Waste water recovery at Suomen Kerta

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Problem

Suomen Kerta is a candle factory located in Riihimäki, Finland. At the factory they have to contend with an enormous amount of waste water that is created after cooling candles and that is currently discharging all the waste water into the river. The purpose of this thesis is to reduce the water and the energy use in the production process of the candles.

Case description

A) Investigation if Seasonal Thermal Energy Storage (STES) is a possibility to improve the energy efficiency of the process by storing the hot waste water seasonally. Eventually battery storage will be investigated based on the amount of energy from the waste water of the production process.
B) A closed hydraulic circuit is designed to use the waste water from machine a in machine b and to do this as energy efficient as possible by dimensioning the right centrifugal pumps.

Case A

STES when the machines are not operating simultaneously (Figure 1)

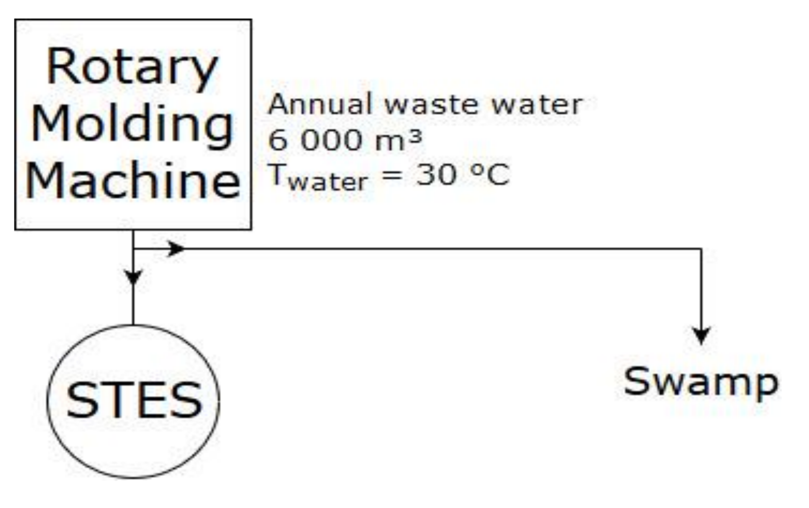


Figure 1: Principle scheme case A

Underground thermal energy storage systems	Aquifer thermal energy storage:	• water at high temperatures required (40 – 70°C), • high installation costs.
	Borehole thermal energy storage:	• water at high temperatures required (70 – 110 °C), • high installation costs.
Above ground thermal energy storage systems	Pit thermal energy storage:	• too cost intensive infrastructure to reach high efficiency at our low temperature application.
	Tank thermal energy storage:	• too cost intensive infrastructure to reach high efficiency at our low temperature application.
	Earth-bermed systems:	• no earth-sheltering storages near the factory to benefit from soil’s thermal property to store waste water.
	Salt hydrate technology:	• not user-friendly enough, • required high water temperatures (52 °C for salt), • too expensive design.
Organic Ranking Cycle (ORC systems):		• useable for power production from low to medium temperature heat sources in the range of 80 to 350 °C.
Domestic heat recovery:		• too many impurities in waste water, • too high installation cost, • too complex to implement in current domestic water circuit.

Case B

Closed hydraulic circuit when the machines are operating simultaneously (Figure 2)

