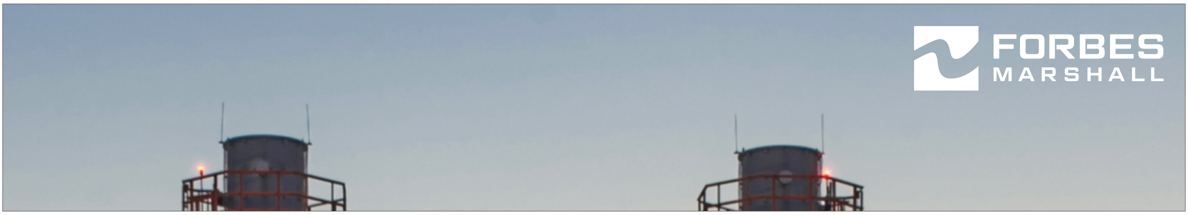
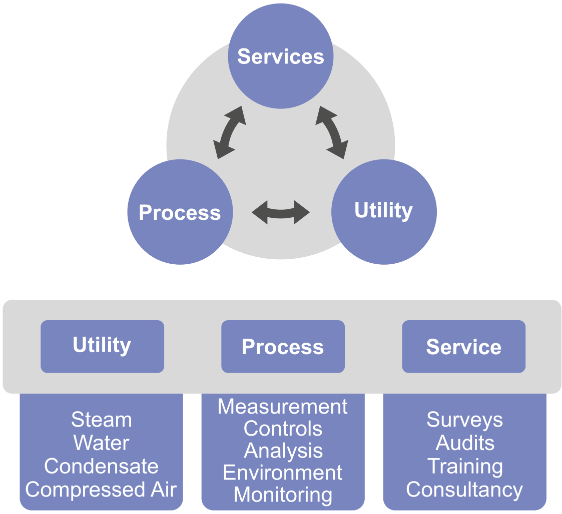


Solutions to Enhance Profitability in Refinery and Petrochemical Industry

Index



For over 75 years, Forbes Marshall has been providing innovative solutions to help the oil and petrochemical industry run reliable and energy efficient plants with reduced downtime, improved productivity, product quality and process yield. By identifying and reducing opportunities for water-hammer to occur, we help improve piping and equipment reliability, and prevent the occurrence of large scale safety problems. Our flash steam and condensate recovery solutions maximise energy utilisation while contributing to reduced plant emissions.

Each year, through our solutions and asset management programmes, we help the Industry save, 4.4 million metric tonnes of steam, 6.8 million litres of water, recover 2.4 million litres of condensate and reduce 0.3 million tonnes of CO_2.

Areas of Expertise

We specialise in a vast range of products, systems, packages and services in the following three areas -

Energy Conservation
- Steam & condensate systems
- Energy services

Utility Management
- Air efficiency solutions
- Remote online pollution monitoring
- Hydro-carbon loss monitoring

Process Efficiency
- Metering solutions
- Mechanical valves
- Control valves and stations
- Machine condition monitoring systems

Forbes Marshall's Presence in Encon Initiatives

Activity	No. of Refineries	Trap Population	Uptime
Audits of steam trap system	20 out of 21 in India	2,20,000	
Steam trap system management	20 out of 21 in India	1,10,000	> 95%
Condensate and flash steam recovery	15 out of 21 in India	70,000	

Various Steam Traps At A Glance		
Type	Thermodynamic	Balanced Pressure Thermostatic
Governor	Disc	Capsule
Governing Factor	Velocity difference (Bernoulli's principle)	Temperature difference
Main Features	• Robust design • Excellent resistance to waterhammer and vibration • Inexpensive • Positive discharge with tight shut-off • Discharge condensate close to steam saturation temperature	• Utilises sensible heat present in the condensate thereby reducing flash steam losses and saving energy • Excellent air venting properties for quick start-up
Application : Main Header Line (Saturated Steam)	First priority	Not recommended
Application : Main Header Line (Superheated Steam)	First priority	Not recommended
Application : Critical Tracing	First priority	Not recommended
Application : Tracing (Saturated Steam)	Not recommended	First priority
Application : Tracing (Superheated Steam)	Second priority	Not recommended
Application : Heating	Not recommended	Not recommended
Pressure Range	Upto 250 bar	Upto 32 bar
% Population in a Refinery and Petrochemical Plant	30%	60%
Cost Effectiveness	Excellent	Excellent
Compactness	Excellent	Excellent
Spares Inventory	Minimal	High
Repair and Maintenance	Very quick and easy	Quick and easy
Steam consumed / functional loss for functioning of the steam trap as per BS EN 27841 steam trap standard (expressed in kg/hr at 5bar steam pressure)	Upto 0.2 kg/hr	0.5 kg/hr

Note : The purpose of the above table is not to establish the fact that one type of trap is more effi
of energy. Losses only become significant when traps are defective. The important thing therefor
and steam wastage will be minimised.

Bimetallic Thermostatic	Mechanical	
	Ball Float	Inverted Bucket
Bimetallic strips/element	Ball float	Inverted bucket
Temperature difference	Buoyancy principle (density difference)	Buoyancy principle (density difference)
• Utilises sensible heat present in the condensate thereby reducing flash steam losses and saving energy • Excellent air venting properties for quick start-up	• High capacity • Excellent air venting capabilities • Continuous discharge of condensate for maximum heat transfer • Will not back-up with condensate	• High capacity • Robust design • Near continuous discharge of condensate • Minimal back-up of condensate
Not recommended	Second priority	Second priority
Second priority	Not recommended	Not recommended
Not recommended	Second priority	Second priority
Second priority	Third priority	Third priority
First priority	Not recommended	Not recommended
Not recommended	First priority	Second priority
Upto 210 bar	Upto 80 bar	Upto 110 bar
2%	6%	2%
Fair	Very good	Good
Good	Good	Fair
High	High	High
Time consuming	Time consuming	Time consuming
0.5 kg/hr	0.4 kg/hr	1.2 kg/hr

cient than another. It is simply to show that steam traps require only a minimal amount
e is to combine selection, checking and maintenance to achieve reliability. If properly done, costs

