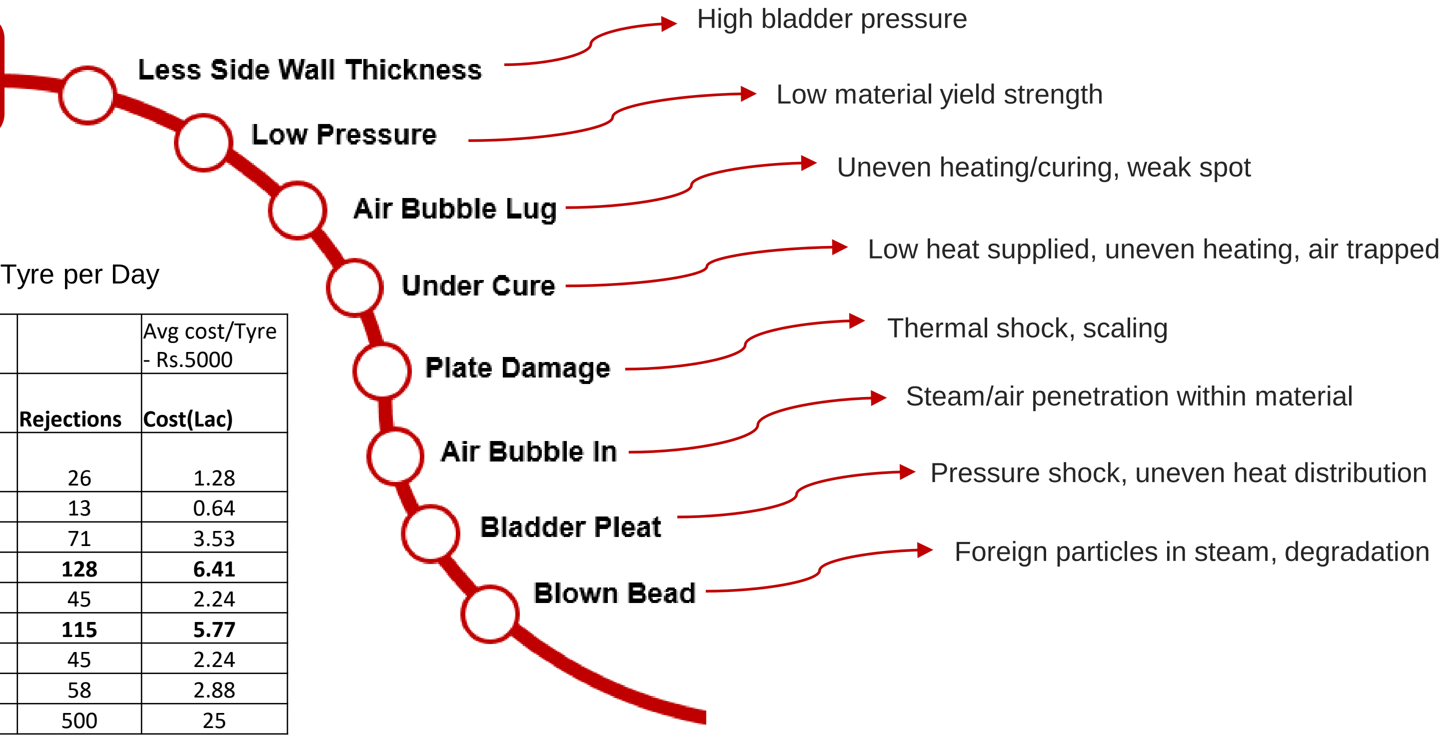
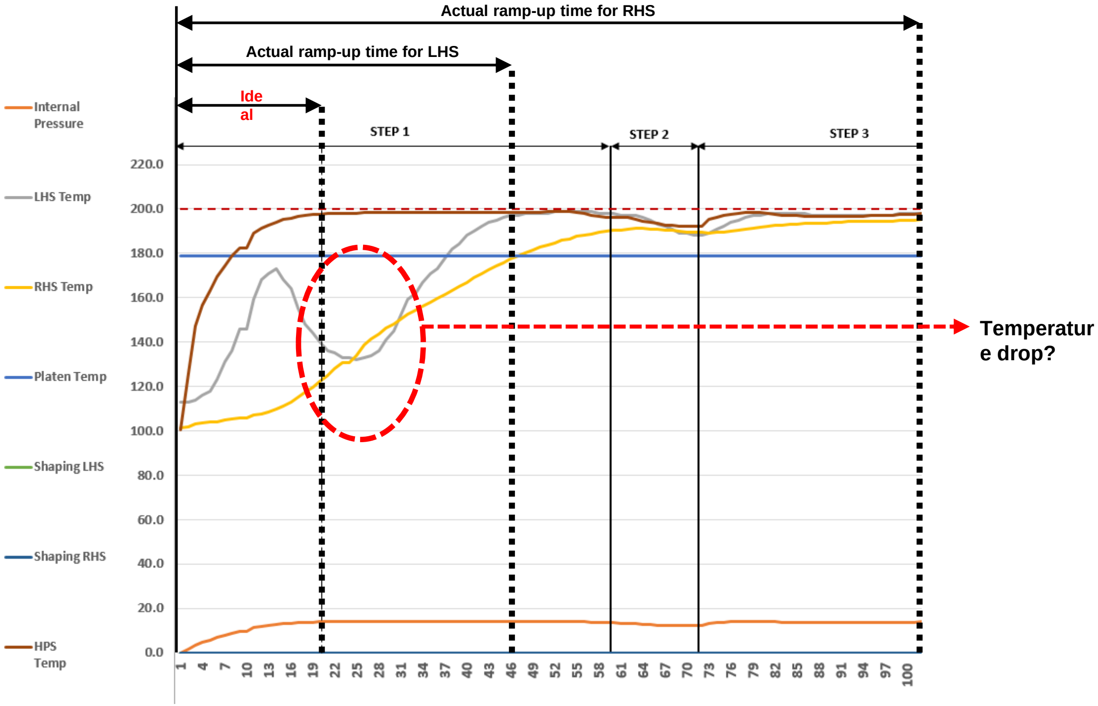
Tyre Rejection factors



