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Chaleur Solaire pour les Procédés dans l'Industrie
Etudes de Cas

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Institut de génie thermique

Introduction

Case studies goals

Evaluating the integration of a solar heating system based on conventional systems in a existing heat process system

- High potential of duplicity and standardization
- Help in the decision to invest
- Implementation

2 case studies

- Pharmaceutical industry : Case study 1 located in Bulle (FR) and case study 2 located in St-Prex (VD)
- Chosen according to various criteria : Energy consumption, temperature level processes, expected payback period,
- Connection at process level → decided with the companies

Case study 1

Solar system – Integration, regulation and sizing

5 processes to be connected

- Low temperature consumers
- Ease of implementation

Goal for the company

1- Substitute steam consumption for low-temperature processes
2- Be competitive with the price of gas (60 CHF/MWh)

Case study 1

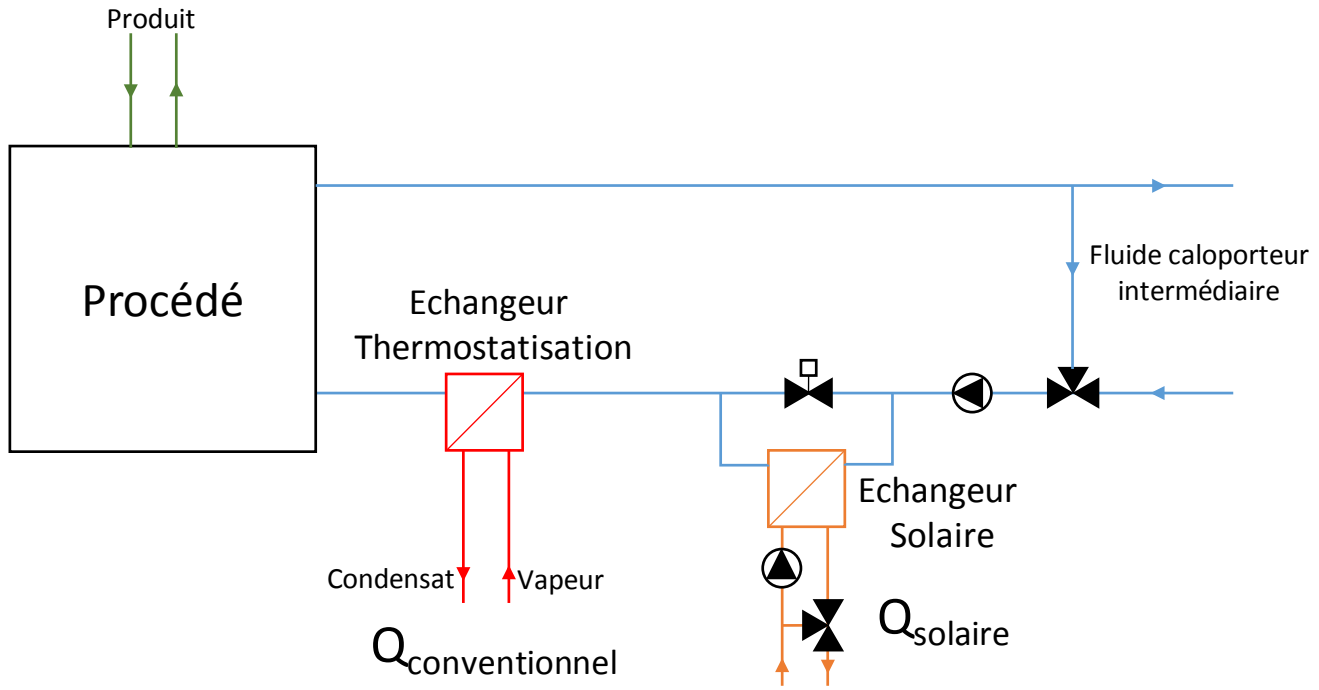
Solar system – Integration, regulation and sizing

5 processes to be connected

- Low temperature consumers
- Ease of implementation

Solar system for preheating

- Robust and efficient
- High potential of duplicity
- Increase energy production