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CIN No.: U28996PN1985PTC037806

TEST RESULTS FOR LIVE STEAM LOSS THROUGH STEAM TRAP

TEST DATE : 7th December 2017

STANDARD : BS EN 27841: (Methods for Determination of steam loss of automatic steam trap)

TEST METHOD : A

TRAP TYPE : FMTD64 (Forbes Marshall Thermodynamic Trap)

TRAP SIZE : 15NB

UPSTREAM PRESSURE : 5 bar (g)

STEAM LOSS (Kg/hr) :

No load condition	Load condition
0.2	0

TEST CONDUCTED BY
Abhijit Jadhav
Forbes Marshall

TEST WITNESSED BY
Mr. Anand Deshpande
Head- Certification
TUV SUD South Asia

TUV SÜD SOUTH ASIA PRIVATE LIMITED 694

Forbes Marshall
Krohne Marshall
Forbes Marshall Arca
Codel International
Forbes Solar
Forbes Vyncke
Forbes Marshall Steam Systems

Energy Conservation | Environment | Process Efficiency

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CIN No.: U28996PN1985PTC037806

TEST RESULTS FOR LIVE STEAM LOSS THROUGH STEAM TRAP

TEST DATE : 7th December 2017

STANDARD : BS EN 27841: (Methods for Determination of steam loss of automatic steam trap)

TEST METHOD : A

TRAP TYPE : FMTLT53 (Forbes Marshall Tracer Line Trap)

TRAP SIZE : 20NB

UPSTREAM PRESSURE : 5 bar (g)

STEAM LOSS (Kg/hr) :

No load condition	Load condition
0	0

TEST CONDUCTED BY
Abhijit Jadhav
Forbes Marshall

TÜV SÜD SOUTH ASIA PRIVATE LTD.

TEST WITNESSED BY
Mr. Anand Deshpande
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TUV SUD South Asia

Forbes Marshall
Krohne Marshall
Forbes Marshall Arca
Codel International
Forbes Solar
Forbes Vyncke
Forbes Marshall Steam Systems

Energy Conservation | Environment | Process Efficiency

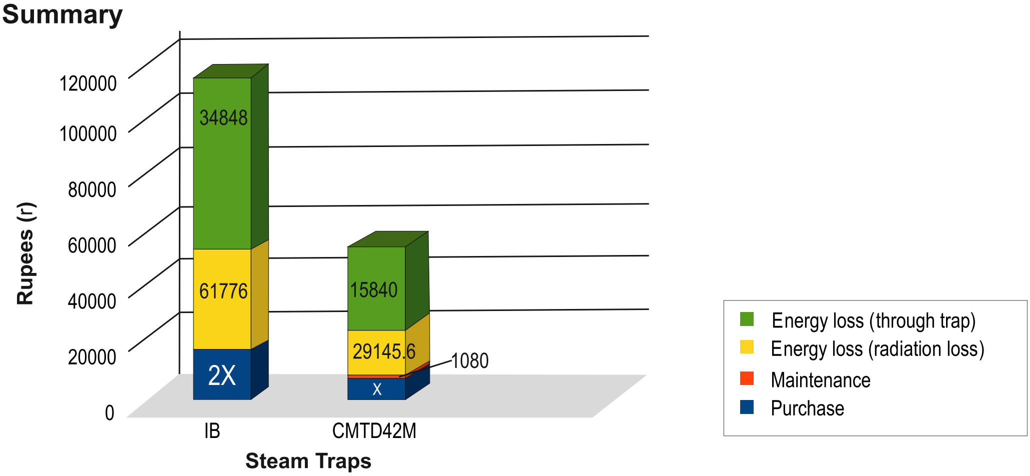
Steam Trap Life Cycle Cost for 5 Years (EN27841)

Steam Cost **2** Rs. / Kg	Working days **330** Working hrs/day **24**	Cost of Compact Inverted Bucket Trap **2X**	Cost of Compact Module Thermodynamic Trap **X**
Steam loss With IB (@14 bar g) **0.44** kg/hr	Steam loss With TD (@14 bar g) **0.2** kg/hr	Radiation loss Compact IB Trap **0.7** kg/hr	Radiation loss Compact TD Trap **0.368** kg/hr

Calculations

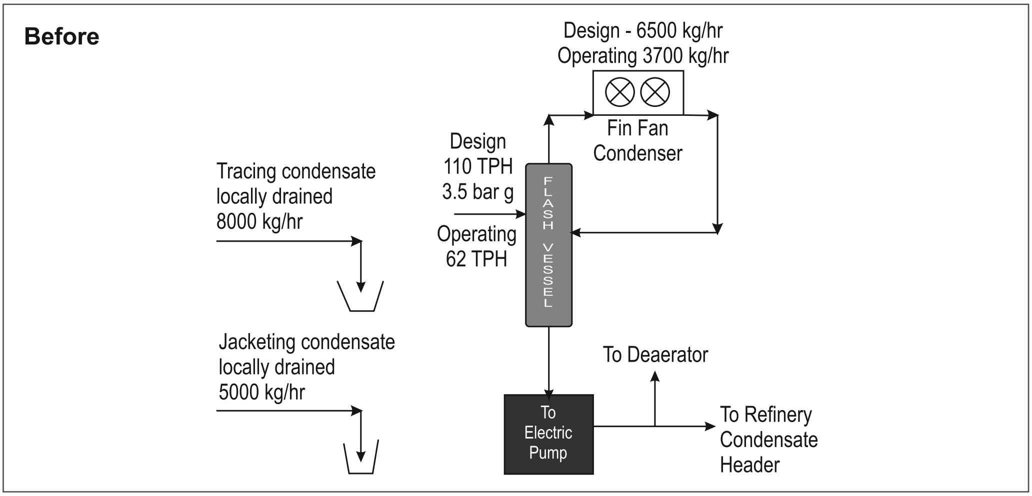
Sr.No.	Description	IB Trap with TVS4000	CMTD42M
1	**Energy loss (through trap)**		
	Steam loss in kg / year	3484.8	1584
	Steam loss in kg / 5 years	17424	7920
	Steam loss in Rs. / 5 years	34848.00	15840.00
2	**Maintenance cost for 5 years**		
	Trap Replacement percent per year	0	3
	Maintenance cost (5 years)	0	1080
3	**Radiation losses from trap**		
	Steam loss in kg / year	6177.6	2914.56
	Steam loss in kg / 5 years	30888	14572.8
	Steam loss in Rs. / 5 years	61776.00	29145.60
4	**Initial cost**	2X	X

