

BMA





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Improved energy usage of continuous crystallization with vapor re-compression

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Without explanations, the information in this document is incomplete.



Improved energy efficiency of a beet sugar factory



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- Reduction of CO₂ emissions
- Mechanical vapor re-compression
- Energy demand of a beet sugar factory
- Beet sugar factory with MVRs: calculation examples
- Summary



Reduction of CO₂ emissions – alternative fuels



- **CO₂ emissions mainly due to the burning of fossil fuels (coal, gas, oil, coke)**

- **Measures to reduce the CO₂ emissions in a beet sugar factory**
 - Biomethane
 - Electrification with renewable energy sources
 - Biomass as fuel (e.g., wood pellets, bagasse)
 - Optimized steam demand (optimized heat balance, use of new technologies)
 - Alternative primary fuel (e.g., green hydrogen)

- **Replacement of fossil fuels with a single measure is not plausible**
 - Reasons: availability and costs

- **ASSBT 2023 presentation: “Improved energy efficiency in the sugar house”**
 - First measure in the reduction of fossil fuel utilization is the electrification of the sugar house
 - Focus was just on the sugar house, hence full picture for the sugar beet factory mandatory



Mechanical vapor re-compression for crystallization



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■ Continuous pans W and HR product operating with MVRs

- LR-VKT heated with surplus steam from MVRs
- Seed (batch) pans on steam from evaporators

■ Steam demand of sugar house is reduced by use of MVRs

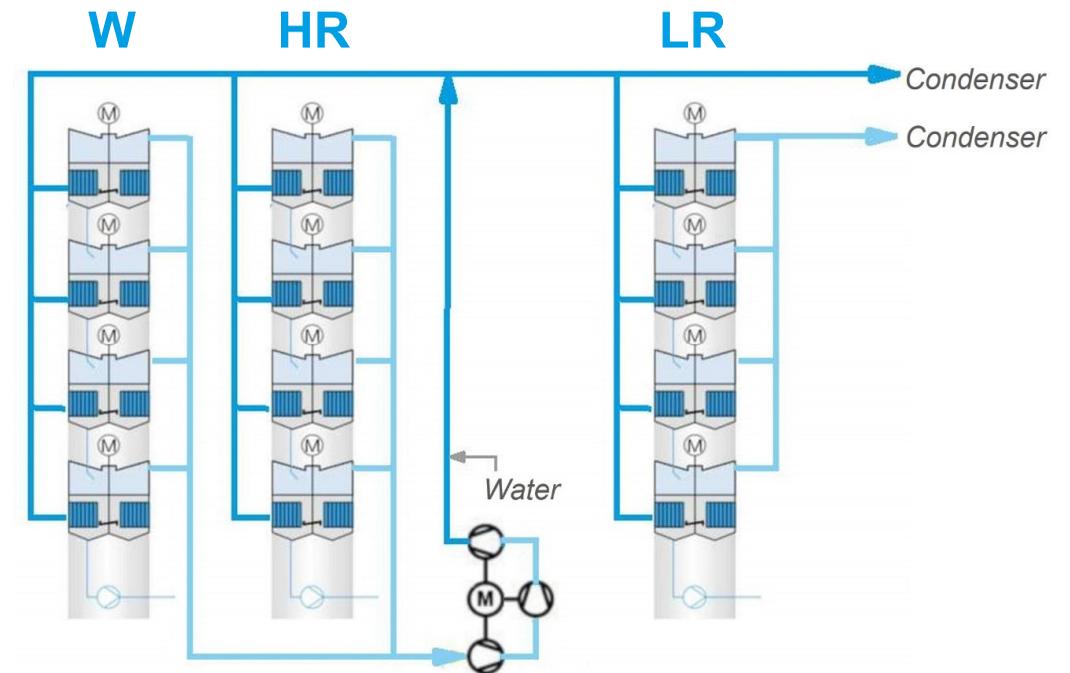
- from 11.8 to 2.7 % o.b.

■ Electrical energy required for MVR operation in the sugar house

- 6.1 kWh_e/sht beet

■ Implementing MVRs in the sugar house reduces vapor utilization in the evaporator station

■ The evaporator station must be adapted to cope with the reduced steam demand of the sugar house



Additional information: Brunner HR et. al. (1992) Energy engineering and heat economy of the Aarberg sugar factory. Zuckerind. 117, 454-458

Mechanical vapor re-compression for evaporation



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■ Questions:

- How are the MVRs used in the evaporator station?
- What is the final energy demand of the entire beet sugar factory?

