

Optimising Energy, Maximising Efficiency, Reducing Environmental Impact

Chemical and Active Pharmaceutical
Ingredients(API)



Optimising Energy.

Maximising Efficiency.

Reducing Footprint.

The chemical sector ranks among the largest process industries and is characterised by rapidly evolving plants producing a diverse and changing product mix. Utility systems need to be flexible enough to meet evolving process needs efficiently and safely. Plants also need to ensure accuracy with every batch, cost control, regulatory compliance and sustainability. Steam is used extensively to facilitate reactions, distillation, drying and for evaporation to meet zero liquid discharge compliance, and contributes significantly to utility cost.

For over 75 years, Forbes Marshall has provided innovative products and services to help industries improve their process and energy efficiency and be more environmentally responsible. We have partnered with major chemical plants globally, manufacturing a wide range of products such as dyes, pigments, agrochemicals (including pesticides, herbicides, and fertilisers), polymers, intermediates, alkalis, amines, fluorides, chlorides, aldehydes, petrochemicals, soaps, DFA (Detergent and Functional Additives), surfactants, soda ash/chlor-alkali, acids, and various specialty chemicals.



Utility Key

Orange Steam

Blue Condensate



Improve process efficiency

We help to enhance quality, consistency, and accuracy of processes, and improve productivity with solutions for measurement and control and by addressing utility bottlenecks.



