Company outline

- Founded in 2000, Pioneer of the 'Cooling Kit' solution
- Specialist for system solutions & systems integrator in the field of thermal cooling
- Design, engineering and sales as well as maintenance of thermal cooling solutions from 3 RT to 3,000 RT (10 kW to 10 MW) cooling capacity
- more than 100 systems realised worldwide
- ISO 9001 certified
- Continually awarded by the Stifterverband for R&D since 2014

Headquarter at Bernau am Chiemsee
From Heat → Cooling

thermal cooling - with chillii® technology
## Compression chiller vs. Absorption chiller

<table>
<thead>
<tr>
<th></th>
<th>Compression chiller</th>
<th>Absorption chiller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerant</td>
<td>Mainly HFCs (Hydrofluorcarbons)</td>
<td>Water with LiBr or NH3 as absorbents</td>
</tr>
<tr>
<td></td>
<td>now also CO2 (only small capacity)</td>
<td></td>
</tr>
<tr>
<td>Cooling capacity</td>
<td>1 kW – 20 MW (per module)</td>
<td>18 kW – 10,000 kW (per module)</td>
</tr>
<tr>
<td></td>
<td>0.3 RT – 5,700 RT (per module)</td>
<td>5 RT – 2,850 RT (per module)</td>
</tr>
<tr>
<td>Chilled water temp.</td>
<td>-40°C to +20°C (flow temperature)</td>
<td>+4°C to +20°C (LiBr-chiller)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-20° to +20°C (NH3-chiller)</td>
</tr>
<tr>
<td>COP (th)</td>
<td>0.65 – 1.5</td>
<td></td>
</tr>
<tr>
<td>COP (el)</td>
<td>2 - 5</td>
<td>15 - 20</td>
</tr>
</tbody>
</table>
Advantages of absorption chillers compared to compressor-based cooling systems

- less electricity consumption ( > 75% of savings regarding electricity costs)
- lower operating costs (because of very few mechanical components)
- non-usage of refrigerants as CFCs and HCFCs for cooling that are typically associated with ozone layer damaging greenhouse gas emissions
- lack of issues related to mechanical vibrations
- stable coefficient of performance (COP)
- easy maintenance and longer life time
- environmental-friendly solution
## Basis of the adsorption and absorption chiller

<table>
<thead>
<tr>
<th></th>
<th><strong>Adsorption chiller</strong></th>
<th><strong>Absorption chiller</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical cooling effect</strong></td>
<td>Evaporation of refrigerant (vapour compression cycle)</td>
<td></td>
</tr>
<tr>
<td><strong>Compression principle</strong></td>
<td>Thermal (Adsorption of water vapour)</td>
<td>Thermal (Absorption cycle)</td>
</tr>
<tr>
<td><strong>Driving energy</strong></td>
<td>Thermal energy 55°C - 95°C</td>
<td>Thermal energy 70°C - 95°C</td>
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<tr>
<td><strong>Refrigerant</strong></td>
<td>Water with solid adsorbents (silica gel, zeolith)</td>
<td>Water with LiBr or NH3 as absorbents</td>
</tr>
<tr>
<td><strong>Cooling capacity</strong></td>
<td>8 kW - 500 kW (per module) 3 RT - 150 RT (per module)</td>
<td>18 kW - 5,000 kW (per module) 5 RT - 1,500 RT (per module)</td>
</tr>
<tr>
<td><strong>Chilled water temperatures</strong></td>
<td>+6°C to +20°C (flow temperature)</td>
<td>+4°C to +20°C (LiBr-chiller)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-20° to +20°C (NH3-chiller)</td>
</tr>
<tr>
<td><strong>COP (th)</strong></td>
<td>0.5 - 0.65</td>
<td>0.65 - 0.85</td>
</tr>
<tr>
<td><strong>COP (el)</strong></td>
<td>8 - 10</td>
<td>10 - 20</td>
</tr>
</tbody>
</table>
System principle of a single-effect absorption chiller
Heat sources for sorption cooling

CHP - Cogeneration

Solar thermal system

Waste heat from compressed air

Process heat

ORC technology
Waste heat from condenser

Adsorption and absorption technology

Cooling
chillii® Cooling Kit – Suitable Heat Exchanger

Adsorption Cooling Systems

Absorption Cooling Systems

thermal cooling - with chillii® technology
chillii® Cooling Kit – Adiabatic Recooling

thermal cooling - with chillii® technology
How to distribute chilled water?