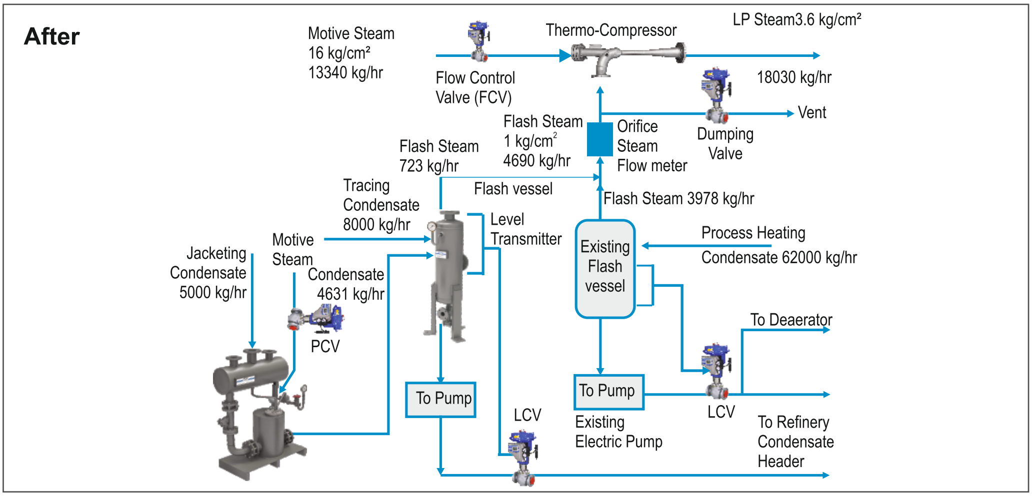
Summary



Case Studies

Recovery of Flash Steam and Condensate in SRU
Payback in 3 Months





Benefits

Improve energy performance (MBN)