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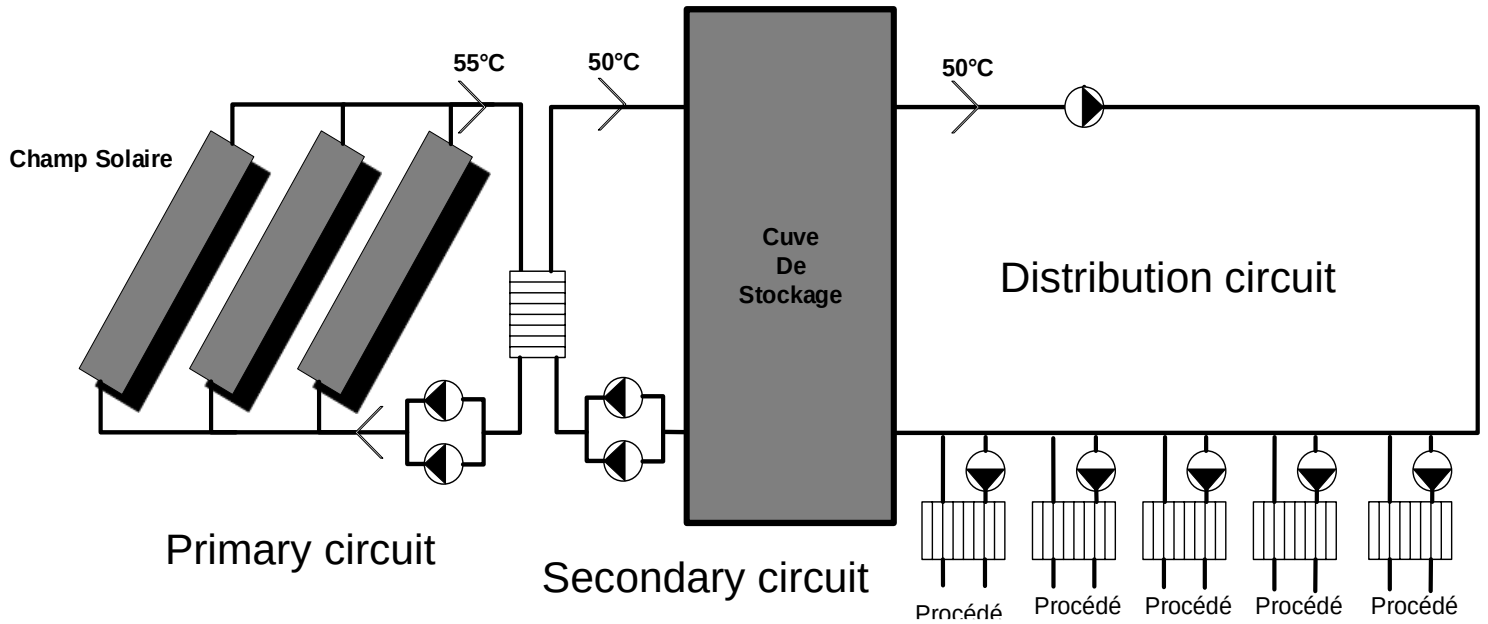


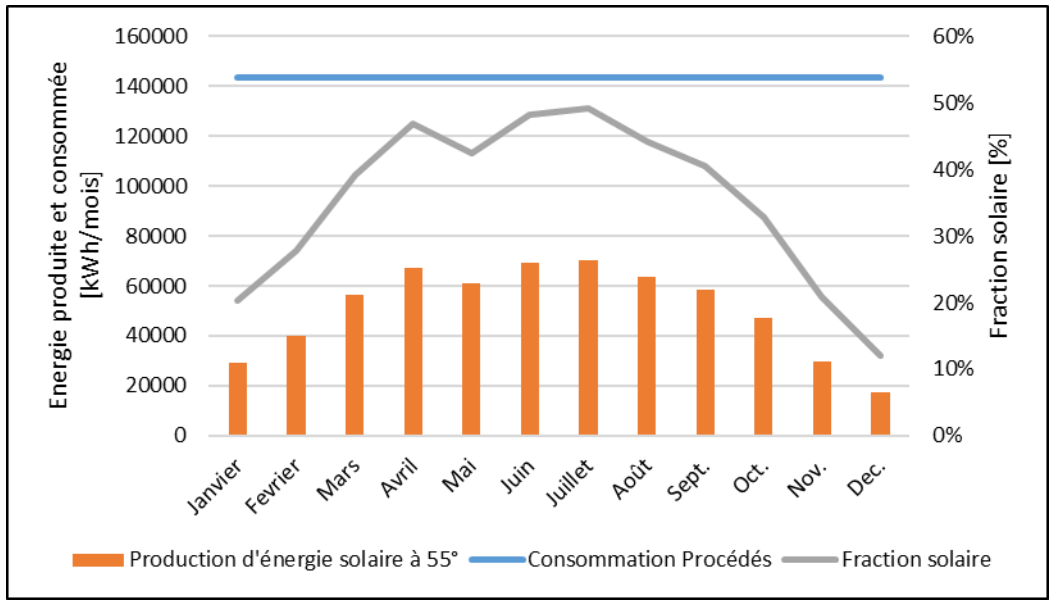
Solar system characteristics

- 1000 m² solar field ; 50 m³ water tank storage
- Solar energy production at 55°C