Cold water distribution

- Fancoil
- Cooling ceiling
- Cooling surface
- Cooled floor
- Concrete core cooling

Cold water temperatures °C

7/12 10/15 15/18 17/20 19/22

thermal cooling - with chillii® technology
Installation Principle – Hydraulic System

- heat source
- backup system
- heating circuit
- chillii® absorption chiller
- cooling circuit
- cold water reservoir
- cooling tower
- buffer reservoir
- warm water reservoir

thermal cooling - with chillii® technology
Installation Example – Hydraulic System
Components of a chillii® Cooling Kit

- Ad- or Absorption chiller
- Re-cooling system
- Optional: Cold and hot water storage
- Pumps and mixer
- System Controller and electric cabinet
- Other components (e.g. temperature sensors)

thermal cooling - with chillii® technology
chillii® Cooling Kits < 1 MW Cooling Capacity

Adsorption chillii® Cooling Kit
- optimally harmonized system components
- system solution for your application
- ready-to-install solution
- no layout and dimensioning required by customer

Absorption chillii® Cooling Kit

thermal cooling - with chillii® technology
chillii® Cooling Kits (water-fired chiller) > 1 MW Cooling Capacity

Absorption chillii® Cooling Kit

- optimally harmonized system components
- system solution for your application
- ready-to-install solution
- no layout and dimensioning required by customer
chillii® Cooling Kits (steam-fired chiller) > 1 MW Cooling Capacity

Absorption chillii® Cooling Kit

- optimally harmonized system components
- system solution for your application
- ready-to-install solution
- no layout and dimensioning required by customer
chillii® Cooling Kits (direct-fired chiller) > 1 MW Cooling Capacity

Absorption chillii® Cooling Kit

- optimally harmonized system components
- system solution for your application
- ready-to-install solution
- no layout and dimensioning required by customer
chillii® System Controller

- different heat sources
- back-up system for heat
- thermal cooling machine
- additional system for cooling
- heat and cold air reservoir management
- domestic water heating
- heat rejection system
- heating and cooling circuit
chillii® System Controller – State of the Art

- system adaptation by parameterisation
- multi user levels
- data logging
- remote access
- remote maintenance
- external interface (GLT integration)
chillii® System Controller – Output data logging to SD card

Log file:
- Measurements are saved on the **SD card**. (csv format)
- **Data can be imported** into spreadsheets (e.g.: Microsoft Excel)
- Actively switching the data logger → permanent recording
- **Measurement time frame** (adjusted by the operator) of one day (e.g. 7 a.m. to 11 p.m.)
- **Measurement interval** individually selected (starting from: 1.5 s → e.g. 60 min.).
- Recording of **instantaneous values**.
- Data points with **date and time** recorded
- **Fixed range** of relevant measurement and operational data.

Excerpt of possible measurements:
Temperatures:
- Hot water storage as a buffer
- Cold water storage as a buffer
- Inlet and outlet flow of cooling unit
- Inlet and outlet flow of unit circuit

4 volume flows
- Pump output
- Solar thermal collector
Imported and formatted log file

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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
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</table>
Representation over a period of time (example time frame)
Conclusion
Advantages of Sorption Cooling

**Active Climate Protection**

- Energy saving / increased energy efficiency
- Significant CO₂-reduction
- Reduction of the Global Warming Potential (GWP) by 99,9% because no F-Gases and therefore no environmentally harmful refrigerants
  - instead water as refrigerant

**Cost savings**

- Reduction of electricity consumption and energy costs (Ø 75% less electrical power consumption compared to compression cooling)
- Increased autonomy regarding energy suppliers
- No peak shaving
- Lifetime extension of CHP
- Less maintenance costs
- Significant reduction of total costs

**Cost savings with simultaneous improvement of the eco-balance**
Excerpt of References
chillii® Cooling Kit HLC220adb
Air conditioning of a new-built urban quarter, Bavaria, 2020

Sources: City of Rosenheim, City works of Rosenheim

chillii® Cooling Kit HLC220adb
Heat Source: district heating
Chiller: chillii® HLC220 (water / lithium bromide), 220 kW nominal capacity
Adiabatic recooling unit with performance control
High-efficiency and energy saving circulating pumps, energy label A
System controlled by the chillii® System Controller
chillii® Cooling Kit HLC220adb
Bavarian Energy Award 2020 – Category 'Regional Energy Concepts'

https://youtu.be/TTNJk4e_S4
chillii® Cooling Kit HLC220adb
Air conditioning of a new-built urban quarter, Bavaria, 2020
chillii® Cooling Kit WFC175

