Modern steam systems

- Steam is used in the manufacture of virtually every product you can think of, e.g.:
  - Textiles
  - Tobacco
  - Plastics
  - Rubber
  - Timber
  - Leather
  - Oils and petrochemicals
  - Paper and board
  - Bio-diesels
  - Building blocks
  - Foods and beverages
  - Metal treatment

And in sterilising, humidification, power generation, space heating, laundry services, hospital services, leisure industry, electronics industry and sewage treatment.
Uses for steam

There are many uses for steam:
• Heating water for space heating.
• Heating domestic hot water.
• Sterilisation.
• Humidification.
• Pasteurisation.
• Laundry services.
• Cooking.
• Cooling.
• Combined heat and power.

Thermal systems options available
Selecting the heating media

<table>
<thead>
<tr>
<th>Steam</th>
<th>Hot water</th>
<th>Thermic Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>High heat content Latent heat approx 2100kJ/kg</td>
<td>Moderate heat content Specific heat 4.19kJ/kg deg C</td>
<td>Poor heat content Specific Heat often 1.69-2.93 kJ/kg deg C</td>
</tr>
<tr>
<td>Inexpensive - some water treatment cost</td>
<td>inexpensive only occasional dosing</td>
<td>Expensive</td>
</tr>
<tr>
<td>Good heat transfer coefficient</td>
<td>Moderate heat transfer coefficient</td>
<td>Relatively poor coefficient</td>
</tr>
<tr>
<td>High pressure required for high temperature</td>
<td>High pressure needed for high temperature</td>
<td>Low pressures only to get high temperatures</td>
</tr>
<tr>
<td>No circulating pumps - small pipes</td>
<td>Circulating pumps, Large pipes</td>
<td>Circulating pumps required, even larger pipes</td>
</tr>
<tr>
<td>Easy to control with two way valves</td>
<td>More complex to control - three way valves or DP valves may be required</td>
<td>More complex to control - three way valves or DP valves may be required</td>
</tr>
<tr>
<td>Temperature breakdown is easy through a reducing valve</td>
<td>Temperature breakdown more difficult</td>
<td>Temperature breakdown more difficult</td>
</tr>
<tr>
<td>No fire risk</td>
<td>No fire risk</td>
<td>Fire risk</td>
</tr>
<tr>
<td>System very flexible</td>
<td>System less flexible</td>
<td>System inflexible</td>
</tr>
</tbody>
</table>
Steam System
Areas to be addressed

- All that burns in your boiler does not energize your process

Considering a high boiler efficiency of 80%, in ideal circumstances only 57% energy is actually producing results.

If the loop was to end here, nearly half the energy in fuel is lost.

100% condensate recovery raises the efficiency to 77%.

Steam Loop

Generation
Distribution
Recovery
Utilisation

Energy Conservation  |  Environment  |  Process Efficiency
New and old steam systems

The following slides travel round the steam and condensate loop comparing a modern way of doing things compared with the old way.

For all the four major areas of the steam look namely Generation, Distribution, Utilisation and Condensate/Flash Recovery

Efficiency by design

• A well designed utility system impacts
  – Initial project cost
  – Recurring day to day running costs
  – Recurring cost of ownership
Steam Systems

- Our utility designs ensure
  - Energy efficiency
  - Safety
  - Ease of operations & maintenance
  - Conformance to environment and pollution norms
  - Reliable life cycle

Energy efficiency by design

- Effective design of steam distribution with
  - Minimum pressure drop
  - Minimum radiation loss
    - Optimum pipe size
    - Pipe routing – best or economical laying of pipes
    - Minimum bends
  - Good Engineering practices followed
    - Air venting at appropriate locations
    - Distribute steam at high pressure
    - Optimum steam line sizes
    - Providing drain points at desired locations
Energy Efficiency by Design

- Selection and sizing of components – so that project costs are kept to minimum
- Removal of condensable gases in the pipe lines
- Meeting process steam requirements
- Ease of operation & maintenance
  - Ergonomic design to facilitate operation, design to facilitate maintenance
  - Use of relevant automation and diagnostics
- Safety
  - Prevents live steam leaks
  - Easy accessibility to equipments

Energy Efficiency by Design

- Conformance to environment and pollution norms
  - Incorporate monitoring systems that enable conformance to norms while delivering savings
- Reliable life cycle
  - Engineering to ensure high utility system reliability to minimize downtime
Process benefits

- Well designed steam systems ensure lowest utility consumption via
  - Right boiler selection and sizing
  - Recovery of heat from economically feasible locations
  - Right steam conditioning
  - Condensate and flash recovery wherever possible
  - Correct steam trapping to ensure lower batch time and steam consumption
  - Utility designs to eliminate issues of pressure drop or stalling
Traditional boiler feedwater tank

**Old system:**
- Loss of flash steam.
- Low water temperature.
- High O₂ content.
- Heat loss from tank.
- Possible hot waste discharge from vent.