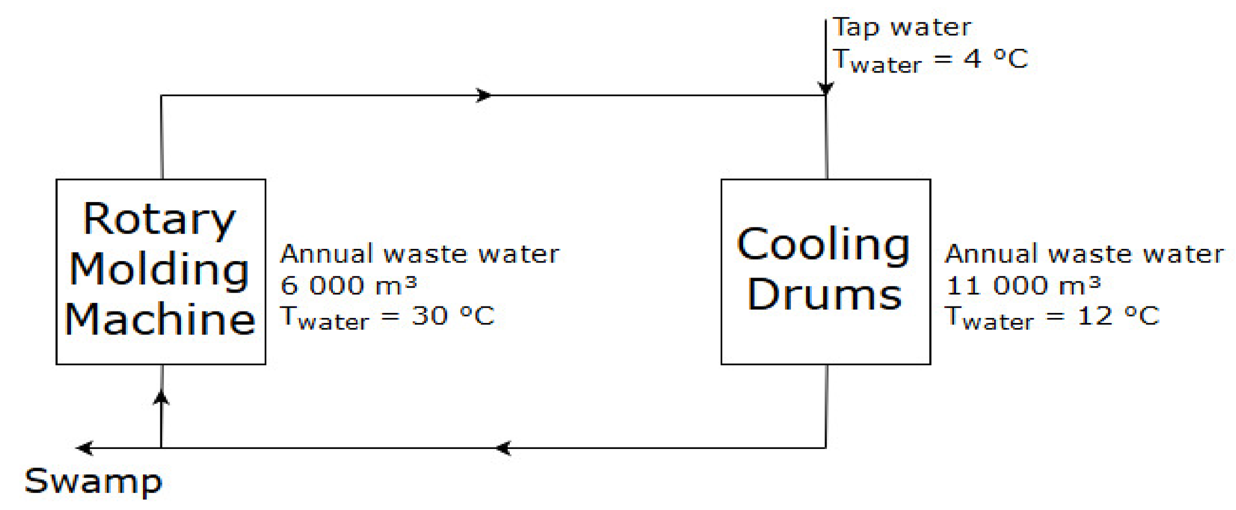
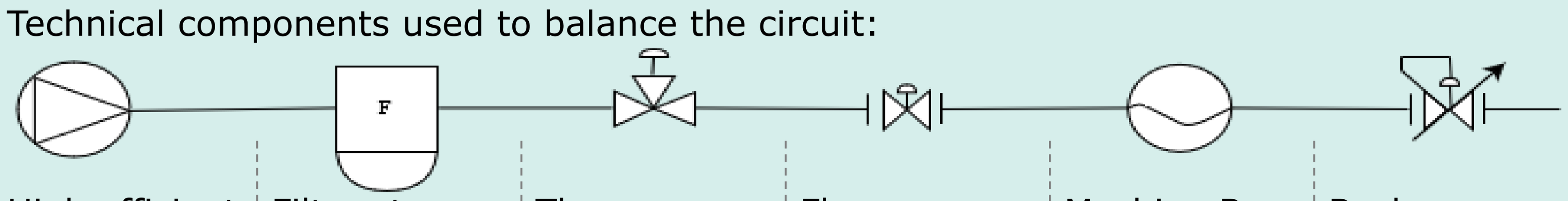


Figure 2: Principle scheme case B

Closed hydraulic circuit to reuse the waste water from machine A (Rotary Molding Machine) in machine B (Cooling Drums) as energy efficient as possible. For proper functioning, the system must be well balanced.

Technical components used to balance the circuit:



High efficient electrically powered centrifugal pump for circulating the water through the system.	Filters to filter the impurities in the waste water (candle wax), which is detrimental to the cooling water.	Three-way valve connects and mixes water flows from machine a (30 °C) with tap water (4 °C) to realize cooling water (12 °C) used in the cooling drums.	Flow regulator maintains a constant flow within a necessary band.	Machine B pulverizes liquid candle material to raw candle material using cooling drums.	Back pressure regulator maintains a defined pressure upstream.

Each component and each pipe has their hydraulic pressure loss.
Total hydraulic loss of the design is = 273 kPa or 27,8 m.
The losses can be compensated using 2 centrifugal pumps connected in parallel and will have an annual electricity cost of € 412,77.

Ability to save 1 643 m³ of waste water each year if the machines are running 1 060 hours at the same time, which corresponds to € 7 361,14.

Conclusion

STES systems will not offer a possible solution (temperature waste water only (30 °C) and the infrastructure for these systems will be too costly. ORC installation will not have a sufficiently high efficiency due to the too low temperature of the waste water. A closed hydraulic system, on the other hand, is cheaper and easier to install and can save up to 1 643 m³ water/year. This will result in water savings, money savings and less environmental pollution since the polluted water is not discharged into the river anymore.

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