Heat source: combined heat and power unit (CHP) + heat from air compressors
Chiller: chillii® WFC175 (water / lithium bromide), 175 kW nominal capacity
Adiabatic recooling unit with performance control
High-efficiency and energy saving circulating pumps, energy label A
System controlled by the chillii® System Controller
Chillii® Cooling Kit WFC175
Process Cooling of a factory, Baden Wuerttemberg, 2019
2 chillii® Cooling Kit WFC175
Heat source: combined heat and power unit (CHP)
Chiller: 2 chillii® WFC175 (water / lithium bromide), 350 kW nominal capacity
Adiabatic recooling units with performance control
High-efficiency and energy saving circulating pumps, energy label A
System controlled by the chillii® System Controller
chillii® Cooling Kit WFC175
Process Cooling of a factory, Baden Wuerttemberg, 2017

thermal cooling - with chillii® technology
chillii® Cooling Kit WFC175adb + WFC70adb
Air-conditioning of server rooms, Saxony-Anhalt, 2014

Heat source: combined heat and power unit (CHP)
Chiller: chillii® WFC175 (water/lithium bromide) + chillii® WFC70 (water/lithium bromide), 245 kW nominal capacity
Heat rejection unit with adiabatic and speed controlled EC-motors
High-efficiency circulating pumps, energy label A
System controlled by the chillii® System Controller
chillii® Cooling Kit WFC175adb + WFC70adb
Air-conditioning of server rooms, Saxony-Anhalt, 2014
chillii® Cooling Kit WFC175
Process cooling and air-conditioning of a factory, Thuringia, 2012

2 chillii® Cooling Kit WFC175
Heat source: process heat (by usage of industrial waste)
Chiller: 2 chillii® WFC175 (water / lithium bromide), 350 kW nominal capacity
Wet cooling tower with performance control and automatic draining in danger of frost
High-efficiency and energy saving circulating pumps, energy label A
System controlled by the chillii® System Controller
chillii® Cooling Kit WFC175
Process cooling and air-conditioning of a factory, Thuringia, 2012
Chillii® Cooling Kit WFC70
Air-conditioning of a turkey production farm, Lower Saxony, 2012

Heat source: biogas CHP unit
Chiller: Absorption chiller chillii® WFC70 (water / lithium bromide), 70 kW nominal capacity
Chilled water storage: 8,000 l
Wet cooling tower with performance control and automatic draining in danger of frost
Chilled water distribution by a ventilation system
chillii® Cooling Kit WFC70
Air-conditioning of a turkey production farm, Lower Saxony, 2012

High efficiency and energy saving pumps
System controlled by the chillii® System Controller
chillii® Cooling Kit STC15
Cooling of a paper production machine, Switzerland, 2011

chillii® Cooling Kit STC15wet
- Heat source: waste heat of a paper machine
- Adsorption chiller chillii® STC15 (water / silica gel), 15 kW nominal capacity
- Wet cooling tower with performance control and automatic draining in danger of frost
- Cooling water distribution by the existing ventilation system by means of a water/air heat exchanger
- System controlled by superior control unit: chillii® System Controller
chillii® Cooling Kit WFC35
Air-conditioning of a factory, Bavaria, 2012

Heat source: industrial waste heat
Absorption chiller: chillii® WFC35 (water / lithium bromide), 35 kW nominal capacity
Wet cooling tower with performance control and automatic draining in danger of frost
Chilled water distribution by cooling ceilings
High-efficiency circulating pumps, energy label A
System controlled by superior control unit: chillii® System Controller
chillii® Cooling Kit WFC18
Solar cooling system in a showroom, Mexico, 2010

chillii® Cooling Kit WFC18
- Heat source: solar thermal collectors
- Absorption chiller: chillii® WFC18 (water / lithium bromide), 18 kW nominal capacity
- Wet cooling tower with performance control and automatic draining in danger of frost.
- Vacuum tube collectors
- Cold water distribution by a ventilation system
- System controlled by superior control unit: chillii® System Controller
chillii® Cooling Kit WFC18
Air-conditioning of a children’s hospital, Kabul, Afghanistan, 2010

- Heat source: solar thermal collectors
- Absorption chiller chillii® WFC18 (water / lithium bromide), 18 kW nominal capacity
- Cold water storage: 5,000 l, hot water storage: 20,000 l, domestic hot water: 500 l
- Wet cooling tower with performance control and automatic draining in danger of frost
- 350 m² flat plate collectors
- Heating and cooling water distribution through heating and cooling ceilings
- High-efficiency circulating pumps, energy label A
- System controlled by superior control unit: chillii® System Controller

Source: SolarNext
chillii® Cooling Kit ISC10
Solar cooling system in a public library, Australia, 2010

- Heat source: solar thermal collectors
- Adsorption chiller chillii® ISC10 (water / zeolite), 10 kW nominal capacity
- Dry heat rejection unit with speed controlled EC-motors and water sprinkling system
- Cooling water distribution by ventilation system
- High-efficiency circulating pumps, energy label A
- System controlled by superior control unit: chillii® System Controller
Thank you for your attention

Frank Molter (CEO)

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