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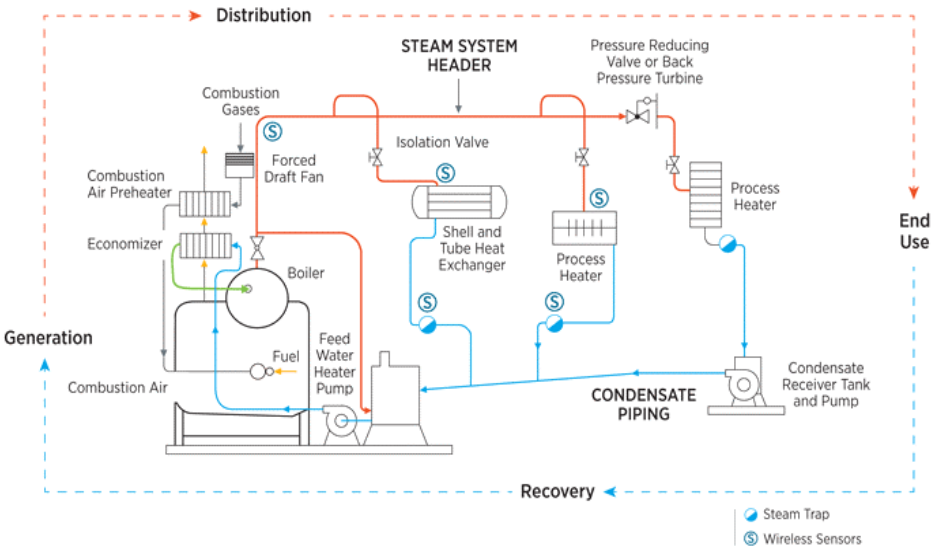
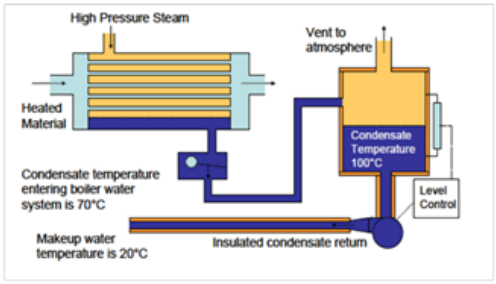
Steam Efficiency: Steam system optimization

STEAM UP

'Improving steam system performance '





Steam Efficiency

Steam usage is very widespread in the industry for a multitude of processes that use steam as a heating, stripping, drying and power generating source. Data from industry shows that average steam energy usage in industry could be as much as 35-40% of the onsite whole energy consumption. Hence, it is very important to optimize these systems and minimize their operating costs.

Steam is an extremely efficient heating source having high heat transfer coefficients and maintains a steady temperature. Steam has the highest amount of transferrable energy (in the form of latent heat) per unit mass and hence, becomes an extremely cost-effective medium of heat transfer.

Steam flows can be controlled very accurately, especially when pumps are equipped with variable frequency drives (VFDs); in these cases, VFD enables the pump to operate over a wide rotational speed range by adjusting the frequency and voltage of power supplied to the alternating current (AC) motor driving the pump itself.

When saturated steam is used, temperature and pressure of steam are correlated by thermodynamics and hence, system temperature can be controlled very accurately by controlling the steam pressure to the end-use.

Investment

Low

Savings

Up to 25% energy efficiency improvement

Other benefits

Reduction of Cost
Lower energy tariffs
Better operational management

The Systems Approach

For understanding and evaluating any industrial utility system, the key to cost-effectiveness is to take a "Systems Approach". For a Systems Approach, the user needs to consider the whole steam system rather than investigate just a single component. The general approach for a steam system optimization starts with the establishment of current system conditions and operating parameters followed by an understanding of both the supply and demand sides of the system. The potential areas (projects) for steam system optimization are then identified, analyzed and implemented to meet both the plant operational and financial constraints.

As a final step, the overall system performance is continuously monitored and trended to ensure that as process needs change the system does remain in its optimal configuration.

Steam System and Components

Five main areas should be investigated to identify significant opportunities to improve steam systems.

1. Profiling the steam system

The objectives of this area are to estimate the fuel costs and operating

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characteristics of the facility and to identify improvements in energy efficiency that translate to operational cost savings.

Action items – Steam system profiling

1.1 Determine the total cost of fuel supplied to the boilers (€/year, €/month).
1.2 Determine the unit cost of electricity supplied to the facility (€/GJ).
1.3 Compare the unit cost of fuel to other available fuel supplies.

2. Identifying steam properties for the system

The steam properties of the facility are identified to allow calculations to be performed in latter phases of the analysis.