■ Case study

- Comparison of various arrangements of MVRs in the evaporator station with the base case

■ Measures

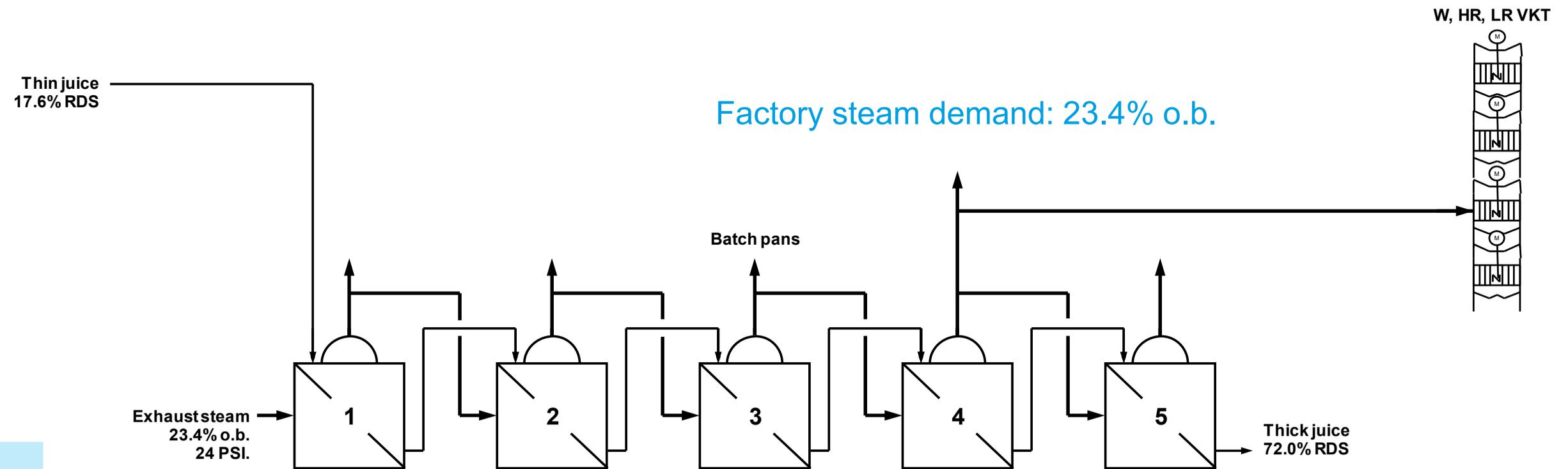
- Installation of two **pre-evaporators** operating with MVRs
- 6-effect **falling-film evaporator station**
- Reduced **raw juice draft**
- Increased **thick juice dry substance content**



