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Development of Solar Assisted Sorption Unit for Extraction of Water from Ambient Air in the Dessert Climate

Tomas Matuska[1], Vladimir Zmrhal[2] and Borivoj Sourek[1]

[1)] University Centre for Energy Efficient Buildings, Czech Technical University in Prague

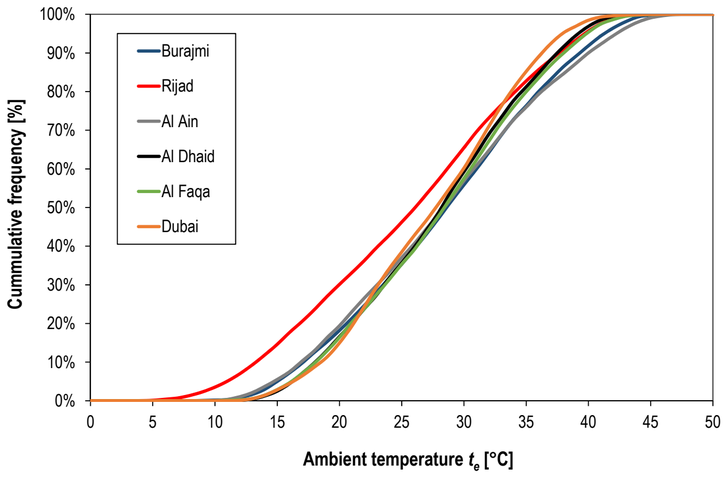
[2)] Faculty of Mechanical Engineering, Czech Technical University in Prague

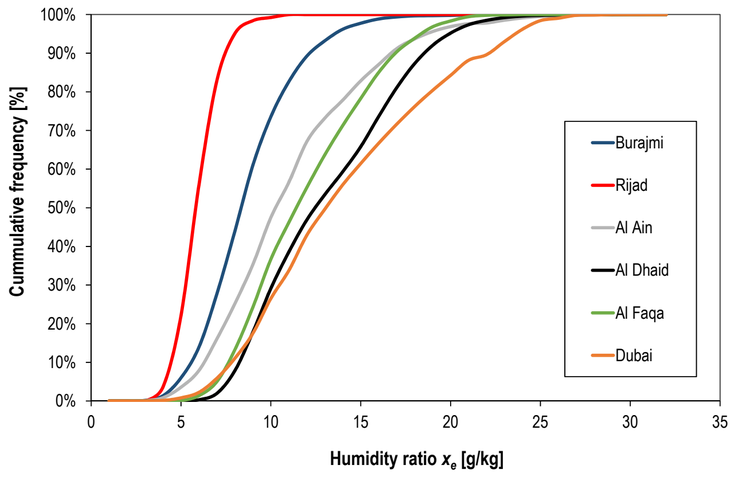
tomas.matuska@fs.cvut.cz

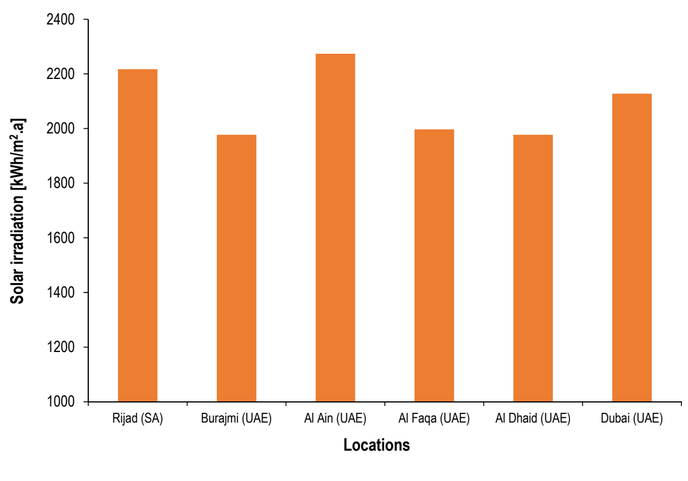
Autonomous unit for extraction of the water from the desert air fully powered only from solar energy resources is an ambitious challenge and subject of development at Czech Technical University in Prague.

Climate conditions

Solar assisted adsorption unit is developed for climate conditions of dessert at Arabian Peninsula which exhibits high ambient temperatures and very low humidity ratio values during the year, but on the other hand also high solar irradiation levels.