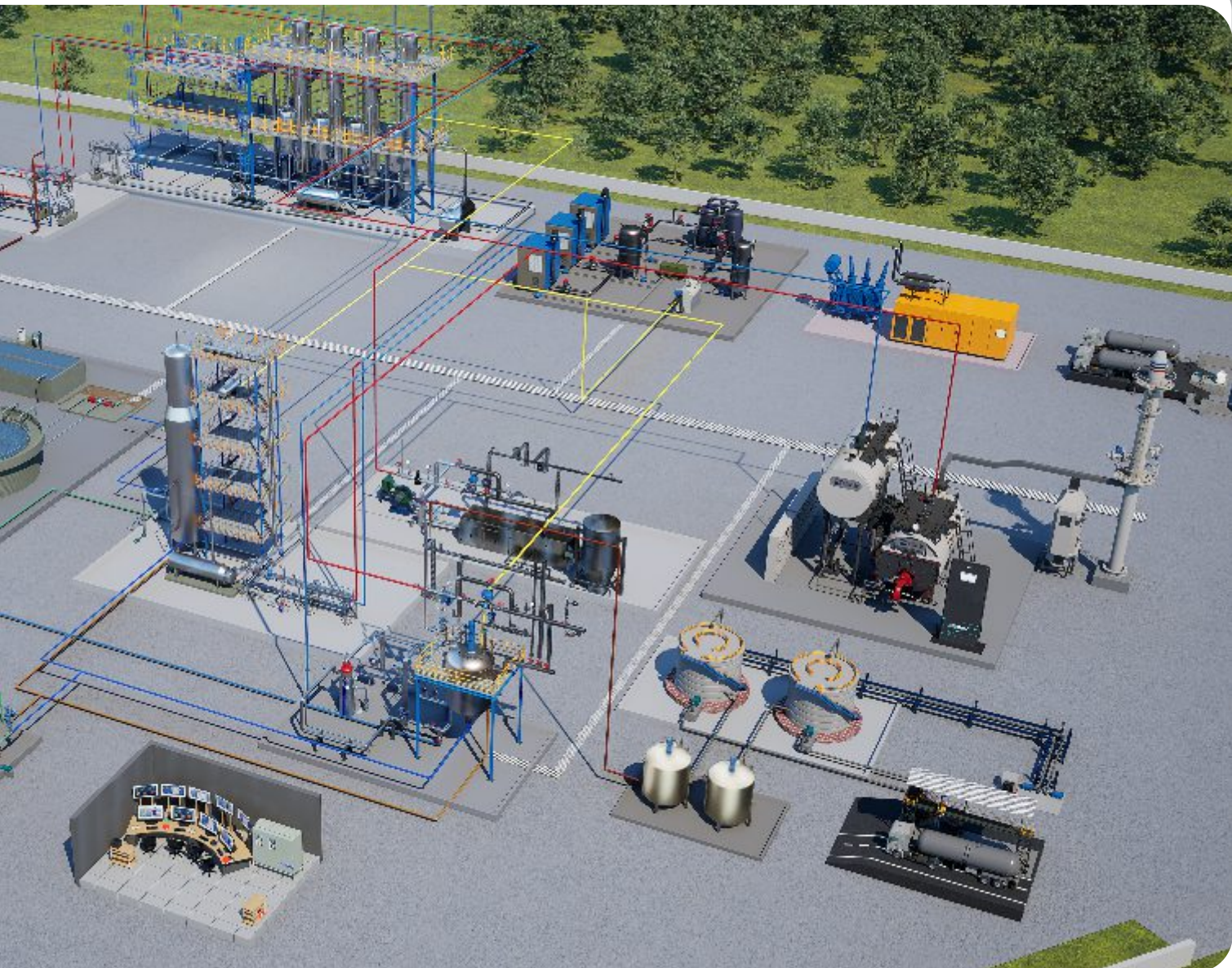
Save energy

We help reduce utility costs and deliver 20- 24% reduction on the boiler fuel bill by reducing steam generation costs, minimising distribution losses, optimising equipment steam consumption and improving condensate



Reduce environmental impact

Our products and services help plants reduce fuel consumption, monitor stack parameters, and reduce CO₂ emissions. We also help to optimise water and effluent management, address contamination, and maximise condensate recovery, reducing environmental impact.



Flash Steam

Product / Process Fluid

Hot / Cold Water

Boiler Blowdown



Run safe operations

Our online monitoring and control solutions prevent and address operational deviations in processes and utilities like steam. Additionally, we identify and rectify design gaps in the steam system that could pose hazards to the plant and personnel.



Improve and Sustain Performance

Our digital services impact key performance indicators across plant, equipment and device level. At device level, we focus on sustaining uptime at >95%. Equipment level services deliver more efficient and precise operations. Plant level services help improve and sustain specific energy consumption, water consumption and condensate recovery factor

Boilerhouse

Steam demand in chemical plants varies widely due to multiple blocks and equipment coming on and off heating, including numerous batch reactors and dryers. Boilers are typically oversized considering peak loads, safety margins, and future expansions, and often operate at less than 50% capacity throughout the day.

Since boilers in the chemical industry are predominantly solid fuel-fired, maintaining optimal operation at low loads is challenging. Slow response to sudden peak loads can also lead to steam pressure fluctuations.

Ensuring steam is available at the required quality and quantity, achieving optimal steam cost, safe operations, and reducing emissions are primary concerns in the boiler house.

The Forbes Marshall Solution

- A complete range of packaged boilers for efficient steam generation
- Boiler monitoring systems to facilitate safe boiler operation at rated capacity
- Emission monitoring systems to track and control emissions
- Vibration monitoring systems to help early detection of equipment issues, and prevent costly downtime
- Steam and water analysis to help prevent corrosion and scale buildup
- Desuperheating and pressure reducing to enhance steam quality and protect downstream equipment



Benefits



Optimum efficiency



Lower steam costs



Safe operations



Improved uptime



Regulatory compliance

Compressor Room

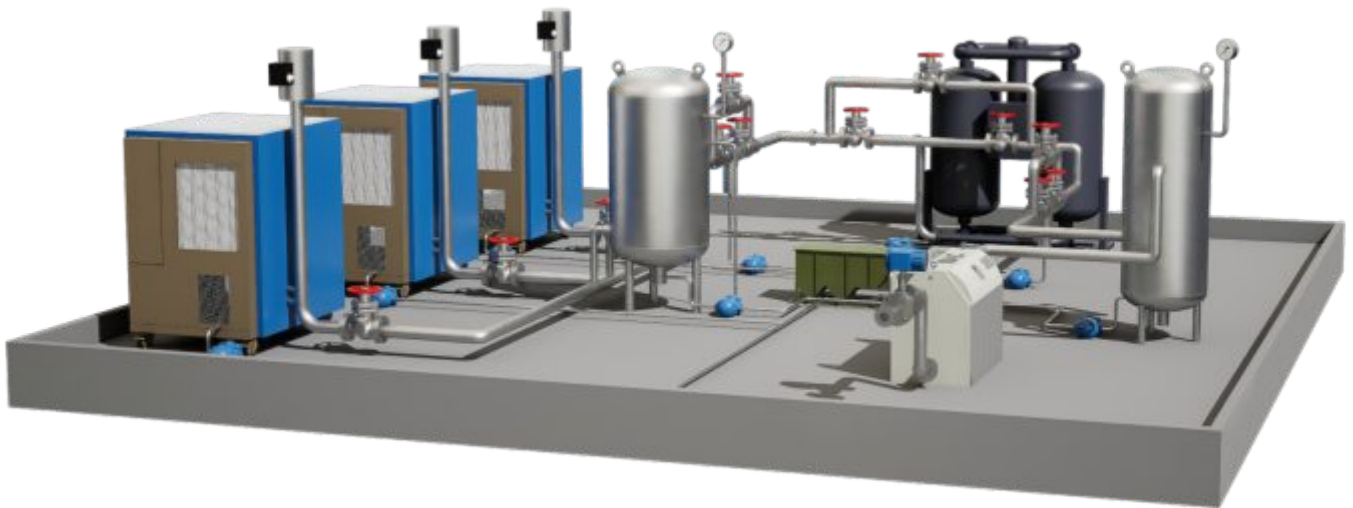
In Industry, compressed air is used for powering pneumatic tools, automation systems, and material handling equipment, and contributes to about 30% of electricity costs. However, despite their critical role, issues in air compressors and the associated compressed air network often go unnoticed, hindering productivity and impacting operational costs.