Rejection rate = 500/40000 Tyre per Day

			Avg cost/Tyre - Rs.5000
Factors	**Rejections Percent**	**Rejections**	**Cost(Lac)**
Less side wall thickness	5%	26	1.28
Low Pressure	3%	13	0.64
Air bubble lug	14%	71	3.53
Under cure	**26%**	**128**	**6.41**
Plate Damage	9%	45	2.24
Air bubble in	**23%**	**115**	**5.77**
Bladder pleat	9%	45	2.24
Blown bead	12%	58	2.88
Total		500	25

Factors Affecting Performance



Delay in ramp-up time (SP Temperature)	
LHS	**RHS**
27 sec delay	80 sec delay

- **Tyre quality on LHS will be better than RHS**
- **Uneven heat distribution in LHS and RHS**
- **Delay in controller response for bladder steam (Under-curing)**
- **Steam line chocking in LHS bladder supply**
- **Steam leak in RHS bladder supply**
- **Any delay will lead to loss in quality.**

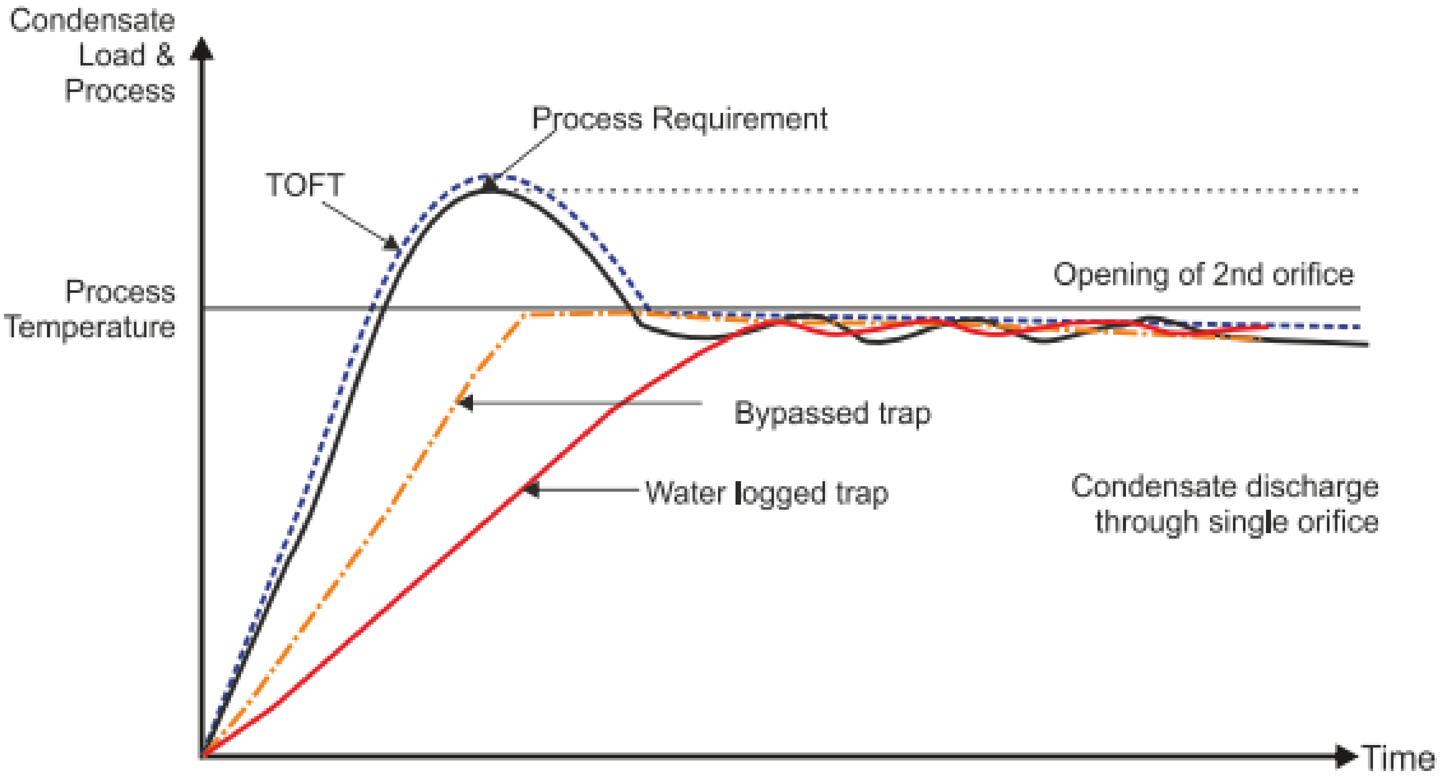
Two Orifice Float Trap

Best Solution for Process Trap Applications

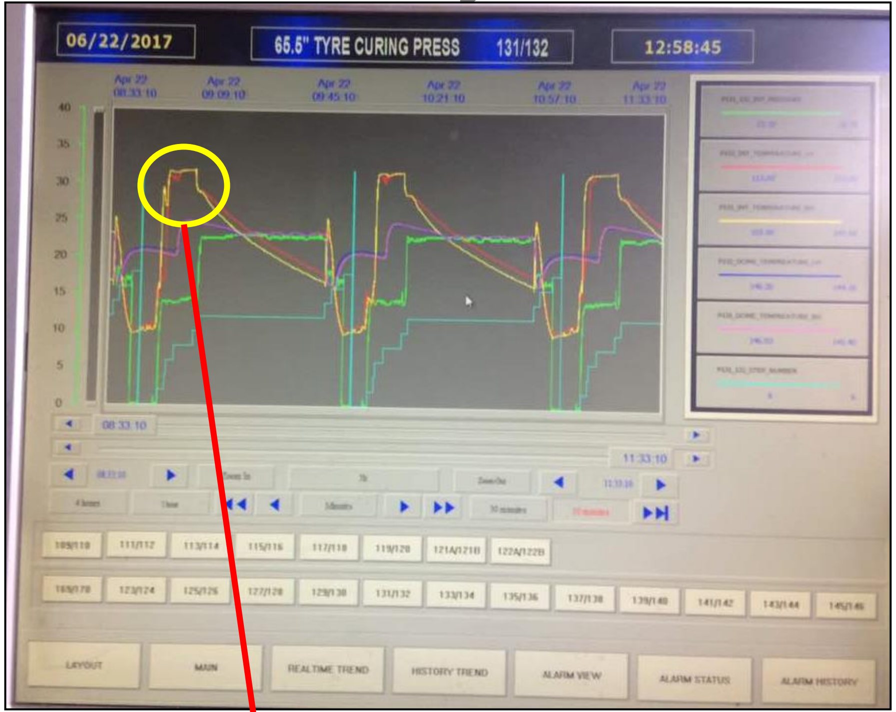
- The condensate load at start up is higher than the average running load
- If the float trap is sized for running loads it often becomes undersized for startup load, whereas if the same is sized for startup load the trap selected at times becomes oversized for running load

