Energy-efficient operation of a multi-unit recovery cycle in LENZING AG

LENZING AG operates in Lenzing (Austria) and is the world’s largest fully-integrated viscose fiber production plant with a production capacity over 275,000 t/a. LENZING’s fibers are made from wood: They are botanic products derived from renewable sources and processed with unique resource-conserving technologies. The production of these high-quality viscose fibers is a multi-step chemical-technological process. The key role in terms of energy and resource efficiency within the viscose fiber production belongs to the spinbath recovery cycle. The recovery cycle itself is a sequence of basic procedural operations carried out in several multi-unit networks. Due to its high-energy demand, the LENZING use case within CoPro is focused particularly on the evaporation and heat-recovery networks.

Use Case

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Challenges, Results so far & Outlook

HMI of the Decision-Support System implemented in LENZING

Evaporator load allocation

Problem:

- Find the most energy-efficient load allocation in a network of 29 different evaporation plants which render service to 9 spinbath cycles.
- Production constraints have to be fulfilled.

Results:

- Plants surrogate models from experimental data.
- MIQP real-time optimisation problem formulated.
- Decision-support system for operator developed and used for daily business.
- 1.8% more efficient operation ≈ 250,000 €/y savings

Cleaning scheduling

Problem:

- Schedule the cleaning operations to recover plants efficiency, which suffer from fouling.
- Several cleaning types available to get rid of the fouling effects.
- Overall cleaning capacity is strictly limited.
- Fiber production is continuous, i.e., total evaporation demand per spinbath cycle needs to be kept.

Results & Outlook:

- Databased soft-sensing method developed to measure the fouling state on heat exchangers.
- Experimental models to predict fouling.
- Scheduling algorithm developed: MILP optimisation to find the most energy-efficient cleaning schedule.
- Tested onsite with 5 plants: potential benefit ≈ 25,000 €/y. Extension to the whole evaporation and heat-recovery networks is ongoing.

Cooling water distribution

Problem:

- Find the most efficient cooling-water distribution to the evaporation network.
- 15 different surface condensers divided in 2 connected subnets.
- Fulfil production and environmental regulation (limits on water temperature)
- Fouling affects the heat transfer on the surface condensers.

Results & Outlook:

- Surface-condensers regression models identified.
- NLP real-time optimisation problem formulated.
- Decision-support tool developed and under evaluation.
- Automatic online update of the fouling state.
- 33.6% relative improvement = 200,000 €/y savings

Optimized water distribution (dark blue) VS current operation (light blue)

Gantt plot of an optimal schedule computed for 30 days with 5 spinbath cycles and 23 evaporation plants