The most common problem faced is leaks in the network which can amount to up to 40% of compressed air costs. Every excess 1 bar of pressure leads to a 7% increase in electricity costs. Inadequate piping design or blockages in the air distribution network can cause pressure drops, reducing the effectiveness of pneumatic tools and equipment.




Artificial demand due to inefficiently designed systems, incorrectly sized compressors, pressure drops or unregulated end use is another significant challenge, contributing to about 10% of the energy losses in a compressed air network.




The Forbes Marshall Solution

- Forbes Marshall provides a comprehensive solution to optimize compressed air networks.
- AirMAP to help understand efficacy, quantity, loss quantification and cost of ownership through real time monitoring.
- FAD metering to help you run the compressor at optimum efficiency always and identify any deterioration in time.
- Accurate flow monitoring of each section with AirMon to help identify any gaps.
- Artificial demand control using Master Air Control



Benefits

-  Increased efficiency of the compressed air network
-  Electricity savings
-  Reduced operating costs

-  Improved productivity
-  Enhanced uptime of processes dependent on compressed air
-  Reduced capex costs

Cooling Towers

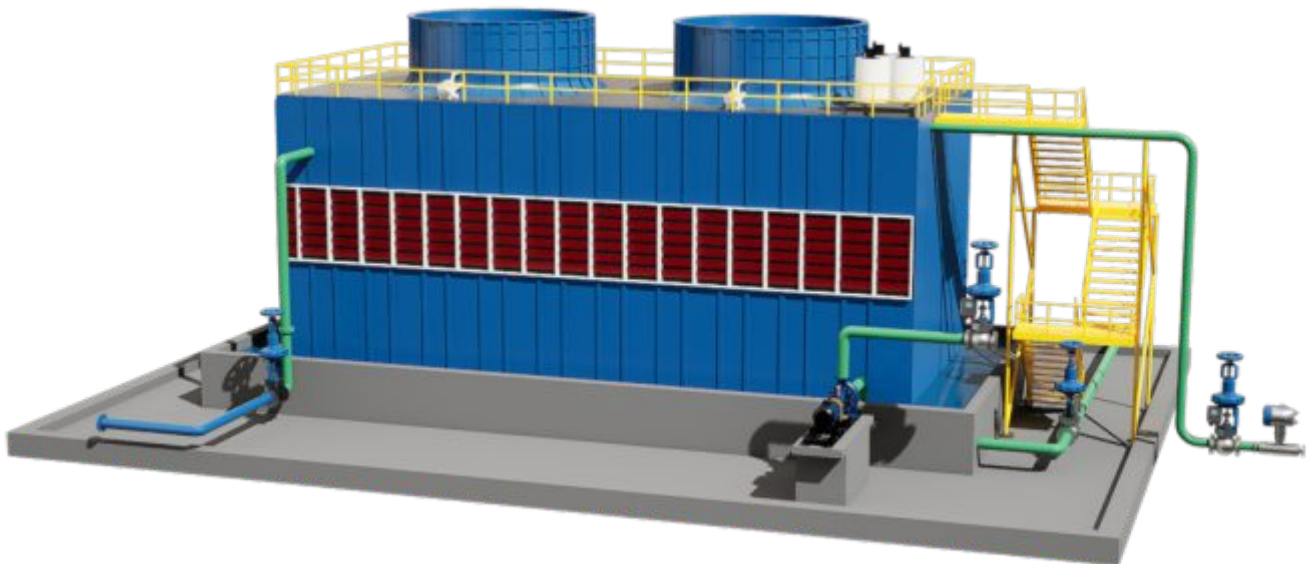
Many industrial processes involve heat generation, both from the processes themselves and from equipment like air compressors and chillers. Cooling towers are crucial for removing this unwanted heat, ensuring efficient operation. They work by transferring heat to the atmosphere through a combination of convection and evaporation.