- Two Orifice Float Trap meets the need of both the startup & running load conditions
- Ideal choice for applications where temperature gradient is steep

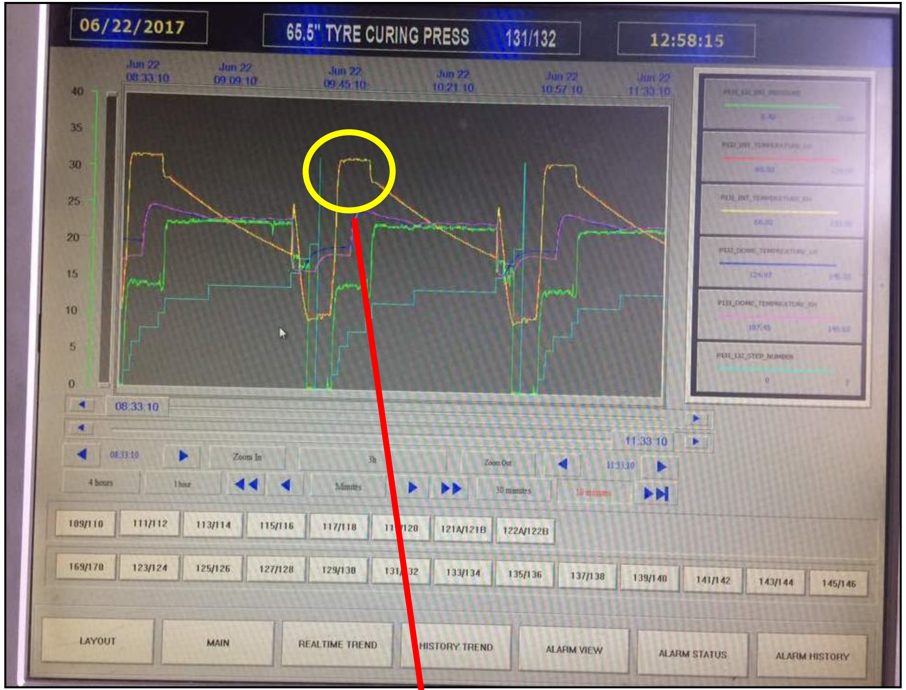
TOFT temperature profile



TOFT in Tyre Press



Temperature variation in bladder when trap other than TOFT were used



Temperature profile is constant when TOFT is used

TOFT in Tyre Press

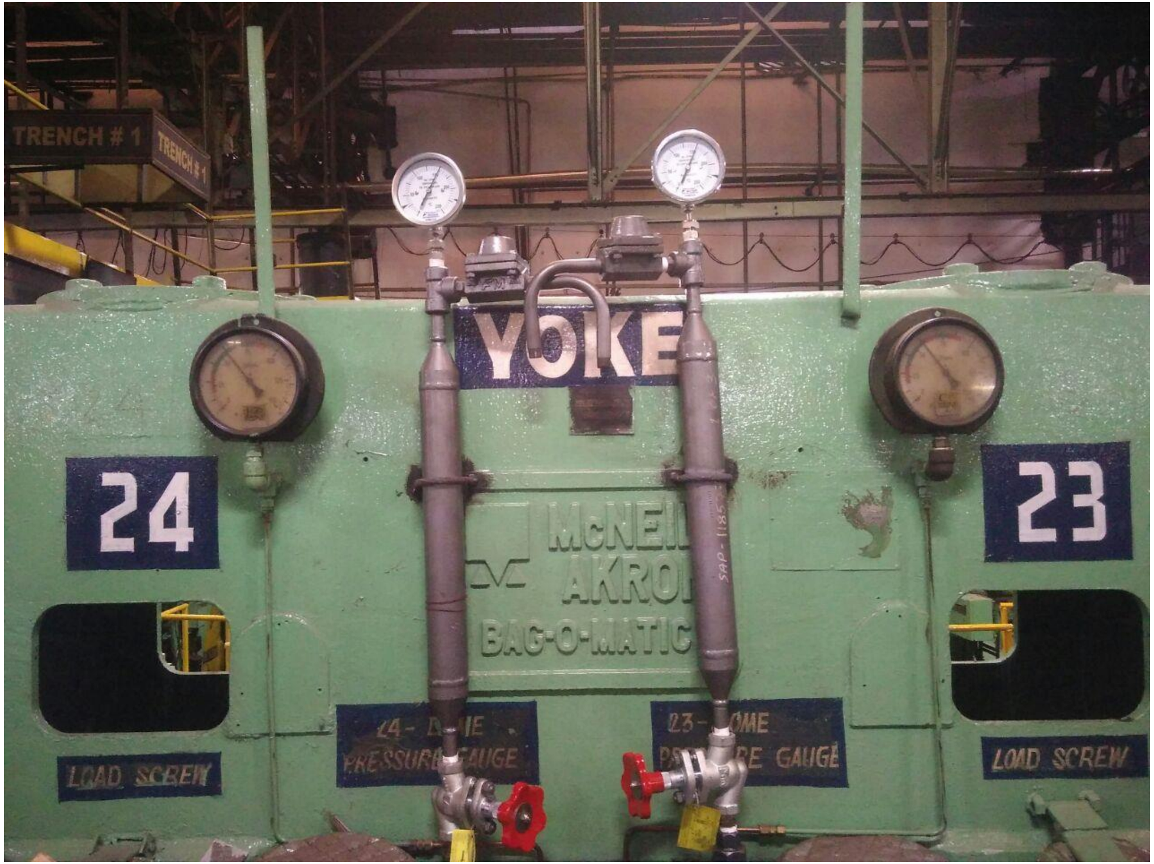
Temperature variation in bladder when trap other than TOFT were used