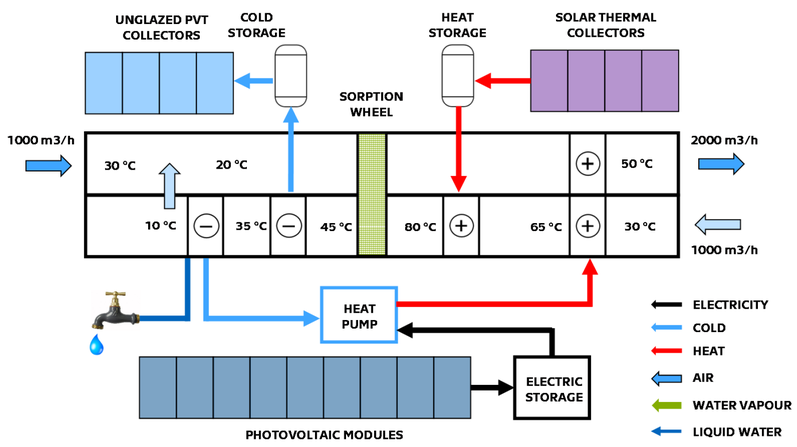




Technology

Core of the system for extraction of the water from desert air is the adsorption unit equipped with a rotary desiccant wheel and integrated refrigerant cycle. To operate the unit autonomously in the desert environment, only available renewable energy sources could be used. Speed controlled compressor will be driven by electricity from the photovoltaic modules coupled with battery storage. Heating of process air in case of insufficient temperature of regeneration air at output from condenser will be provided by solar thermal collectors coupled with thermal water storage tank. Heat removal from precooling heat exchanger will be realized by night radiant cooling (to clear sky, low ambient temperatures) by unglazed PVT collectors in combination of the storage of night cold.

Adsorption unit in test chamber

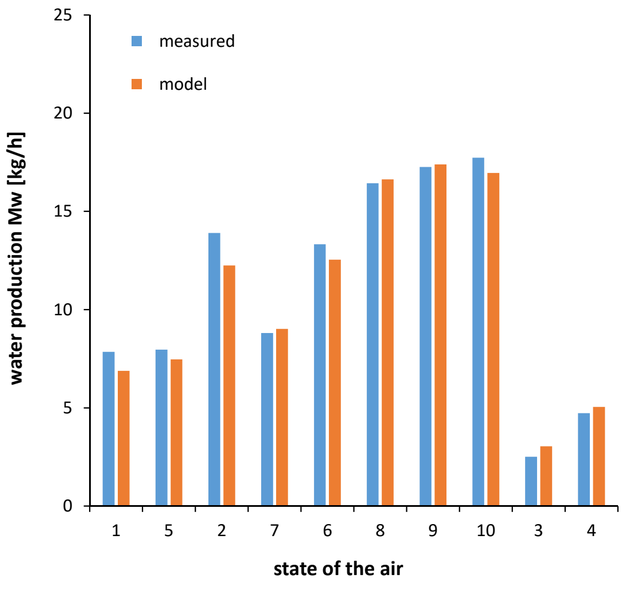


Scheme of system

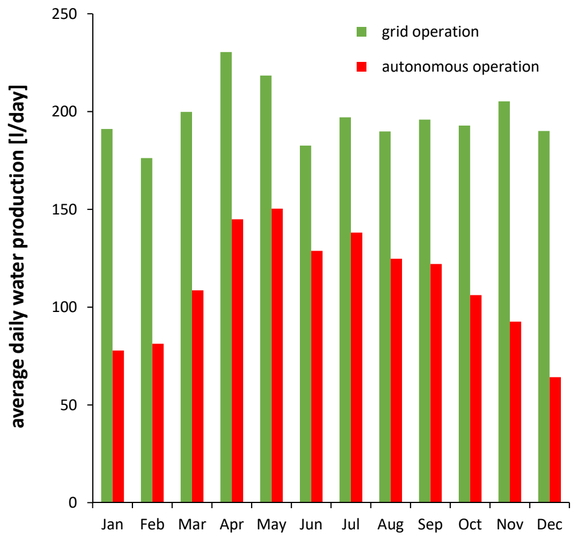
Unglazed PVT tested for night cooling

Results and conclusion

The adsorption unit has been built and tested in laboratory and existing theoretical model describing the behaviour has been further developed. The system concept of the autonomous unit has been developed with use of renewable energy sources available in the desert climate. First calculations of potential water production for the developed unit with air flowrates 2000 / 1000 m³/h has been performed. The initial target for production 100 litres of water per day on the average can be achieved even in extreme climate of Rijad.



Validated model of adsorption unit



Simulation of water production

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