FLIE event – Case Ducor Heat Pump

Royal HaskoningDHV
Enhancing Society Together

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Original heat-supply and water-loop heat-pump design

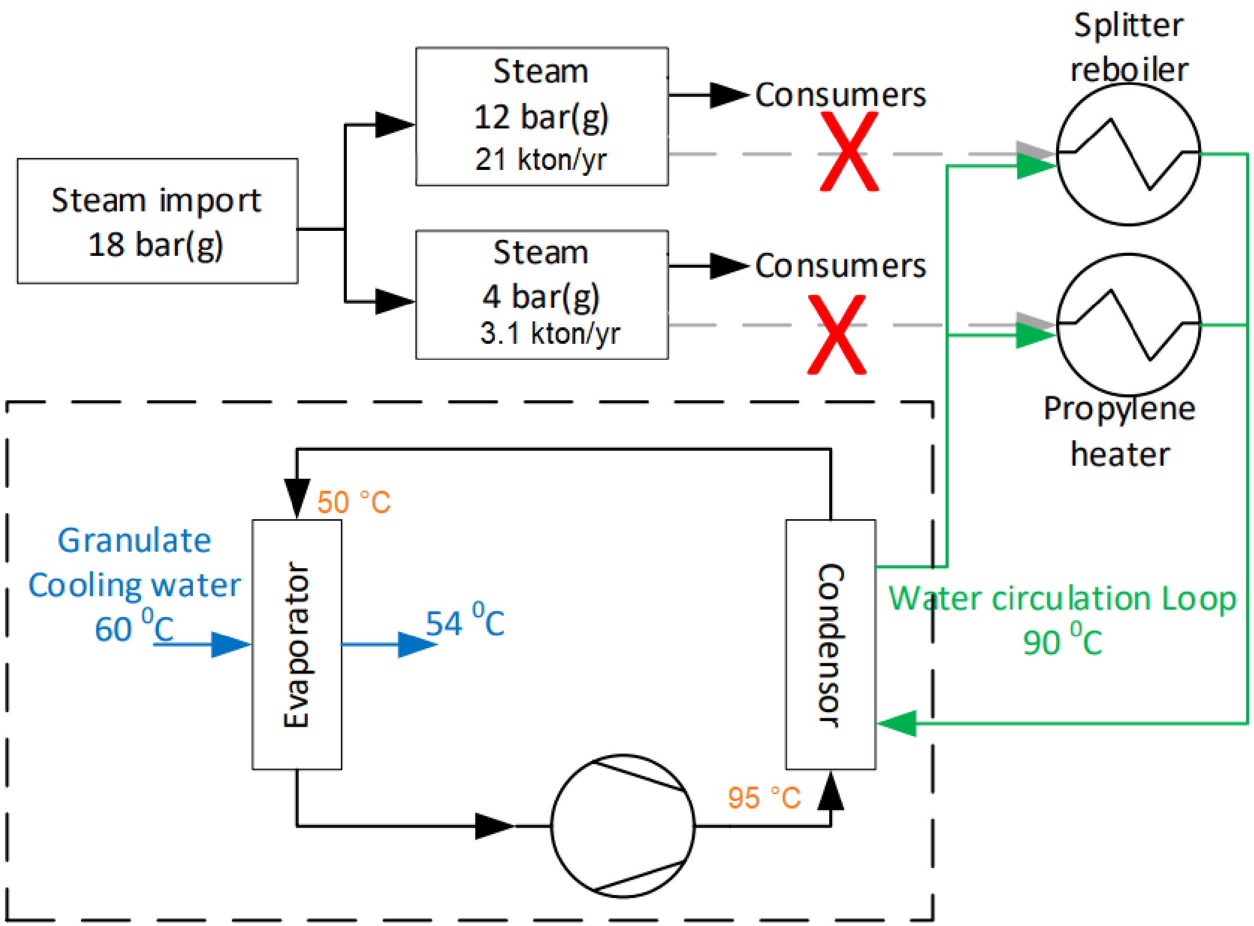


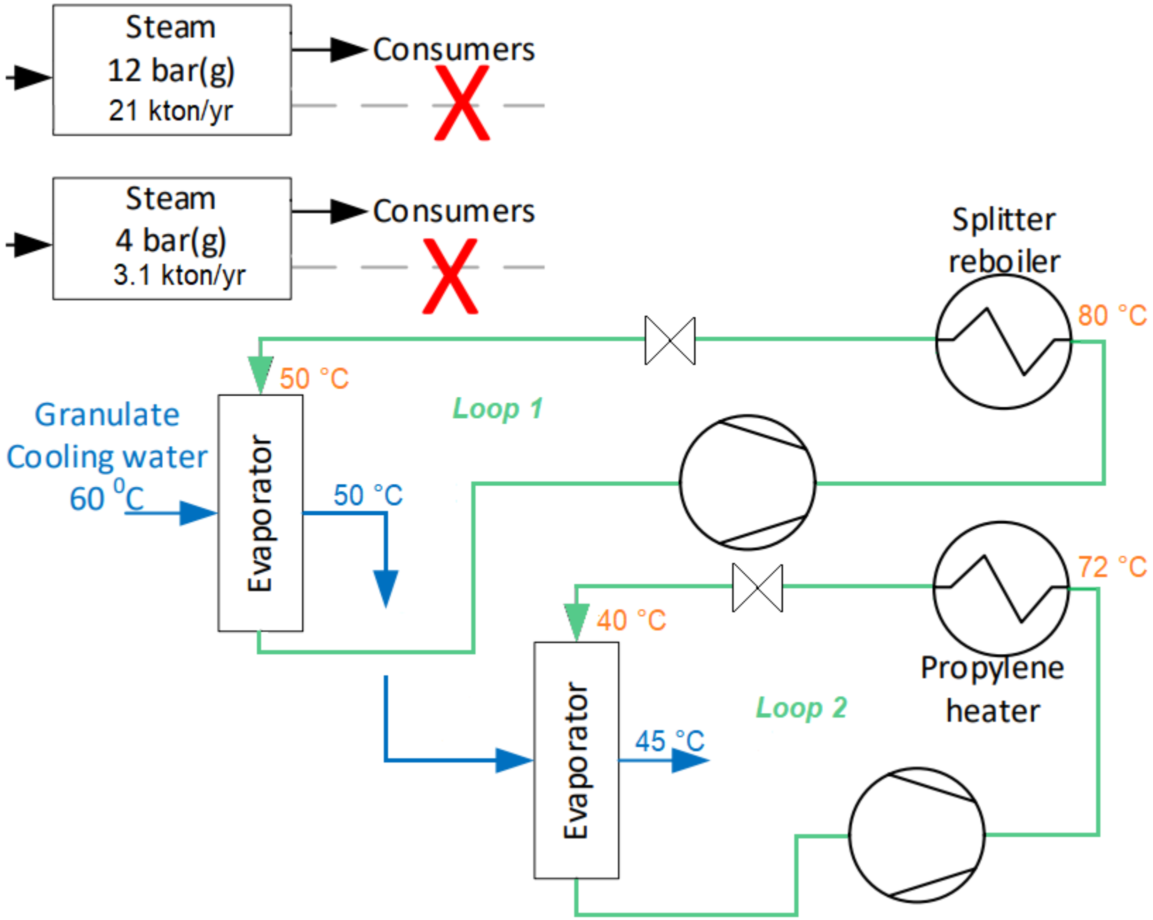
Figure 1 Illustration of proposed heat pump to reduce steam consumption

$T_{HeatSink}$	$T_{HeatSource}$	COP
95 °C	50 °C	**4.1**

<u>Two main challenges:</u>

- COP is relatively low
- Much larger Heat Exchangers required since energy density of condensation is much higher than the energy density of hot water.

Alternative heat-supply and integrated heat-pump design



Loop	$T_{HeatSink}$	$T_{HeatSource}$	COP
1.	80 °C	50 °C	**5.9**
2.	72 °C	40 °C	**5.4**
Weighted average (energy)			**5.7**

Alternative design:

- Elimination of the waterloop by integrating the heatpump systems with the heat exchangers.
- COP 4.1 → 5.7 => 28% less electricity consumption
- Similar size heat exchangers needed compared to existing situation. Therefore less complex modifications required.

Energy cost reduction

Energy consumption	EUR/jr
Cost of current Steam Energy Consumption	1,2 mln EUR/yr
Cost of electric energy consumption of the two heat pumps in alternative design	0,3 mln EUR/yr
Reduction in energy cost	0,9 mln EUR/yr

Investment

Investment of alternative design	Investment (+/- 50%)
Heatpump #1 (0,24 MW) *)	EUR 750.000,--
Heatpump #2 (0,13 MW) *)	EUR 350.000,--
Supporting E&I-systems	Excluded
Supporting Civil, Piping and Mechanical installations	Included but based on rough guestimate
Heat pumps integration with currect exchangers (i.e. propylene heater and splitter reboiler)	Excluded
Total	Difficult to estimate at this stage

*) NB: Heatpump in original design: 0,51 MW = EUR 1,5 mln which is more expensive than two smaller heatpumps

Conclusion

Alternative dual loop heatpump design results in:

- Lower energy consumption

- Lower CAPEX

- Better payback time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Summary of theoretical thermodynamics background