Case study 1

Solar system – Energy production

Solar energy production Solar field 1000m², Storage tank 50m³		
Solar resource on the collectors plane	Total	1’355 MWh/an
	Per m² of collector	1’399 kWh/m²/an
Yearly production	Total	609 MWh/an
	Per m² of collector	629 kWh/m²/an
Solar system efficiency		41 %
Solar fraction		35 %



- Equivalent to 690 MWh of gas saved (η=88%) → 175 tonnes of CO_{2_eq}

(96.-/TCO_2) → 16.8 kFrs

- Better productivity obtained with the offers received → up to 820 MWh/an

Case study 1

Solar system – Quotation and economic calculation

- 5 quotations obtained for the primary and secondary circuits (equipment, installation and commissioning)
  - → Price range: 602’000 CHF à 1’350’000 CHF
  - → Estimated energy production: 577 MWh/an à 820 MWh/an

- CAPEX : 1’100’000 CHF
  - → Site preparation (20’000 CHF), primary and secondary circuit (739’000 CHF), distribution circuit (234’300 CHF), engineering (19’500 CHF), miscellaneous expenses 8% (82’000 CHF)

- OPEX : 10’400 CHF
  - → Electrical consumption, maintenance and supervision costs
  - → Around 1% of the initial investment value

Case study 1

Economical results

Considerations

- Discount rate 3%
- No CO_2 tax
- No subsidy
- Lifetime of 25 years

Energy costs of the solar thermal system
76 CHF/MWh to 128 CHF/MWh

↳ Ref. price : Gaz (60 CHF/MWh)

