case study

ENERGY SYSTEMS OPTIMISATION in an SME

Klein Karoo International

Steam Systems Optimisation

May 2012

THE ISSUE AND MAIN FINDINGS

Klein Karoo International is located in Oudtshoorn, Western Cape, and manufactures ostrich products. The abattoir produces ostrich meat in frozen raw and freeze cooked form, while the tannery produces ostrich and game hides. Klein Karoo Feathers manufactures all types of ostrich feathers and products such as handbags, clothing accessories and feather dusters.

- The abattoir boilers operate on Low Sulphur Oil (LSO) and provide the thermal energy for hot water cleaning systems, bone meal cooking, and dry cleaning of overalls.
- The tannery plant is provided with steam from the abattoir LSO boilers for hot water thermal requirements, toggle hide drying, and dry cleaning of hides.
- The feathers division plant involves drying and dyeing processes, and steam is provided by a paraffin fired boiler.

The status quo of the plants steam systems were investigated using a Steam Systems Scoping Tool, which is essentially a questionnaire covering the various aspects of the steam system and showcases the main focus areas for potential improvements.

Key findings: after an investment of ZAR 66,500 a saving of ZAR 154,200, with a payback of 0.4 years has been realized. Additional energy saving opportunities were identified that will require longer term investment.

30.9 tons fuel/year
790 m^3/yr of water
97 tons CO_2/yr reduction

ENERGY AND WATER CONSERVATION OPPORTUNITIES IDENTIFIED

ECO1: Control of boiler feed air through automatic control trimming

The boiler feed air is currently automatically controlled through throttling the valve from the forced draft fan. If the air supplied is too low, incomplete combustion occurs (carbon monoxide formation), and if it is too high then the large quantity of excess air extracts thermal energy in the heater flue.

ECO2: Use of heat pumps for 42°C cleaning water

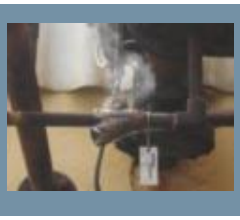
Electrically driven air-to-water heat pumps (with ambient air as the heat source) can be used to generate 42°C hot water requirements for cleaning purposes rather than making use of steam via heat exchangers. The heated water is then stored for usage (existing storage vessels would be used and insulated).

ECO3: Repair condensate leak

The condensate return line adjacent to the Carcass Meal/Rendering business unit of the abattoir exhibited a leak. Repairing the condensate leak near to the carcass meal plant would reduce thermal energy loss in the steam system. The condensate leak was measured to be in the order of 0.2l/min.

ECO4: Condensate return from dry cleaning machines

The condensate from the dry cleaning machines (x2) is currently being discharged to the drain along with its associated thermal energy. Returning this stream to the boiler feed tank would reduce make-up water requirement and improve the efficiency of the steam system.



ECO5: Repair steam leaks

A failed open thermodynamic steam trap at the Tannery represented a leak of 0.4l/min (based on steam leak rate at 8 bar for 3mm hole). The Feathers division dyeing section currently vented out used steam to the atmosphere and this can be diverted for re-use in the boiler via steam traps and condensate recovery.

ECO6: Insulate steam pipelines

A 10 meter portion of the insulation along a 4-bar steam pipeline has been removed and not replaced. The radiant and convective heat loss from an un-insulated steel pipe carrying 4-bar steam is in the order of 590 W/m. Insulation could feasibly reduce the heat loss by 90%.

ECO7: Reduced toggle exhaust airflows

The large toggle has three 0.75kW fans, while the small toggle has one 0.75kW fan. The measured moisture content of the exhaust air was 0.02 kg water per kg dry air, and given optimal conditions for fabric dryers of 0.1-0.15 kg water per kg dry air, the quantity of throughput air can be significantly reduced.

ECO8: Insulate condensate return tank

The boiler condensate return tank is currently not insulated and proper insulation would significantly reduce heat loss in the steam system. The radiant and convective heat loss from an un-insulated steel tank is in the order of 780 W/m2. The tank area is about 24 m2, and hence annual heat loss is 190 250 kWh/year.

Other possible low cost ECOs were identified which were only superficially investigated because of the limited time available for the assessment, and include:

- A high flue gas temperature often reflects the existence of deposits and fouling on the fire and/or water side(s) of the boiler. The resulting loss in boiler efficiency can be closely estimated on the basis that a 1% efficiency loss occurs with every 22.2°C increase in stack temperature.
- The stack gas temperature should be recorded immediately after boiler servicing (including tube cleaning) and this value should be used as the optimum reading. Stack gas temperature readings should be taken on a regular basis and compared with the established optimum reading at the same firing rate. A major variation in the stack gas temperature indicates a drop in efficiency and the need for either air-fuel ratio adjustment or boiler tube cleaning.
- Check all controls frequently and keep them clean and dry.
- Reducing boiler steam pressure if possible, given that the highest pressure is required by the Bone Meal/Rendering plant for meal sterilisation/drying and amounts to 7bar.
- Further improve condensate return quantities.

- Improved monitoring of plant performance.

The following further suggestions are proposed in terms of monitoring aspects:

- Developing a steam balance for both the abattoir and the tannery plant
- Calibrating existing measurement equipment on site
- Using portable instruments for daily investigations in the plant
- Monitoring and plotting/trend reporting of equipment efficiency

IMPLEMENTED SAVINGS MEASURES

ECO/WCO	Capital Cost ZAR	Savings ZAR	Payback Yrs	Environmental Benefit
ECO1: Boiler O_2 Trim Control	30 000	71 700	0.4	• 19 000 kg LSO/year • 59 tons CO_2/year reduction
ECO3: Repair condensate leak	-	2 000	-	• 280 kg LSO/year • 40 m³/yr of water • 1 tons CO_2/year reduction
ECO 4: Boiler condensate return	22 500	35 500	0.6	• 5 000 kg LSO/year • 650 m³/yr of water • 16 tons CO_2/year reduction
ECO5a: Repair steam leaks (tannery)	7 500	23 000	0.3	• 3 900 kg LSO/year • 50 m³/yr of water • 12 tons CO_2/year reduction
ECO5b: Repair steam leaks (feathers)	6 500	22 000	0.3	• 2 700 kg paraffin/year • 50 m³/yr of water • 9 tons CO_2/year reduction
Total	**R66 500**	**R154 200**	**0.4 yrs**	• **30.9 tons fuel/year** • **790 m³/yr of water** • **97 tons CO_2/yr reduction**

ECO2, ECO6, ECO7 and ECO8 are not included in the above table but are intended to be implemented slowly based on available capital funding.