Typical concerns that plants have regarding cooling tower operations include



- Scaling, deposition and microbiological growth which decreases heat transfer efficiency, restricts water flow and causes equipment corrosion
- Higher energy consumption
- Mechanical failures of motors, fans and pumps
- Water loss and increased makeup water consumption



The Forbes Marshall Solution

- TDS based blow down control and pH monitoring and dosing to precisely maintain water quality, eliminating issues that cause corrosion, scaling and deposition. Optimised blowdown also helps reduce water loss.
- Flow monitoring and control of makeup and process water. Level based makeup water control further helps to optimise water consumption.
- Water temperature and delta based control of the cooling tower fan and cooling water pumps not only ensures that process requirements are achieved but also helps reduce cooling tower electrical consumption.
- Vibration monitoring system for motors and pumps helps capture anomalies in operation providing valuable timely information to help prevent unplanned downtime by facilitating effective preventive and predictive maintenance.



Benefits

-  Achievement of process parameters
-  Higher uptime

-  Energy efficient operations
-  Reduced operator dependency

Effluent Treatment Plant (ETP)

Effluents from chemical factories contain various pollutants, often highly toxic. Effluent treatment plays a critical role in mitigating the impact of wastewater produced during manufacturing to safeguard health, ensure regulatory compliance, and facilitate resource recovery.

Typical operational issues across ETPs include chemical and biological imbalance, high energy consumption, longer processing times, reduced treatment capacity and challenges in meeting regulatory compliance.

The cause for this can majorly be attributed to fluctuation in inflow volume or contaminant concentration, insufficient monitoring, inadequate dosing / deaeration and conventional/ manual management systems

The Forbes Marshall Solution

- Multiparameter analysers for online monitoring of COD, BOD, TSS and pH enabling precise dosing and treatment
- DO based aeration control enabling stable COD and BOD values, with lower electrical consumption
- Automatic sludge level control
- Precise flow monitoring of effluent loads



Benefits



Reduced energy consumption



Safe operations



Efficient inventory control



Lower operational costs

Tank Farm

Tank farms are used to store a wide range of raw materials and finished products across industry segments. In many cases steam heating and tracing is required to heat or trace these product or raw materials within the storage tanks and pipelines at a specific temperature, so as to keep them in a fluid state for easy pumping and distribution. This process reduces viscosity and prevents crystallisation or solidification.

Often, plants face challenges such as failing to reach the desired temperature, delays in temperature attainment, temperature overshoots, water hammering and tank coil punctures in storage tanks. Other common issues include problems with condensate evacuation from tank coils and tracers, excessive steam consumption in the heating and tracing network, contamination of condensate from tanks and tracers and losses due to open trap bypasses. Significant manual intervention is also required to manage storage tanks and tank inventory.

The Forbes Marshall Solution

Forbes Marshall's comprehensive solution for storage tanks and tracing networks includes

- A central monitoring and management system, with accurate level and flow measurement for effective inventory management and accurately monitoring quantities and offtakes, as well as manage heating
- Steam pressure optimisation and precise temperature control to ensure lower energy consumption
- A complete range of steam trapping solutions that address issues like leakages, tank coil failures, temperature inconsistencies, and condensate contamination
- Condensate contamination detection systems, in combination with condensate recovery systems for safe and complete recovery of condensate



Benefits



Reduced energy consumption



Safe operations



Efficient inventory control



Lower operational costs

Tanker Loading and Unloading

In Industry, tankers are used for efficient and safe movement of bulk quantities of raw materials, intermediate products, and finished goods between production sites, storage facilities, and end-users.

In the chemical industry, handling hazardous chemicals poses significant safety risks, including exposure to toxic substances, spills, leaks, and potential explosions or fires. Contamination control is critical, as residual chemicals in tankers can lead to cross-contamination. Temperature and pressure management are also crucial to maintain stability. With increasing focus on sustainability, environmental concerns such as management of emissions and waste generated during loading and unloading processes is of prime importance.

The Forbes Marshall Solution

The Forbes Marshall solution for safe, efficient and reliable loading and unloading of tankers includes

- Customised packages for monitoring fluid flow in or out of the tankers to accurately control the flow rate and prevent overfilling, spills, and excessive pressure build up
- Earthing detection with fail-safe alarms to prevent static electricity buildup, which could lead to explosions
- Accurate flow monitoring to help maintain records of quantities received or transported, which is essential for regulatory compliance, operational efficiency and cost management
- Data logging and report facility for inventory management



Benefits



Lower operating costs



Enhanced safety



Better productivity and product quality



Reduced manual dependency

Chemical Batching System, Reactor Automation / Bulk Storage Tank

Most primary processing occurs in reactors where products are made under controlled conditions. Consistent product quality for each batch is critical. Traditional systems can cause inconsistencies in raw material intake, affecting product quality and process and energy efficiency. Similarly conventionally managing pH dependent reactions can lead to inaccurate or prolonged batch times.