Action items – Identifying steam system properties

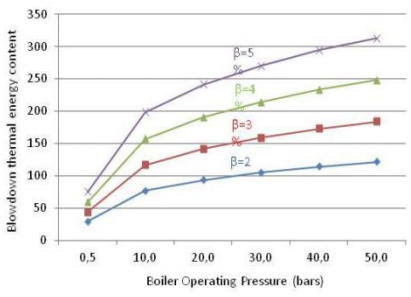
2.1. Determine the properties of the steam generated in the boilers (temperature, pressure, saturated, superheated enthalpy and other thermodynamic properties).
2.2. Determine the properties of boiler feedwater (temperature, pressure, enthalpy).

3. Opportunities for boiler efficiency improvement

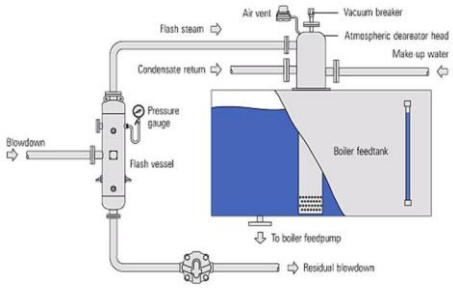
The boiler operation is investigated. This analysis centres on evaluating the fuel-to-steam conversion efficiency of the boiler.

Action items – Boiler efficiency

3.1 Determine boiler efficiency (%)
3.2 Investigate boiler shell for hot spots
3.3 Install economizer and/or air pre-heaters
3.4 Determine boiler blowdown rate (%) of feedwater flow, kg/h).



3.5 Investigate blowdown heat recovery opportunities.



3.6 Monitor flue gas oxygen content (%).
3.7 Monitor flue gas exhaust temperature with respect to boiler load, ambient temperature, and flue gas oxygen content (°C).

4. Effectiveness of resource utilization

The fourth analysis area is concerned with resource utilization throughout the facility. The main concerns in this area are to use the most appropriate fuel, to maintain the proper steam balance throughout the system and to integrate process energy.

Action items – Effectiveness of resource utilization

4.1 Investigate alternative fuels.

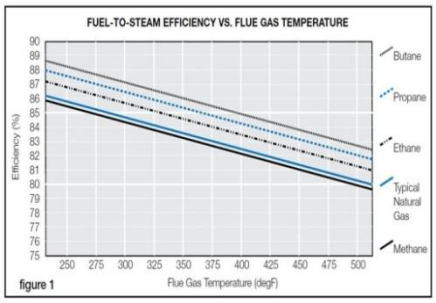


figure 1

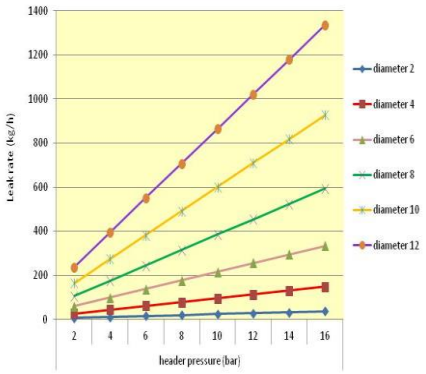
4.2 Monitor steam flow through vents and pressure-reducing stations.
4.3 Investigate the effect of changing the current boiler operating pressure.

5. Steam distribution system losses

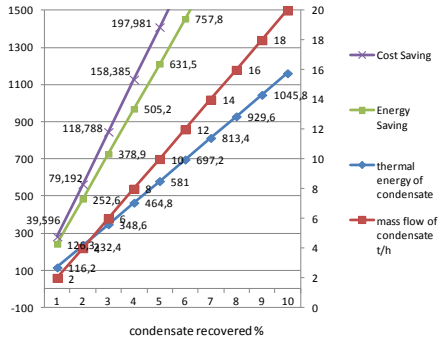
The fifth category investigates the loss of energy throughout the distribution system. The main categories of loss are leaks, insufficient insulation and unrecovered condensate.

Action items – Distribution system losses

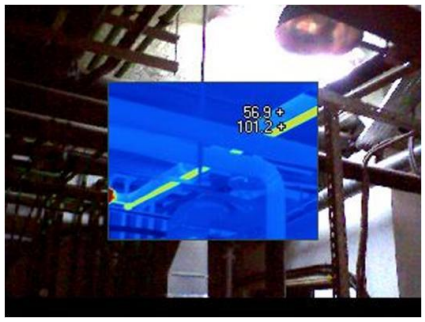
5.1 Find and repair steam leaks.



5.2 Implement a management program of steam traps.



5.3 Investigate potential areas for condensate return.
5.4 Evaluate insulation condition.



5.5 Investigate opportunities to reintroduce flash steam.

Reference

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Co-funded by the Horizon 2020 Programme of the European Union

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