Reduce wastage of steam and condensate

Increase gross refinery margin

Reduce utility cost

Monetary Savings per Annum

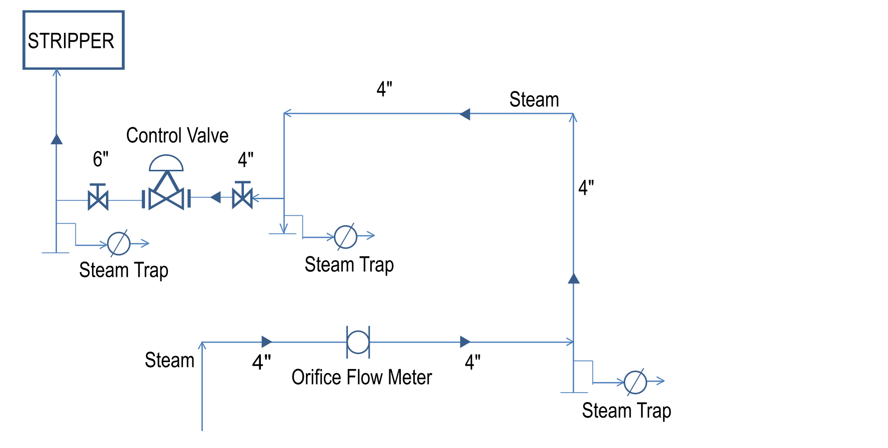
Flash Steam – INR 675 lacs

Condensate – INR 29 lacs

Payback in 3 Months

Improved Stripping Steam Quality Through Improved Dryness Fraction

Before

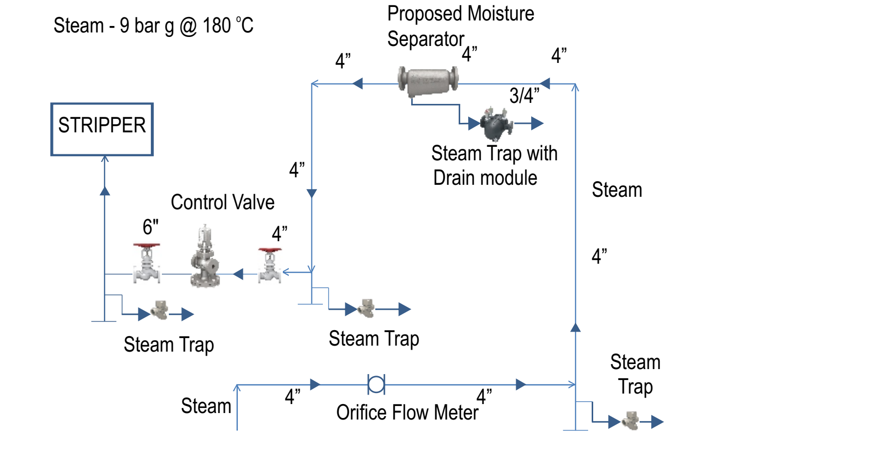


Before

Wet steam affects the quality of the final product

Higher steam consumption

After

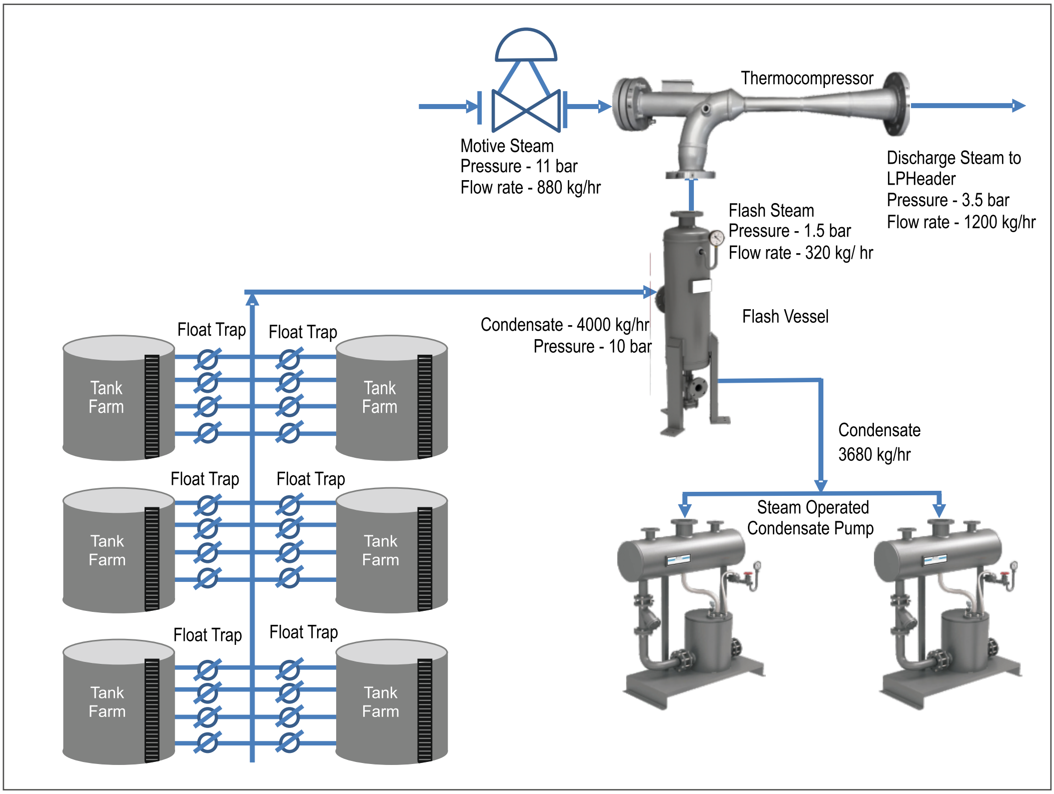


After

Quality of final product improved

Reduced steam consumption

Flash Steam and Condensate Recovery in Tank Farm Area



Before

Condensate getting drained

Group trapping with one trap

Uneven heating of product

Wrong selection of traps

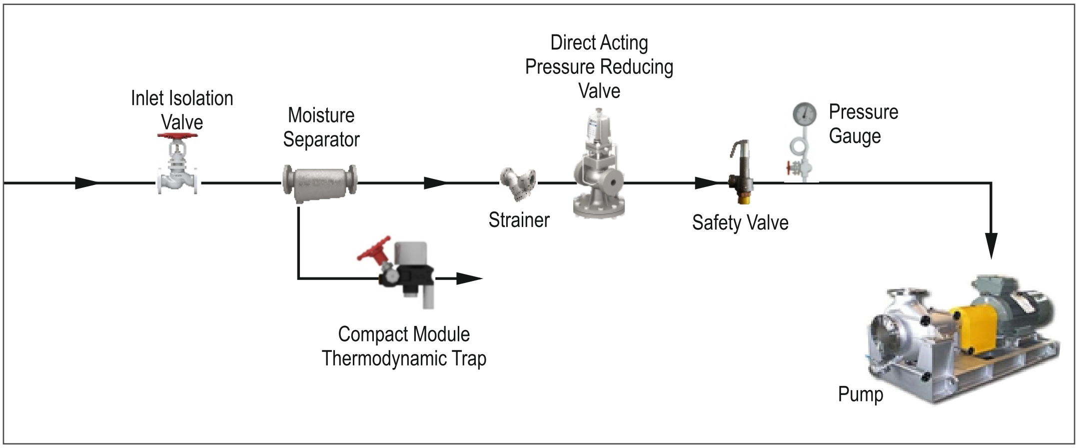
After

Flash steam and condensate recovered

Individual trapping leading to uniform heating of product at required temperature with optimum steam consumption

Application wise correct selection of traps

Reduce Pump Seal Failure by Ensuring Correct Pressure and Dry Steam



Objective – To reduce pump seal failure by controlling pressure and removing condensate to ensure dry steam reaches the pump seal.

Piping plan 62 of API 682/ISO21049 specifies that environment on the atmospheric side of single seals can be improved by quenching with steam. The average number of pumps under plan 62 in a 6 MMTPA is in the range of 40 to 50.

Steam quenching is essential for long seal life and as a safety measure for a number of high temperature and heavy hydrocarbon duties. Most common pump problems include seal failures associated with inadequate or the lack of a steam quench, which is used to prevent coke formation and to cool the seal at high temperatures or to heat the seal faces on some medium temperature hydrocarbon residue duties.

The provision of dry steam flow at pressure below 1 bar g is not a simple task. Over pressurisation will cause early seal failure. Steam traps and insulation are essential. Site surveys often find a flow of tepid water to the seal, which on hot duties flash off into steam in a dramatic fashion causing pressure pulsation at seal.