In multi-utility reactors, steam, cooling and chilled water are supplied to the same jacket. Conventional hook-ups cause fluctuations in heating/cooling profiles, temperature overshoots, batch inconsistencies and utility contamination. Contaminated condensate is drained to the ETP/cooling tower.

Steam load is significantly higher at start-up and conventional traps often fail to evacuate condensate completely, leading to steam loss.

The Forbes Marshall Solution

Forbes Marshall provides a complete solution designed to address these issues

- Accurate mass, level and flow measurement for precise management of inputs, eliminating variations.
- Utility control with pressure and temperature sensors to ensure precise temperature profiles as per the recipe.
- pH or temperature based automation for precise chemical dosing without manual intervention for consistent batch quality and productivity
- Multi Utility Process Trap to effectively discharge start up and running condensate loads eliminating water hammer and steam loss due to open bypasses with TDS and temperature based systems to monitor condensate quality enabling recovery of only pure condensate
- Complete reactor automation

Benefits



Consistent product quality across batches



Lowest energy consumption



Optimum start-up and batch times



Lower effluent load and water consumption



Safe operations



Reduced operator dependency



Equipment uptime

Distillation Column

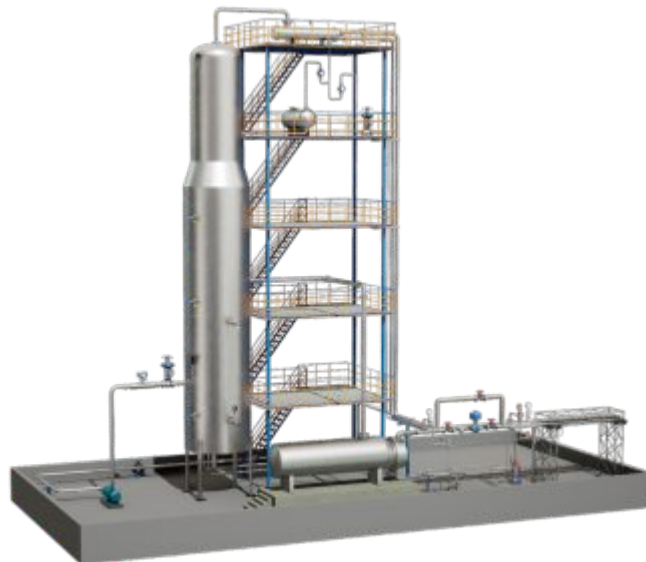
Distillation is the most commonly used separation technique in the chemical industry. It consumes a large amount of energy, both in terms of cooling and heating requirements. Achieving high product recovery and throughput with lowest energy consumption is critical but often a challenge with traditional methods, as multiple parameters need to be managed.

Variations in feed flow, high reflux ratios, low reflux temperatures or high bottom temperatures can lead to poor quality, lower throughput and higher energy consumption. Other issues faced include not achieving process temperature, issues in achieving column equilibrium, draining of condensate and increase in cooling tower or ETP load

The Forbes Marshall Solution

Forbes Marshall provides a complete solution designed to optimise column operation.

- Accurate flow monitoring and control of product feed to the column
- Reflux ratio control automation for feedback to the column and product outputs
- Pressure and temperature management based on sensors at various stages of the column
- Measuretrol, our innovative digitally enabled PID control solution with patented technology, is equipped with built in steam measurement and accurately controls steam pressure to the column as per desired accuracy with built in steam flow measurement
- Steam operated pump trap to resolve the issue of stalling, eliminating water hammer and steam loss through the bypass
- Flashjet pump to recover condensate and flash steam from the column



