Solar cooling technologies: state of the art and feasibility in the hotel branch

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La promotion du solaire thermique et de l’efficacité énergétique dans le secteur hôtelier
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How does solar cooling work?

Thermal driven cooling process

heat

chilled water

conditioned air
How does solar cooling work?

- **SOLAR COLLECTOR**: driving heat at high temperature, \( T_H \) (i.e. 90 °C)
- **COOLING MACHINE**:
- **ENVIRONMENT, E.G. COOLING TOWER**: heat rejection at intermediate temperature, \( T_M \) (i.e. 30 °C)
- **USEFUL COOLING**: low temperature, \( T_C \) (i.e. 7 °C)
- **AIR-CONDITIONING SYSTEM**

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Available technologies

Open cycles – Dessicant
Evaporative Cooling
systems with silica gel

Absorbtion chillers
- LiBr/water, LiCl/water or ammonia/water
- single or double effect

Adsorbtion chillers
- silica-gel / water & zeolite
Some products on the market

- SorTech AG
- ClimateWell
- EAW
- YAZAKI
- Invensor
- SK SonnenKlima GmbH
Pavia (Italy) – elderly house

Collector area: 230 m²
Absorption chiller – 70 kW_{fr}
Chilled water temperature: 7 °C

Source: Kloben
Dalaman (Turkey) - hotel

Place: Dalaman (Turkish mediterranean sea coast)
Parabolic trough collectors with 180 m² aperture surface for production of 180°C hot water
2-stage absorption cooling machine with 116 kW cooling power rating (4 bar saturated vapour; COP > 1.2)

Cooling of a Hotel and Steam delivery for Hotel laundry
Backup-Steam boiler operated with liquid gas

▶ First application with 2-stage cooling machine
▶ High efficiency
▶ Interesting concept for sites with high direct irradiation

Source: Fraunhofer ISE
Heemstede (Netherlands) – Office building

Solar DEC

Collectors: 77 m² (flat-plate)
Manufacturer: ZEN (NL)
Frigorific power: 40 kWf
Air flow: 8,500 m³/h
Solar cover: 36%
Regeneration temperature: 65°C
Hotel owners point of view: why solar cooling?

- Because chilled water or chilled air distribution system are quite common in hotels (not in domestic households)

- Because Tunisian hotels’ energy needs match very well with solar cooling:
  - Long cooling season
  - Long cooling load along the day
  - Significant domestic hot water loads along the year

- Because all cold distribution systems can be integrated with solar
  - Ab-adsorption if chilled water network available
  - DEC if chilled air network available

- All collector types can be used: flat plate, evacuated tube, concentrating

- Because hotels have as well high energy needs for hot water, which can be easily produced with solar, e.g. on heat rejection side
The policy point of view: why solar cooling?

- Because cooling is becoming more and more necessary due to higher comfort requirements and to climate change.
- Because solar cooling is one of the very few available technologies for producing renewable cooling.
- Because solar radiation matches cooling needs.
- Because solar cooling helps reducing peak power loads on electricity network.
- Because solar cooling components can be largely manufactured locally (solar collectors, piping, heat exchangers, tanks).
- Because the solar market is already well developed in Tunisia (manufacturers, installers, subsidy mechanisms...).
Task 48 is a research task under the framework of Internationa Energy Agency program for Heating and Cooling

Finding solutions to make solar thermally driven heating and cooling systems efficient, reliable and cost competitive through four levels of activities:

- Development of tools and procedures to characterize the main components of solar air-conditioning systems.
- Creation of a practical and unified procedure, adapted to specific best technical configurations.
- Development of quality requirements targets—prescriptive and performance based.
- Production of tools to promote solar thermally driven cooling and heating systems.

Politecnico di Milano – Italy’s largest technical university – has been involved in solar cooling since 2004, designing, realising and monitoring several systems in Italy, Tunisia and Morocco.
Thank you for your attention