Temperature ramp up is smooth when TOFT is used

Temperature profile is constant when TOFT is used

Temperature ramp up is not smooth when trap other than TOFT is used

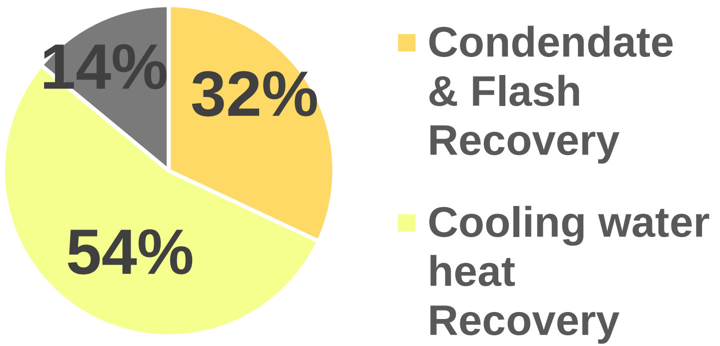
AIR VENTING IN DOME PROCESS

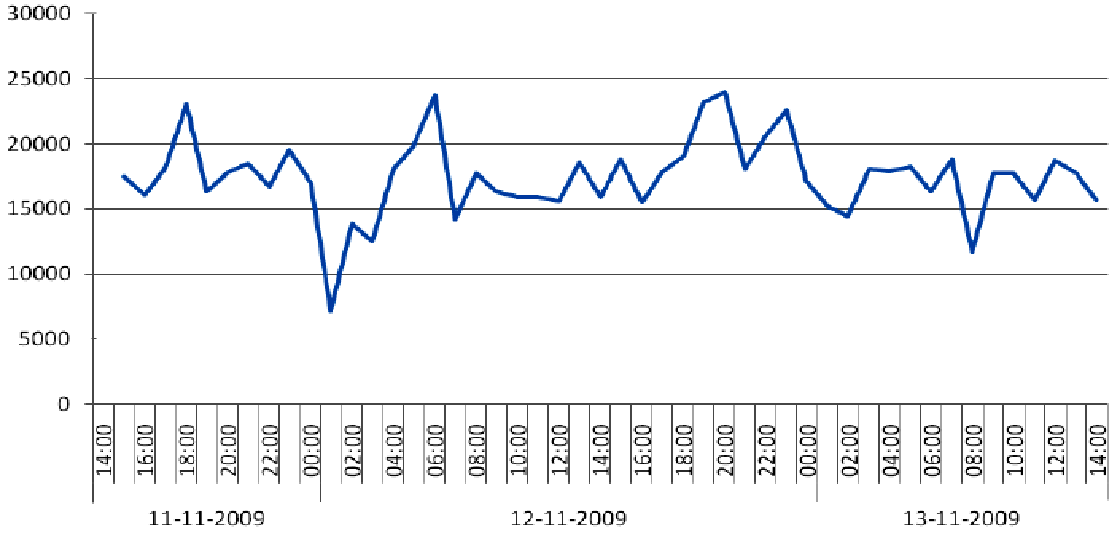


We have observed average 30 sec. saving on total heating cycle of 2 Mins. Which is 25 % reduction in initial heating