Benefits



Lower cost of production



Reduced batch time



Safety assured



Higher yield



Utility optimisation,



No operator dependency



Repeatable batch quality

Dryers

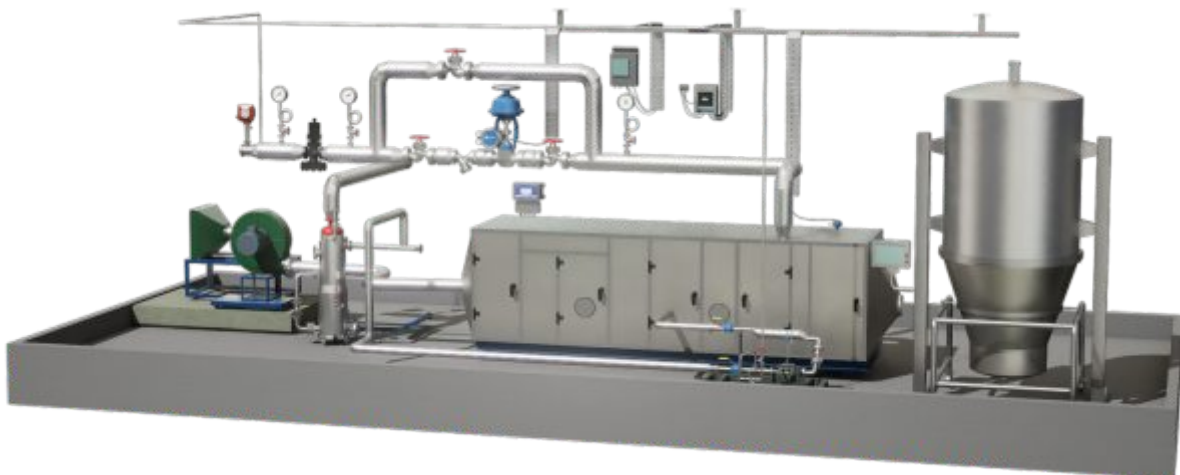
Dryers are widely used in pharmaceutical and chemical manufacturing to dry material. Various dryers are used in the industry, including spray dryers, continuous dryers, tray dryers, fluidised bed dryers. Achieving the desired outlet moisture is crucial, as overdrying can degrade product quality and lead to a loss in gross weight, while underdrying can also affect quality. Hot air flows across the material drying it. Steam is often used to heat air to the required temperature in the air battery and this hot air enables drying.

- Some common issues that plants face across dryers
- Hot air temperature variations ($\pm 5^{\circ}\text{C}$ from the set value)
- Difficulty reaching desired temperatures
- Water hammering in the air heater battery, causing coil failures
- Condensate evacuation issues
- Higher energy consumption
- Higher batch and startup times

The Forbes Marshall Solution

Forbes Marshall provides a complete solution for dryers. This includes

- Precise control of steam pressure, air temperature and flow based on product flow rates and outlet moisture and outlet air relative humidity
- Steam Operated Pump Trap which enables evacuation of condensate under stall (when air temperatures required $<100^{\circ}\text{C}$) eliminating water hammer and the need to open trap bypasses
- Steam operated condensate recovery pumps
- Flash steam recovery to preheat air (where required dryer temperatures $>100^{\circ}\text{C}$)



Benefits



Reduced batch time



Utility Optimization



Repeatable batch quality



Precise temperature with optimised steam consumption and optimise pressure



Zero Steam Trap bypass valve opening

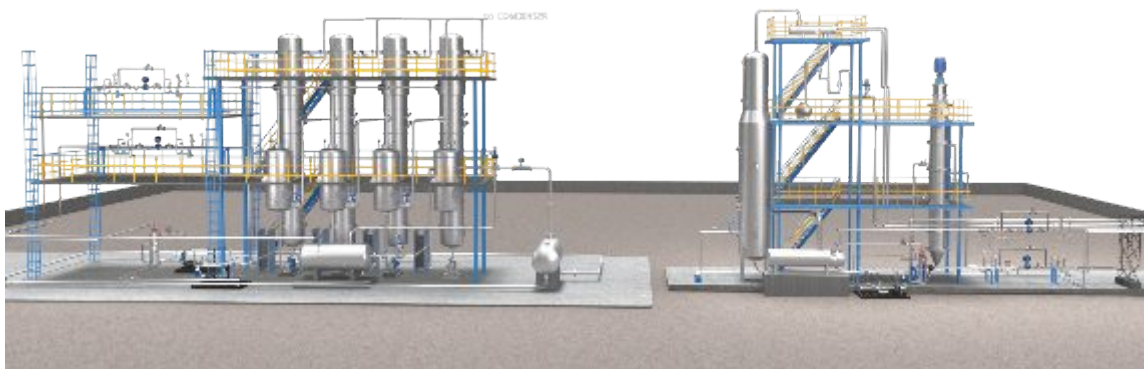
ZLD MEE + ATFD + Stripper

Zero Liquid Discharge Systems help plants to conserve water and minimise effluent discharge. The system, comprising a stripping column, Multiple Effect Evaporator and Agitated Thin Film Dryer, removes dissolved and suspended solids from wastewater. The resulting water stream is reused and the solid waste stream disposed. ZLDs consume about 40% of total plant steam. Besides high operating costs, high moisture in the solid stream and not being able to operate the ZLD at design capacity are also issues prevalent across plants.