Initial Problems

Failure of pump seal

Root Cause

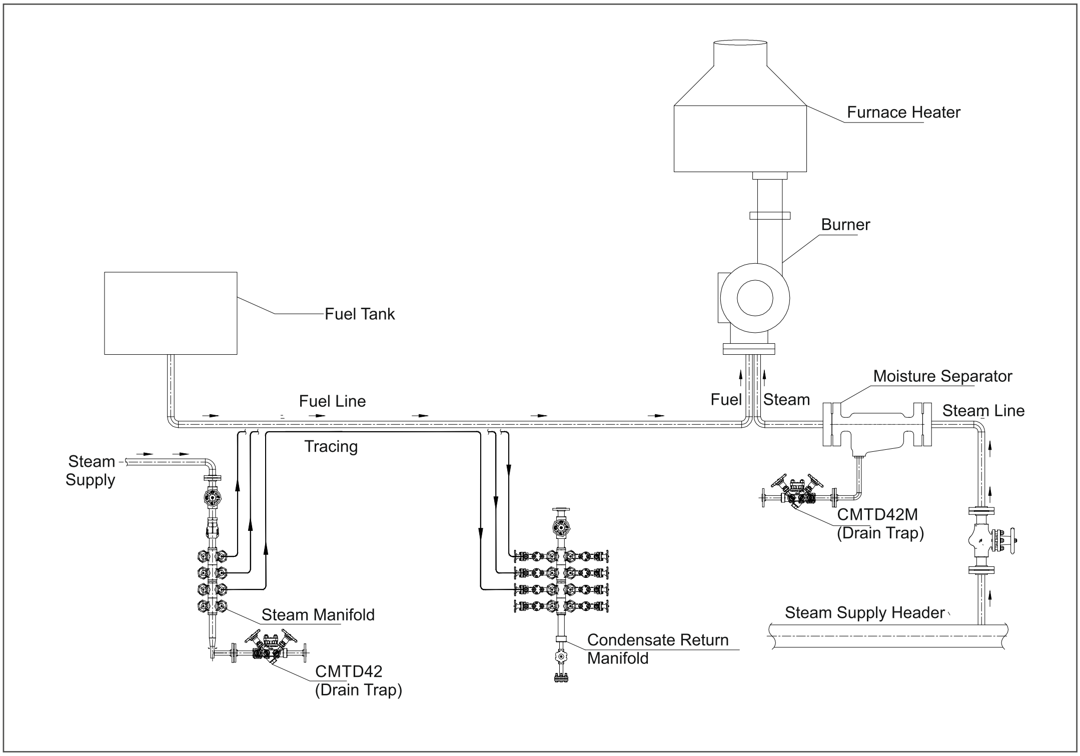
All pumps encounter condensate carry over with steam at the pump seal because of wrong installation of the trap and routing which causes the pump seal to fail.

Solution

Steam should be dry saturated before it is utilised. We recommend the installation of a single module comprising of a self-acting pressure reducing valve and a moisture separator in the supply line of quenching steam.

This will ensure that the steam supply is dry saturated and pressure is controlled precisely as per API norms. Also, all the condensate deposited in the drain pocket can be easily removed through the trap. Refer figure above.

Perfect Fuel Atomisation to Stop Wastage and Improve Efficiency



Problem

Dribbling of fuel oil from the furnace burner

Low burner efficiency

Cumbersome to maintain the trap under the furnace due to oil spillage

Root Cause

Lack of proper atomisation of fuel oil due to wrong selection of trap in atomisation steam header drain i.e. balance pressure trap is installed instead of thermodynamic trap

Improper heat transfer between tracing and fuel oil because of group trapping in fuel oil tracing line which leads to water logging in the tracing line

Advantages of the Modified System

Proper atomisation of fuel oil in the burner

Thermodynamic trap removes the condensate as soon as it forms in the header

Permissible required temperature of fuel oil maintained resulting in perfect atomisation and hence increased burner efficiency

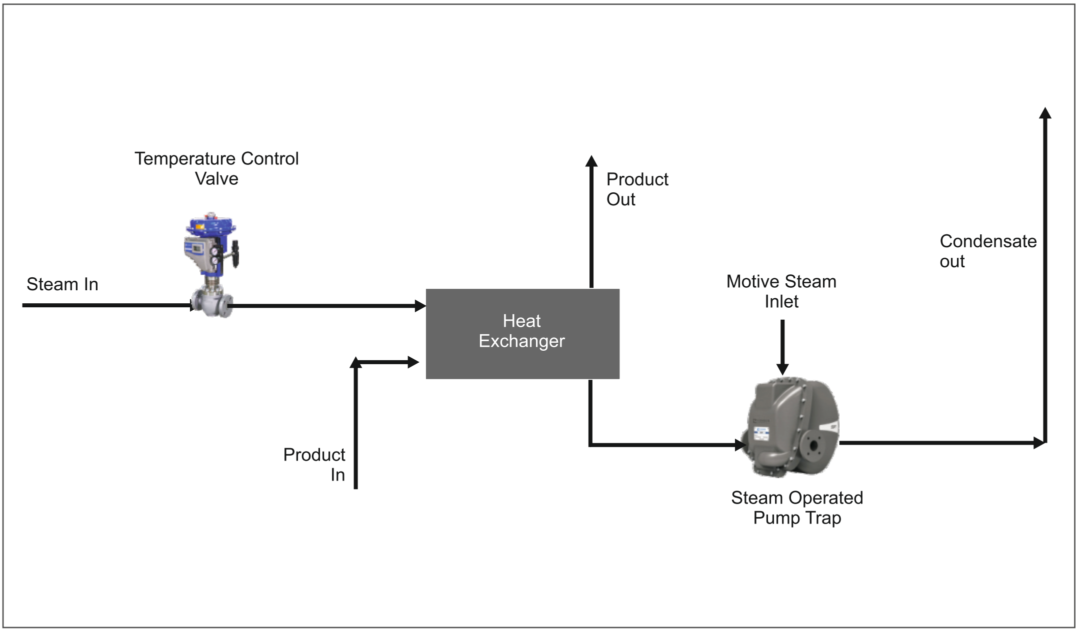
Dribbling of fuel oil at the burner nozzle reduced, leading to reduction in fuel oil wastage

Correct atomising temperature of fuel oil leads to complete combustion and thereby reduced fuel loss

Piston valve provides positive isolation to the trap with tight shut off bypass valve, vent valve and test valve

Ease of maintenance

Condensate Evacuation Made Easy Even under Stall Conditions - Lean Amine Heater



Problem

Steam traps are passive devices, which means they need positive differential pressure to evacuate the condensate.