Subsidies, a way to reduce to energy costs of the solar system

- 200'000 CHF of subsidies → around 20% of the CAPEX

↳ Energy costs of the solar thermal system
64 CHF/MWh to 111 CHF/MWh

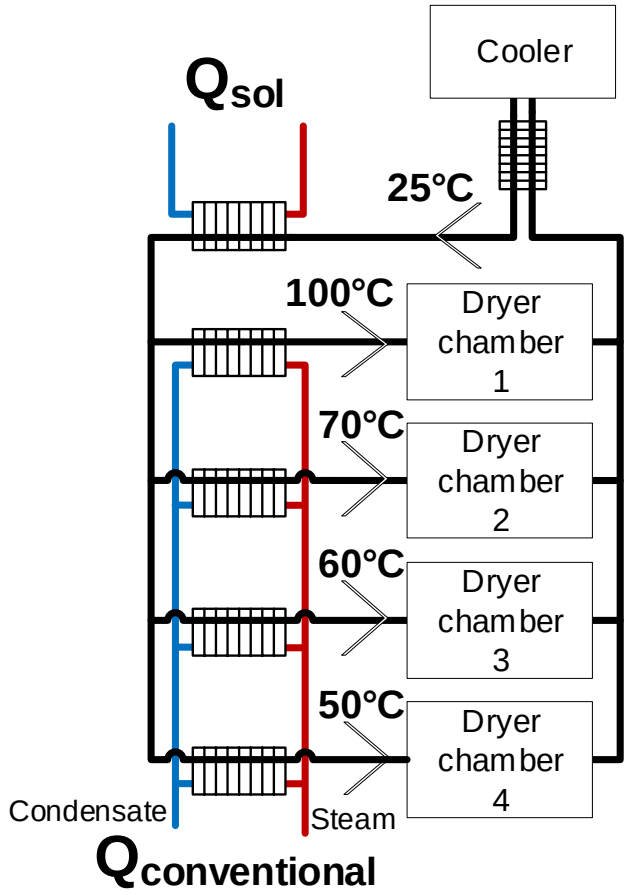
Case study 2

Solar system – Integration, regulation and sizing

1 process selected

- Air drying process

Same integration and regulation concepts as the first case study



Case study 2

Solar system – Integration, regulation and sizing

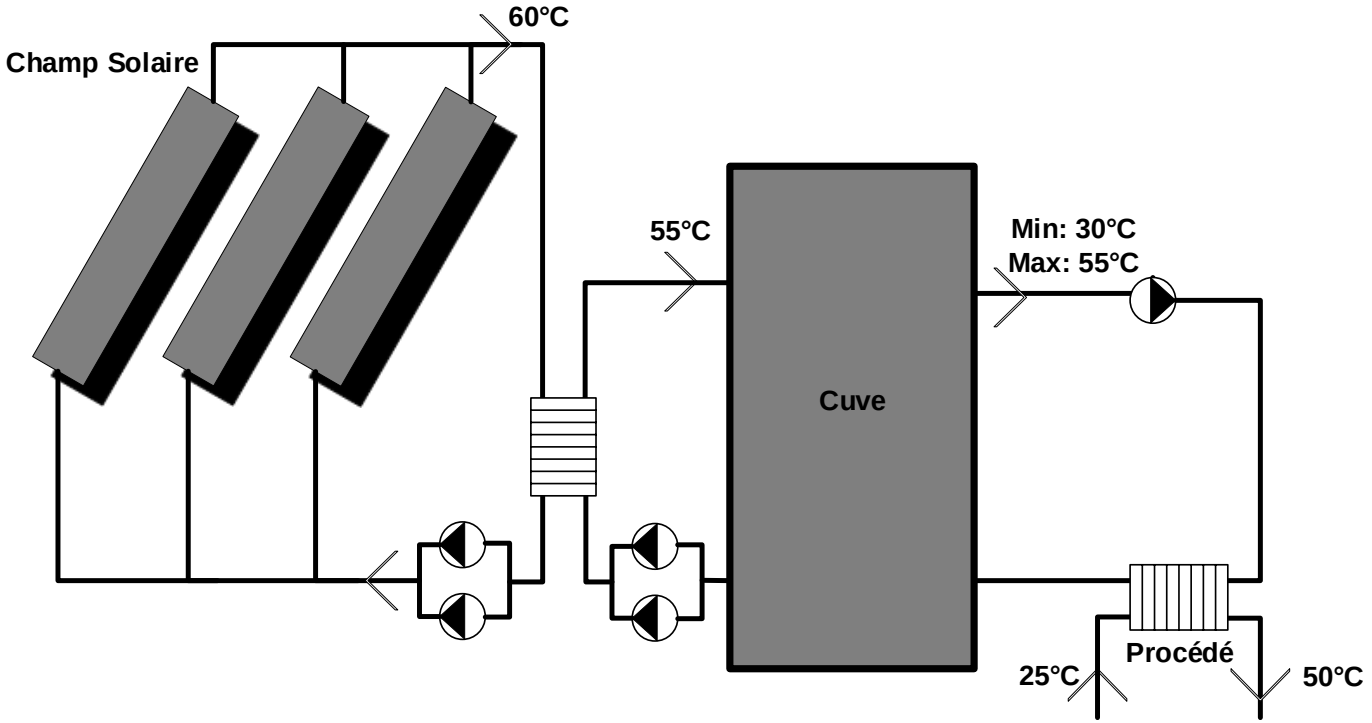
1 process selected

- Air drying process

Same integration and regulation concepts as the first case study

Solar system characteristics

- Solar energy production at 60°C



Case study 2

Solar system – Technical and economical aspects

Request for quotation

- Constraints: Limited available area 1400 m² ; Storage capacity 50 litres/m² of collectors
- Different size, price and energy production

Techno-economical study made using the same methodology as for the case study 1

Solar System	System 1	System 2	System 3
Solar field (net surface)	608 m²	531 m²	695 m²
Storage capacity	30 m³	28 m³	35 m³
Annual energy production	495 MWh/years	414 MWh/years	538 MWh/years
Cost of the energy produced	98.1 CHF/MWh	95.6 CHF/MWh	89.4 CHF/MWh

Conclusions

Techno-economic indicators	Case study 1	Case study 2
Solar collector field Storage tank capacity	1000 m² 50 m³	611 m² 30 m³
CAPEX	1’100’000 CHF	770’000 CHF
Annual energy production	715 MWh/years	482 MWh/years
LCOH Cost of the energy produce	76 CHF/MWh to 128 CHF/MWh Average → 94.4 CHF/MWh	89 CHF/MWh to 98 CHF/MWh Average → 94.3 CHF/MWh

Others advantages

- ✓ Fixed cost of solar energy over the next 25 years
- ✓ Energy efficiency and CO2 reductions
- ✓ Positive corporate image

Ways of improvement

- ✓ Subsidies mechanism
- ✓ Contracting
- ✓ Standardization

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Merci pour votre attention

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