The Forbes Marshall Solution

The holistic solution from Forbes Marshall encompasses

- Supply steam pressure reduction to 1-1.5 barg and use of ATFD flash steam to operate the stripping column instead of live steam
- Complete condensate evacuation
- Monitoring of feed flow, feed and outlet concentration, steam pressure, temperature and flow, feed transfer between effects, effect pressures and temperatures and cooling water temperatures. Steam is controlled based on these parameters.
- Live steam to the preheater to control variations in feed temperature
- Maintaining vapour balance (vapour control valve).
- Evacuation of non-condensables (AV)
- Vapour loss prevention (trap between 1st and 2nd effect) and condensate evacuation (SOPTs for subsequent stages)
- 100% condensate and flash steam recovery
- Optimised pressure control and individual trapping for each zone (ATFD).



Benefits



Reduced batch time



Utility Optimisation



Repeatable batch quality



Precise temperature with optimised steam consumption and optimise pressure



Zero steam trap bypass valve opening

Reactor Automation

Reactors are large, specialised vessels, made in metal or glass-lined, used in the Pharmaceutical and Chemical industries to manufacture various ingredients. They are designed for to process hazardous and non-hazardous chemical reactions.

Challenges

- Manual operation : Lack of proper monitoring and control mechanism.
- Manual records/ database to be maintained.
- Frequent batch failure issues
- Inconsistency of final product
- Operator dependency

The Forbes Marshall Solution

Forbes Marshall's comprehensive solution for storage tanks and tracing networks includes,

- Automatic batch start & Stop function.
- Running the batch according to the user-selected recipe
- pH measurement with control loop and dosing system
- Heating and cooling cycles to control steam and cooling water utilities



Benefits



Consistent Product Quality with user specific controls



Reduced operator dependency



Optimised batch time with accurate recipe management.



Safe operations by automatic dosing of hazardous chemicals.



Optimised utility usage with heating and cooling controls



Production to utility ratio per day/per batch

Layer Separation

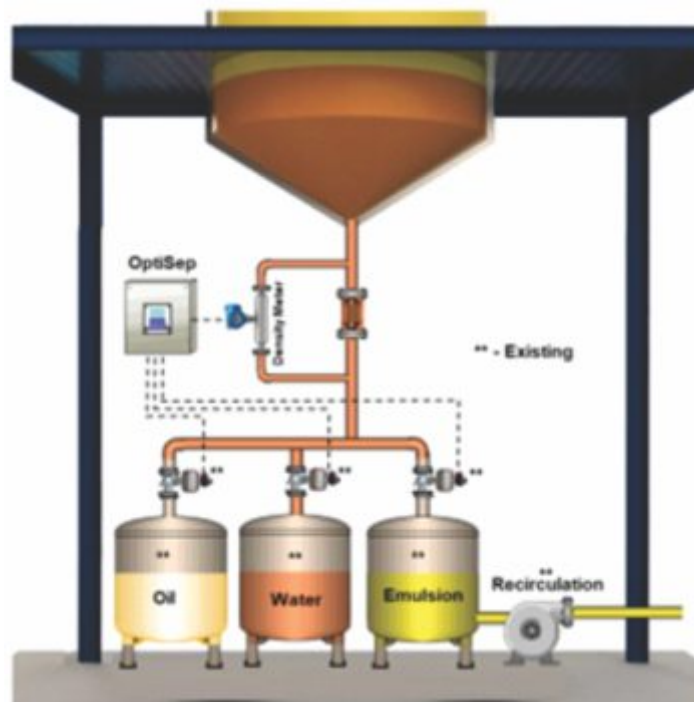
Layer separation is a one of the most common solvent extraction processes in a chemical plant. It is a key step in purifying chemicals, isolating products, and removing impurities. Traditionally the layers are separated manually by the operator through a viewer glass.

Challenges:

- Operator dependency
- Inaccurate separation
- Mixing of the chemicals lead to repeating the process (2 or 3 times in some cases)
- Time consuming process

The Forbes Marshall Solution

- Control panel with facility to control the diverter valves based on conductivity or density of the contents is used for effective and operator free operations.
- Conductivity based layer separation uses a conductivity sensor to detect the change in conductivity and divert the valve.
- Whereas a density/ mass flow meter is used to detect the change in density to control the operations.



Benefits



Stand alone operations with conductivity or density based measurement.



No operator dependency



Optimised process time



Better product recovery

Efficient Hot Water Generation

Utility reactors require instantaneous hot water for reaction process and processing bulk drugs. For maintaining required RH levels, hot water is used in HVAC.