Modern boiler feedwater tank

**Modern system:**
- Much of flash steam recovered.
- Water heated.
- Low O₂ content hence reducing chemical usage.
- Minimum heat loss from tank.
- Safe vent.
Traditional boiler level controls

Old system:
- Daily testing of controls.
- Trained boiler attendant required on site.
- On-off level controls – possible fluctuations in boiler output.

Modern boiler level controls

Modern system:
- Weekly testing of controls.
- Trained boiler attendant required on site at night only.
- Modulating controls mean consistent boiler output.
Traditional boiler TDS controls

Old system:
- Manual blowdown can waste energy, water and chemicals.
- Can lead to foaming and carryover causing problems in the steam system.

Modern boiler TDS controls

Modern system:
- All blowdown now automated.
- Saves energy, water and chemicals.
- Boiler maintained at design conditions.
- Steam quality improved and maintenance reduced.
- Manpower saved.
Heat recovery from blowdown

**Modern system:**
- Energy (and water) recovered from TDS blowdown.
- Flash steam from blowdown vessel vent reduced.
- Feedtank heating improved.

Chemical treatment

**Modern system:**
- Feedwater treatment now automated.
- Manpower reduced
- Steam and condensate systems better monitored.
- Scale and corrosion minimised meaning less system maintenance.
Traditional Boiler Control System

• No monitoring of the operating efficiency of the boiler
• Leads to boiler losses like stack losses, enthalpy losses, radiation losses, blowdown losses going unmonitored which impacts the indirect efficiency of the boiler.
• With the result the plant assumes that the boiler is operating at rated efficiency whereas it is actually operating much lower than the rated efficiency (typically 3% to 12% lower!)

Modern Boiler Control System

• Online boiler efficiency monitoring system that provides a minute by minute report of boiler efficiency.
• Quantifies the losses to enable operator to take remedial action enabling sustained high efficiency
• Historical data available for diagnosis and proactive maintenance
Modern Boilers

- A complete Boiler house package consisting of Boiler + Feedwater tank + Day oil tank.
- Complete control instrumentation available on the modular unit to ensure efficient operations.
- Complete in-house assembly leading to right engineering and reduced erection time essentially being plug and play!

Overall Combined Efficiency of 85% Plus

- Suitable to Operate Single, Any two or all media in any combination
- 55% saving in Civil and Peripheral cost
- Turn down of 30% for combined or individual media based on process loads
- Stable Output for each media irrespective of change in load in any one media
Traditional Steam Distribution

- The conventional steam trap station consists of multiple valves and joints, each being a potential source of steam leak.
- Unable to identify leaking trap in closed loop
- Estimated Weight 10kg

Modern Steam Distribution

- Compact steam trapping station prefabricated with reduced no. of joints – reduced possibility of leaks
- Trap health can be checked online
- Weight of the assembly reduced by 50%
Traditional heat exchangers

Old system:
- Heating and hot water calorifiers occupy significant plant room space.
- High heat loss from shell and tube heat exchangers.
- Condensate removal can be difficult affecting temperature control.
- Safety valves and vents often used.
- Requires regular strip down and inspection.

Modern heat exchangers

Modern system:
- Compact, efficient and flexible.
- Normally exempt from inspection.
- Can be supplied as a package for easy and quick installation.
- Complete condensate removal.
- Heat output easily increased or reduced.
- Safety valves and vents usually unnecessary.
Traditional steam trap arrangement

Old system:
• Several joints and potential for leaks.
• Manual trap testing required.
• High maintenance.

Modern steam trap arrangement

Modern system:
• 2 joints minimise leakage.
• Installation time reduced.
• Trap can be replaced in 2 minutes.
• Inbuilt, automatic steam trap monitoring included.
Traditional condensate recovery

**Old system:**
- Condensate pumped via electrical pumps where cost of pumping is higher
- Condensate is pumped at temperatures below 90deg C.
- Large wastage of energy in flash steam and loss of condensate (from flash steam).
- Unsightly discharge from the vent.
- Possibility of the receiver overflowing due to pressurisation.

Modern condensate and flash steam recovery

- Condensate is recovered by a steam operated Pump which pumps condensate at temperatures at which it is formed.
- Reduced cost of pumping by steam
- Flash steam is recovered before it’s lost from the receiver vent.
- Energy and water saved.
- Less likelihood of receiver overflowing.
Modern Flash Recovery System

- Flash steam separated from condensate leads to effective condensate evacuation
- Eliminated bi-phased flows
- Recompression of flash steam to generate LP steam which can be used in the process

Modern boiler feedwater arrangement using recovered heat

Modern system:
- Excess heat in the condensate return is used to heat the boiler feedwater.
- Flash steam loss from the tank is minimised.
- High feedwater temperature smoothes the boiler output.
- Steam system can be virtually sealed.
- Maximum energy and water savings.
Summary

Steam technology has developed faster over the last ten years than any other decade. Compared to the older systems, modern steam systems are:

- Much more efficient.
- Require much less maintenance.
- Safer.
- More automatic.
- Virtually sealed.
- Need reduced supervision.
- Easier to monitor.
- More environmentally friendly.

Which means lower installation, operating and maintenance costs.

Thank You