Experiences with Industrial Solar Process Steam Generation in Jordan

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Solar Field at RAMPharma, Amman

- Solar field: linear Fresnel collectors of Industrial Solar GmbH
- Supply of saturated steam at 6 bar gauge
- Start of operation: March 2015

Collector field and steam drum with piping to steam network
Solar Field at RAMPharma, Amman

General design, SD only
Experience of Operation with SD

7th of April 2015
Experience of Operation with SD

- Reliable operation
- No negative interference with conventional steam supply
- Solar steam supply often higher than demand
- SD function as Ruth storage works well by supplying steam in a pressure range from 7 bar$_g$ to 14 bar$_g$
- High concentration of minerals in steam drum
  => need for blow down more often
- High pH values can damage components
  => choose accordingly
Cyclone at RAMPharma, Amman

- SolSteam project: test of alternative separator
- Motivation: save investment costs
Solar Field at RAMPharma, Amman

Solar Field

Recirculation Pump

EPD I-96

LT I-98

EPD I-97

V-54

V-57

V-58

V-68

V-67

CL-2

V-64

V-61

Customer steam network

Feed water tank

Steam drum

<16 bar_g

2000 l; l=2.6m; d=1.1m

P&ID with cyclone
Solar field at RAM Pharma, Amman

Instrumentation to control the water level in the piping below the cyclone
Solar field at RAMPharma, Amman

Manual control of condensate level during cyclone operation
Conclusions

Operation along steam drum:
• Works well
• Stabilizes operation
  ➤ Solar steam supply constant even at strong variations in demand

Operation along cyclone:
• Manual control works
• Automatic control will be implemented
• Fast control needed