Challenges:

- Frequent water overflow and uneven temperatures in direct steam injection hot water systems
- Improper hot air temperatures in HVAC and reactor processes
- +/- 3 OC to 5 OC temperature fluctuations and frequent bypass valve opening of trap in jacket based hot water systems with on-off valve for steam along with ball float traps
- Frequent cleaning of plate heat exchangers due to scaling and non-prediction of fouling and excess steam consumption

The Forbes Marshall Solution

- The Forbes Marshall instantaneous hot water system, HeatMax+
- Heat transfer rate which 3-5 times more than a calorifier
- Reacts load fluctuations instantaneously
- No intermixing of fluids, even in the extreme eventuality of gasket failure
- Stall free - compact steam operated pump trap forms a critical component of the HeatMax+ ensuring no condensate logging and precise hot water temperatures are maintained to the accuracy of +/-0.5°C
- Fouling prediction
- Patented control valve technology which has the capability to predict flow rate
- Smart PLC to render visible parameters and minimise downtime by predictive actions



Benefits



Optimised pressure operation enabling maximum throughput and stability of operation



No water hammering



Digital Connectivity to render parameters visible



Precise temperature control of +/-1°C

Steam consumption monitoring leading to dual advantages:

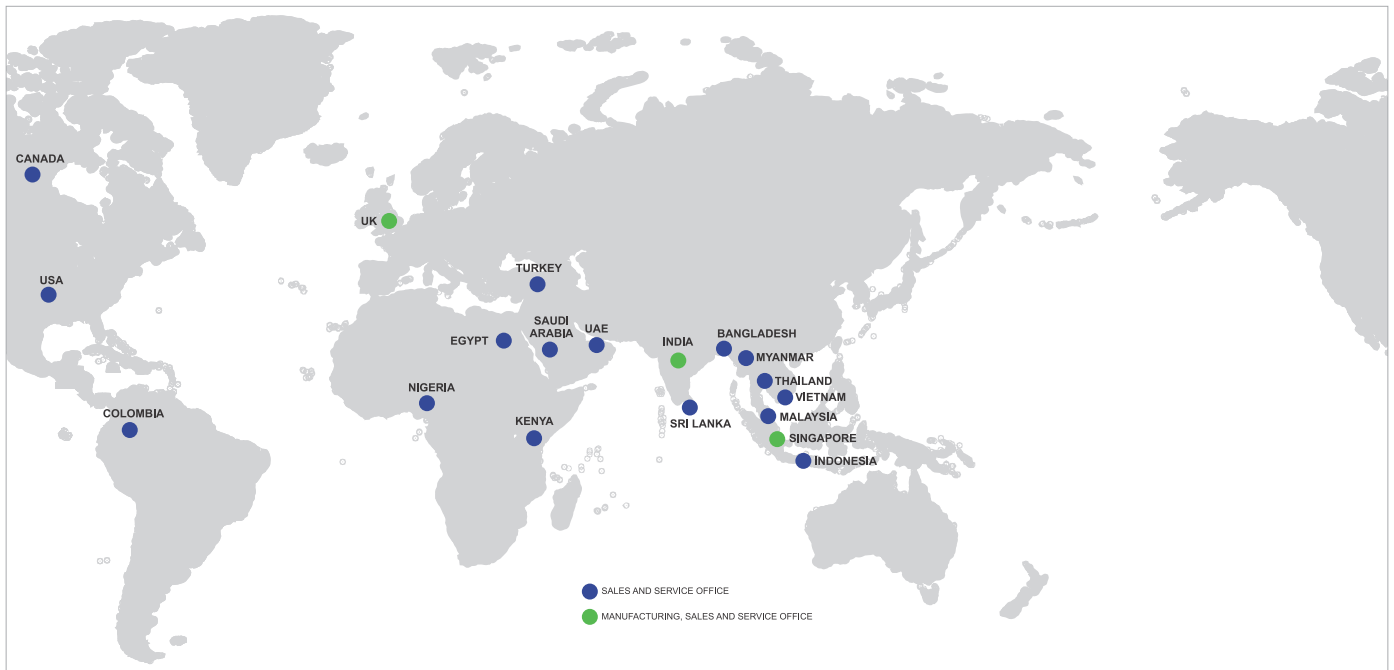


Knowing precise consumption with respect to water flow



Steam trap failure – If this situation occurs, it can be easily monitored with respect to increased steam consumption due to steam leak or bypass valve opening or valve hunting due to water logged condition

Energising Businesses and Communities Worldwide



A Multinational with Indian Roots

18	Countries
37	Offices Worldwide
18	Distribution Centres
500	Sales and Services Engineers
8,000	Customers Worldwide

World Class Technology from World Class Facilities



Enabling Results



Process Efficiency



Energy Efficiency



Optimum Productivity



Improved Asset Uptime



Environmental Responsibility



Safety and Regulatory Compliance



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