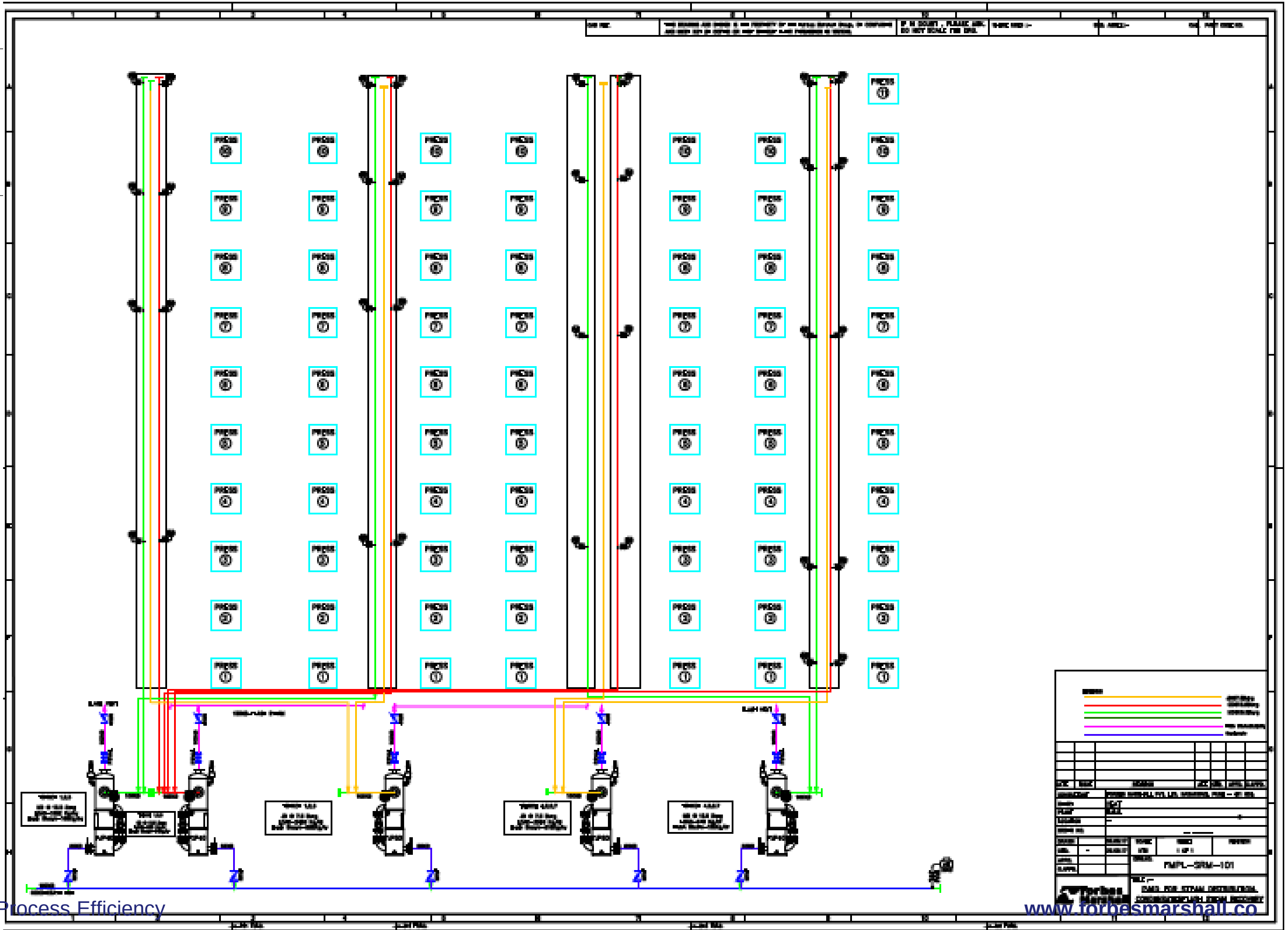
IMPROVING SFC – S:F

- ✓ Improving S:F by addressing
  - ***Boiler efficiency –***
    - ***Load variations –*** depends on loading of presses
    - ***Peak load –*** (shift change, lunch time , dinner time)
  - ***Blow down***
    - Optimum TDS of blow down
  - ***Feed water temperature***
    - ***Condensate recovery factor*** – impact of correct trapping & backpressure on traps
    - ***Trench wise condensate Recovery***- depressurizing the line)
    - ***Cooling water heat recovery (PHE)*** – cold blow down water temp about 60oC)
    - Blow down heat and flash recovery





TRENCHWISE CONDENSATE USING FJP



BENEFITS

- Improved CRF %
- Zero live steam injection in feed water tank
- Negligible back pressure on process trap
- Improved performance of process trap

Flash Jet Pump

Flash Jet Pump is ideal solution closed loop recovery of condensate and flash steam that ensures complete energy balance.