In a lean amine heater, the process parameters are such that the differential pressure across the trap is usually negative. This causes stalling which in turn forces the bypass valve of the steam trap to remain open at all times and results in the passing of live steam along with condensate.

Solution

The installation of a pump and trap combination system will ensure that the heat exchanger is always free from condensate while allowing 100% space to be used for heat transfer using steam.

Benefits of the System

The steam operated pump trap maintains uniform heat transfer rate under all conditions

Increased productivity and reduced batch timing due to elimination of moisture which is a barrier to heat transfer

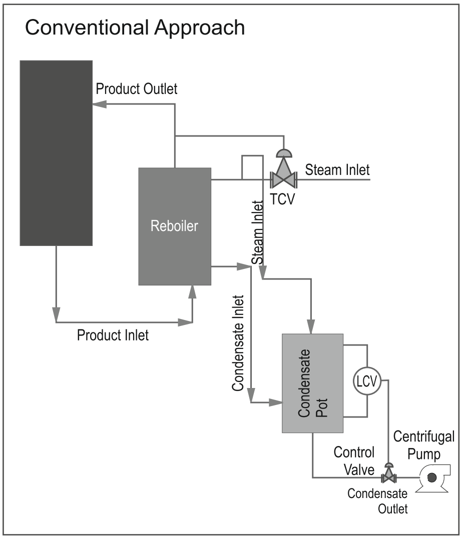
The bypass valve does not need to be opened, thus avoiding steam wastage

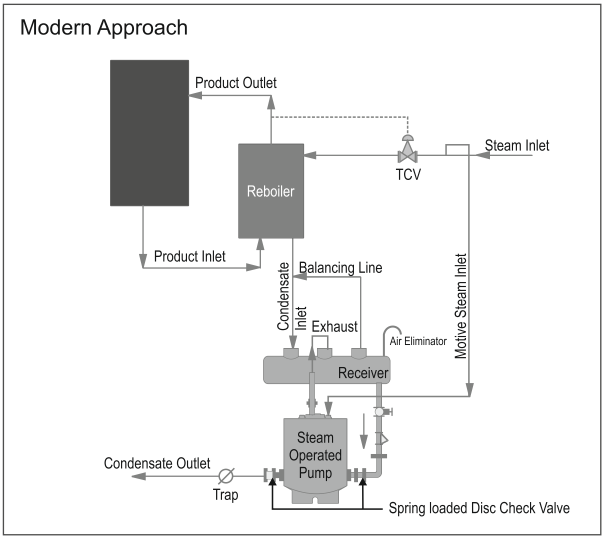
The steam operated pump trap saves condensate by returning it to the local condensate collection tank, which was earlier being drained due to negative differential pressure

Safety – no water hammering, no steam leaks or condensate spillage

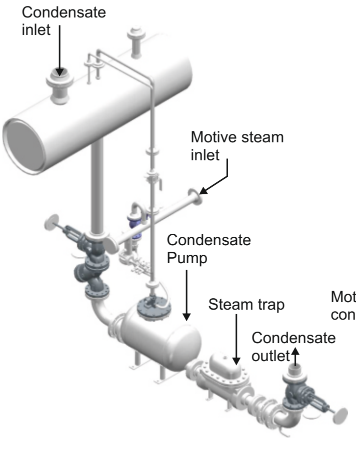
Reduction in corrosion of heat exchanger by avoiding sub-cooled condensate

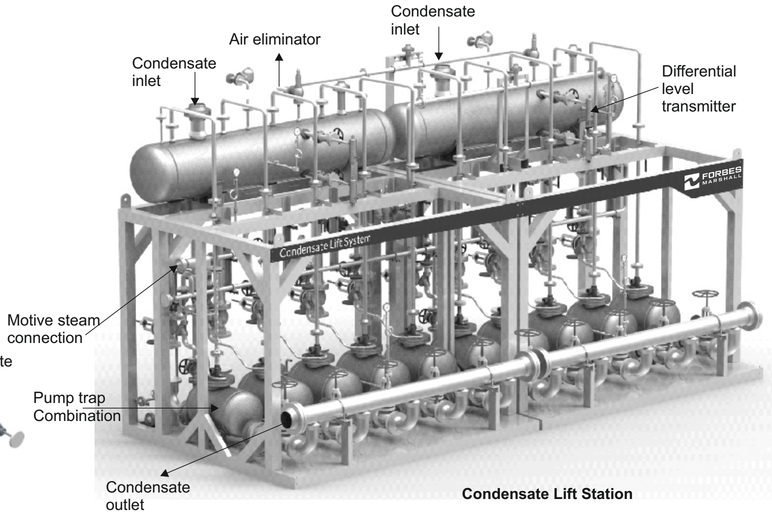
Effective Condensate Evacuation for Large Condensate Loads Against High Back Pressure





Condensate Pump Trap Combination System





System Range Details

Condensate Load	Outlet Pressure	Motive Pressure Required
1 to130 TPH	Upto 8 Bar	Upto 13 Bar

Limitations of Conventional Approach

Allows condensate to back up and flood the heat exchanger, causing
- loss of thermal performance
- corrosion of tubes
- water hammer

Electrical centrifugal pumps are used to pump the condensate

Benefits of a Modern Approach

Smooth condensate evacuation and pumping against the system back pressure thereby avoiding flooding and water hammering

No electrical / external power required to drive the steam operated condensate pump