Evaporator station w/o MVRs: base case



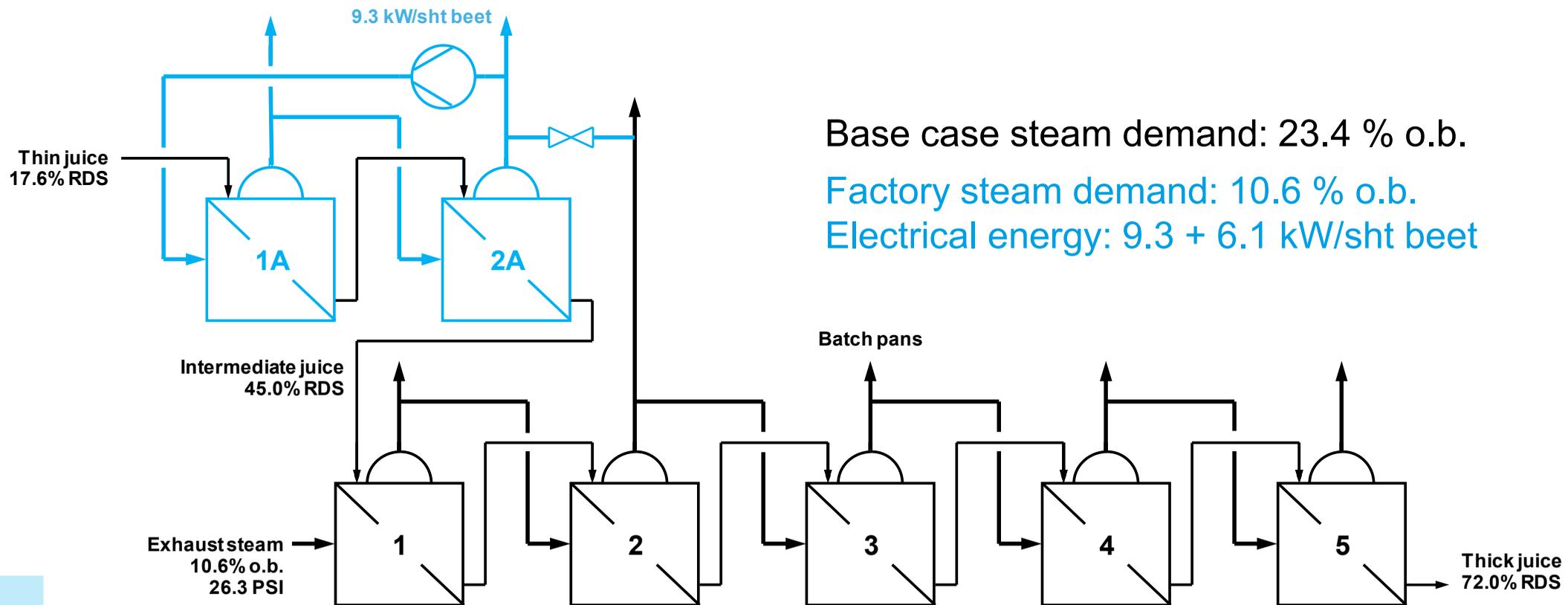
- Extraction: fresh beets – 110 % o.b. raw juice draft
- 5-effect falling-film evaporator station
- Thick juice: 72% RDS
- Seed batch pans for W, HR and LR product on vapor 3
- Continuous crystallization for W, HR and LR product on vapor 4



MVR for evaporator station – case A

■ Modifications from base case:

- MVRs in the sugar house
- Installation of two **pre-evaporators** operating with MVRs

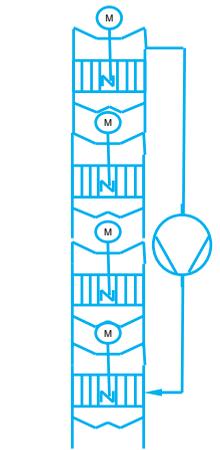


Base case steam demand: 23.4 % o.b.

Factory steam demand: 10.6 % o.b.