Features & Benefits

Footprint area

0.65 m²

Condensate Temperature

100 °C +

Energy Recovered

8% +

Ergonomics

No Steam Venting

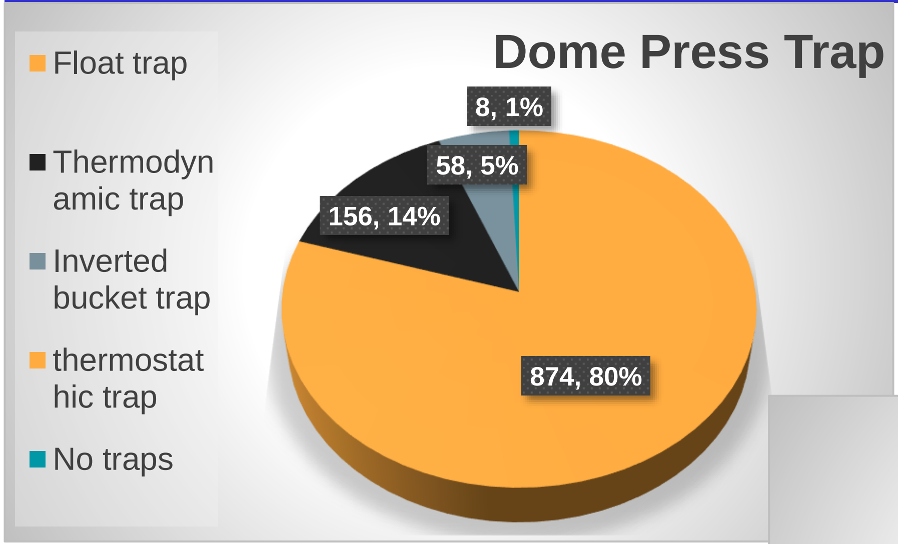
Flash Steam Recovery

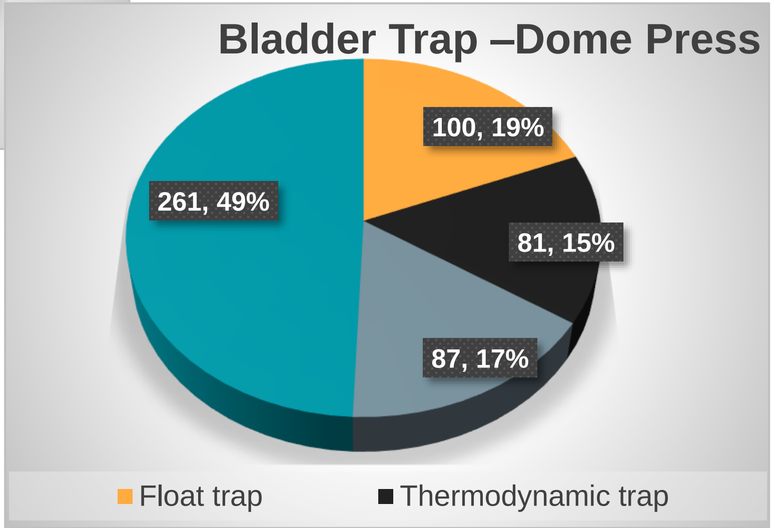
In Process

Ease of Installation

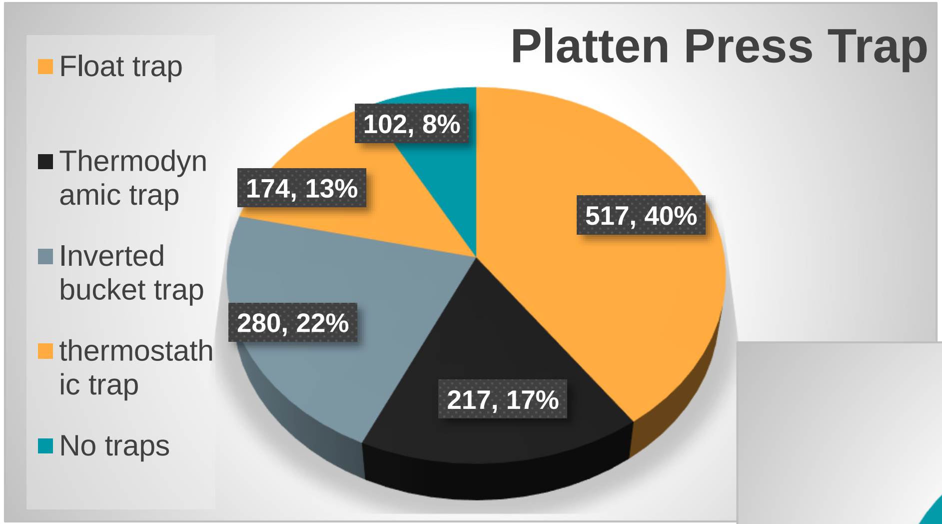
No Pits & Structure

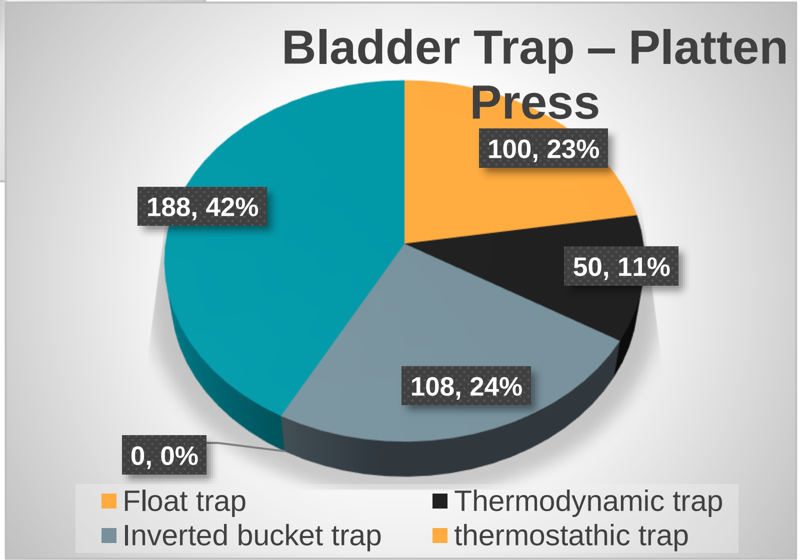
Dome press – Cavity and Bladder trap status





Platten press – Cavity and Bladder trap status





HEAT RECOVERY

Flue gas heat recovery (Pressurized Eco., APH), blow through heat recovery, final dome drain recovery, LP hot water recovery system, Main drain heat recovery

OPTIMIZE

Heat recovery from contaminated condensate, flash steam recompression, Group Vs. individual trapping, Process cycle optimization , Shaping steam optimization, Boiler load management, Boiler efficiency enhancement, Boiler Water quality (Makeup water, Blow down water), Fuel quality

STOP WASTAGE

Selection of right steam trap based on application, Right quality of steam at right pressure (dry sat.), free of air and non condensable (Air vent on dome press), Condensate and flash recovery factor, condensate and flash steam line sizing and layout, leakages, Insulation of dome and platens, Valve monitoring system to ensure zero internal leak system

Thank You

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