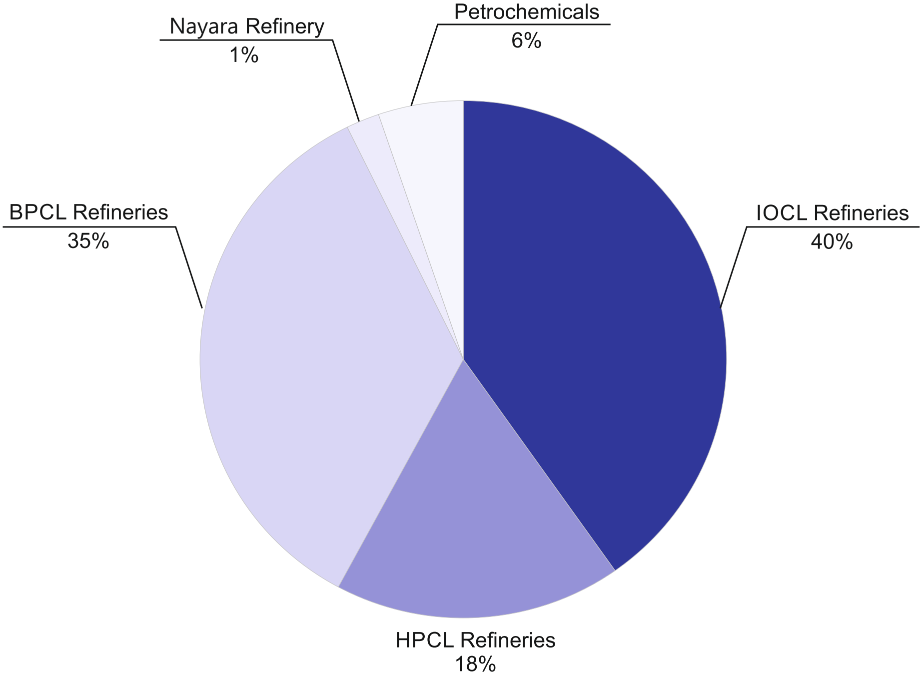
Compact and robust mechanical design

Heat Tracing : Steam V/s Electrical	
Steam Tracing	**Electrical Tracing**
LP steam is not generated from direct fuel firing. It is available from LP flash vessels (flash generated from MP and HP condensate), waste heat recovery boilers (process requirements), turbo-drive extraction, etc.	In India, electricity is invariably generated from steam, hence direct fuel firing required
With closed loop steam tracing system, effective cost of steam required to supply needed heat duty is only the latent heat cost. DM water and sensible heat gets recovered to the boiler, thereby saving these costs as well.	Can't be recovered or reused, hence costlier
It is non-toxic and fire proof	Possibility of fire hazard
Less capital investment since steam distribution and condensate recovery is already part of refinery infrastructure	New set up needed, hence higher capital cost
Steam gets condensed at constant temperature. Hence, heat output is uniform and temperature is easy to control.	Temperature needs to be controlled through RTD or thermostats mounted on pipelines
Lower operating cost (less than 30-40% of electrical tracing)	High operating costs, advisable only for cross county pipelines where steam distribution and condensate recovery network does not exist
Semi-skilled manpower is sufficient to maintain new technology steam tracing, without any hot work in a running plant . Hence, maintenance cost is very low.	Specific skilled manpower required.
Reliable and proven mode of heat tracing	When one considers the use of electricity for heat tracing, specifically in a developing country like India, the reliability of power for uninterrupted delivery, available voltage, and the consequences of outages must be evaluated.

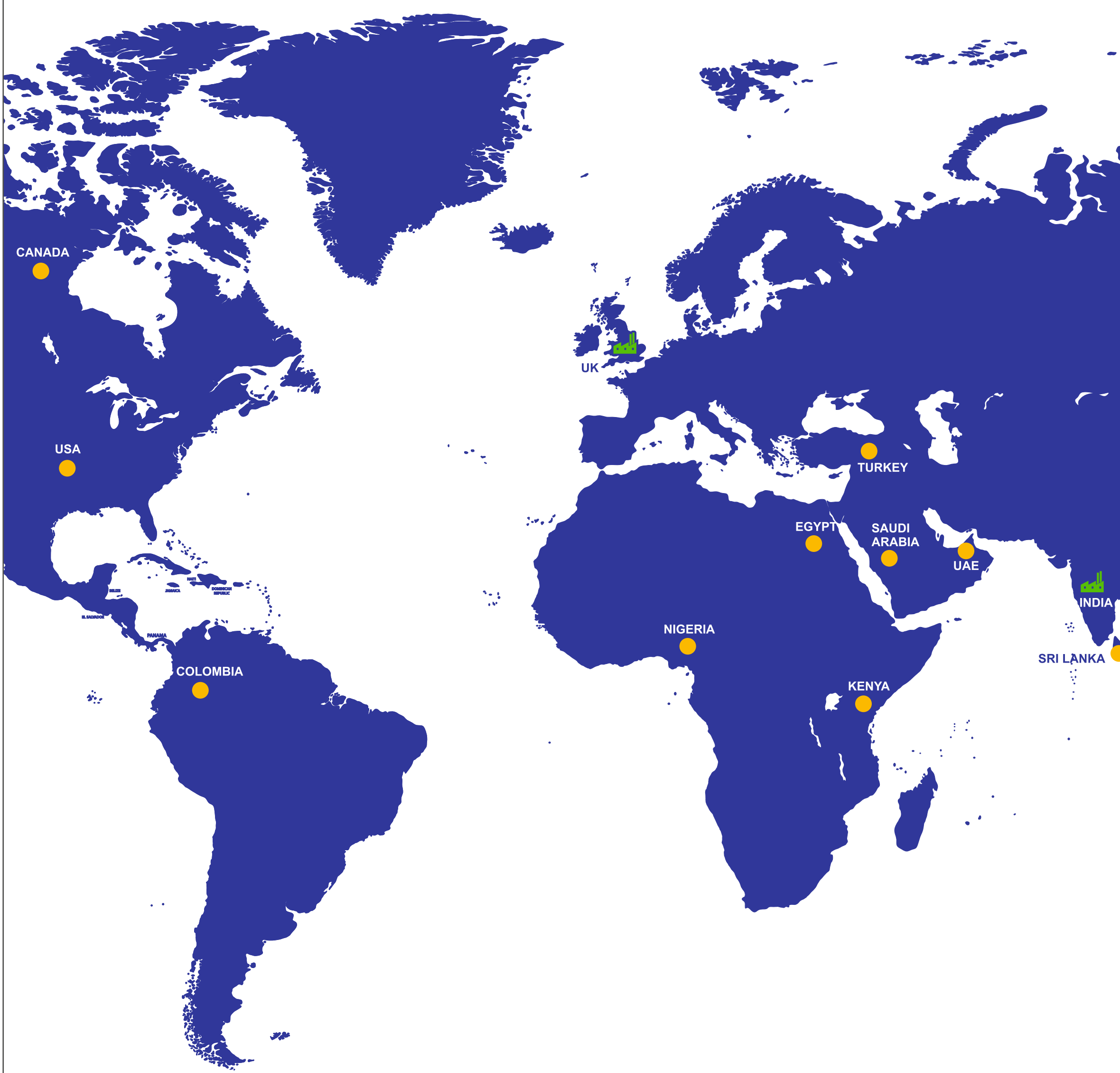
Credentials in Steam Trap System Management