Electrical energy: 9.3 + 6.1 kW/sht beet

W, HR, LR VKT

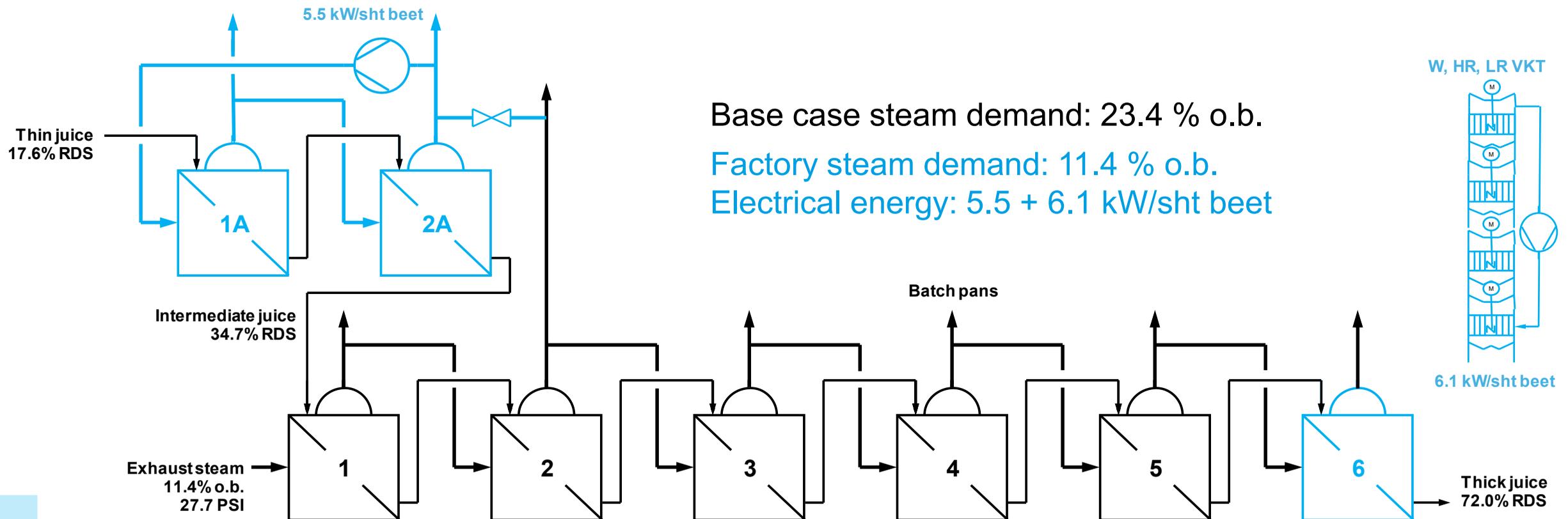


6.1 kW/sht beet

MVR for evaporator station – case B

■ Modifications from case A:

- 6-effect falling-film evaporator station instead of 5-effect



Base case steam demand: 23.4 % o.b.

Factory steam demand: 11.4 % o.b.

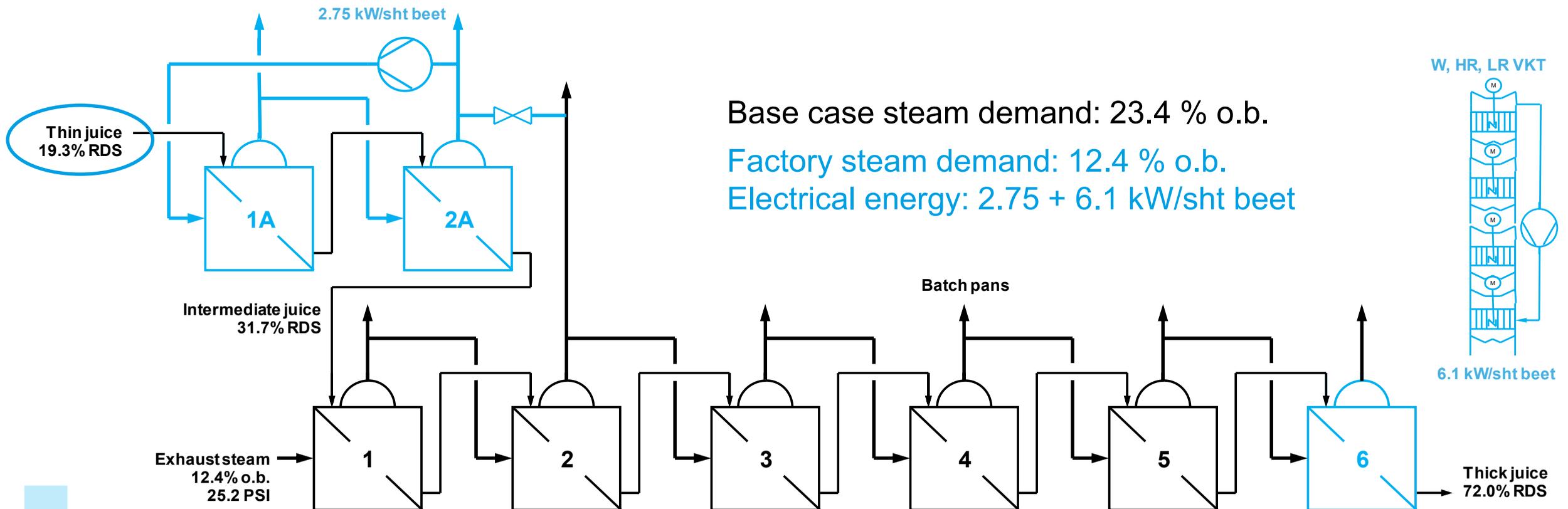
Electrical energy: 5.5 + 6.1 kW/sht beet



MVR for evaporator station – case C

■ Modifications from case B

- Reduced **raw juice draft**: 100 % o.b. instead of 110 % o.b.
- Increased thin juice dry substance content: from 17.6 to 19.3 % RDS



MVR for evaporator station – case D

■ Modifications from case C

- Increased **thick juice dry substance content**: from 78 % RDS to 72 % RDS
- Reduced steam and energy demand in the sugar house