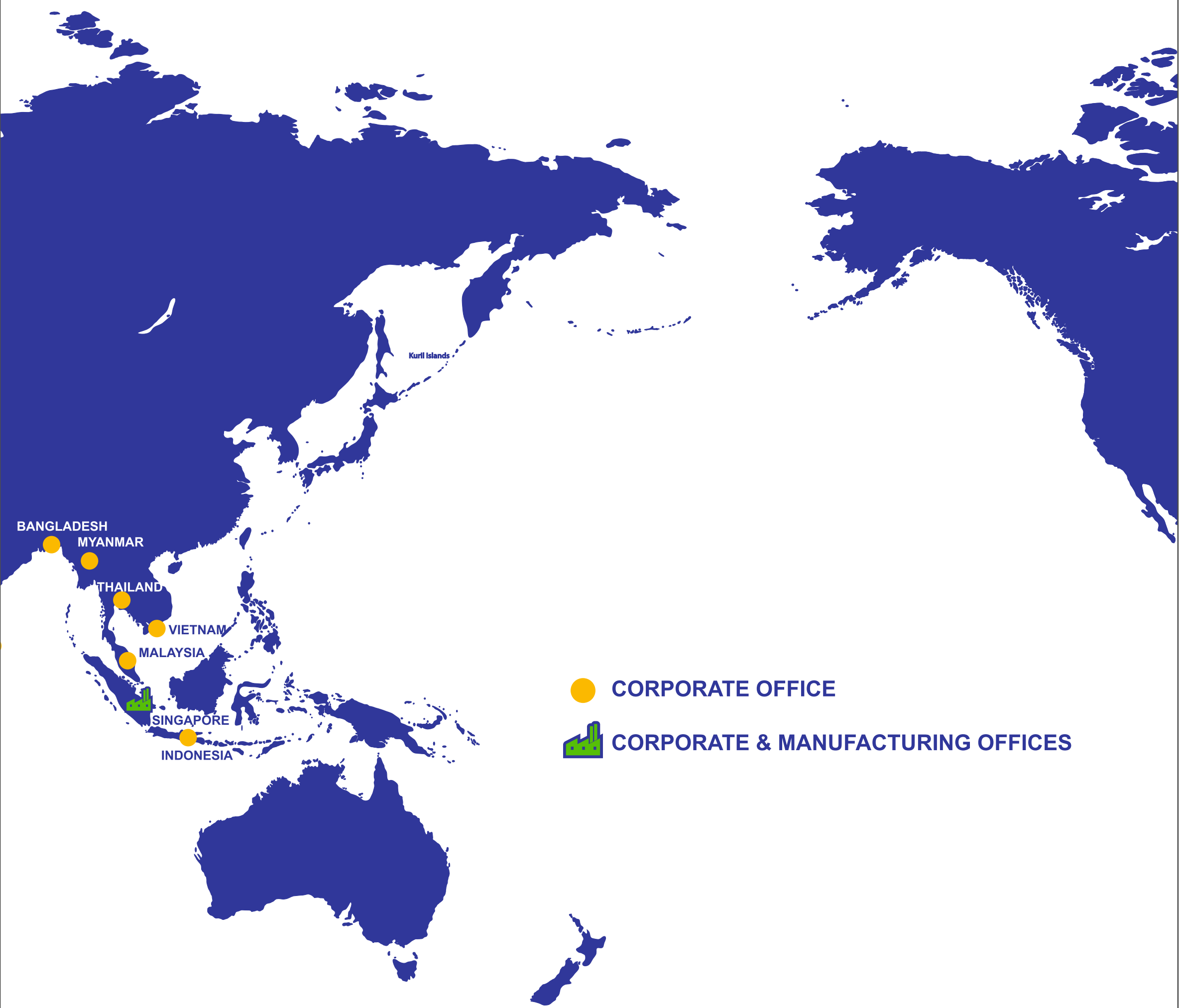
35	2 Lakh+	385 TPH
Steam Trap System Management contracts executed in the last 15 years	**Steam traps covered**	**Total steam savings achieved**

Steam Savings (%) in Different Industries (2007 to 2022)



We Are Near You





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BANGLADESH
MYANMAR
THAILAND
VIETNAM
MALAYSIA
SINGAPORE
INDONESIA
CORPORATE OFFICE
CORPORATE & MANUFACTURING OFFICES

Our Work in the Oil and Petrochemical Industry

> 80% Trap population (%) in Indian refineries	**>60000** Installed base of traps in the world's single largest refinery	**>2,20,000** Number of steam traps audited in refineries
>1,00,000 Trap Population (%) in Indian Refineries	**>250** Million Tons Condensate savings achieved through condensate recovery system	**>1,150,000** Steam savings achieved through steam trap analysis and optimisation

Accreditations (Product Based)

TUV NORD	TUV RHEINLAND	CE MARKING
ASME-R STAMP	TSSA	DNV-GL
TRCU EAC	KIWA	ASME-U STAMP

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