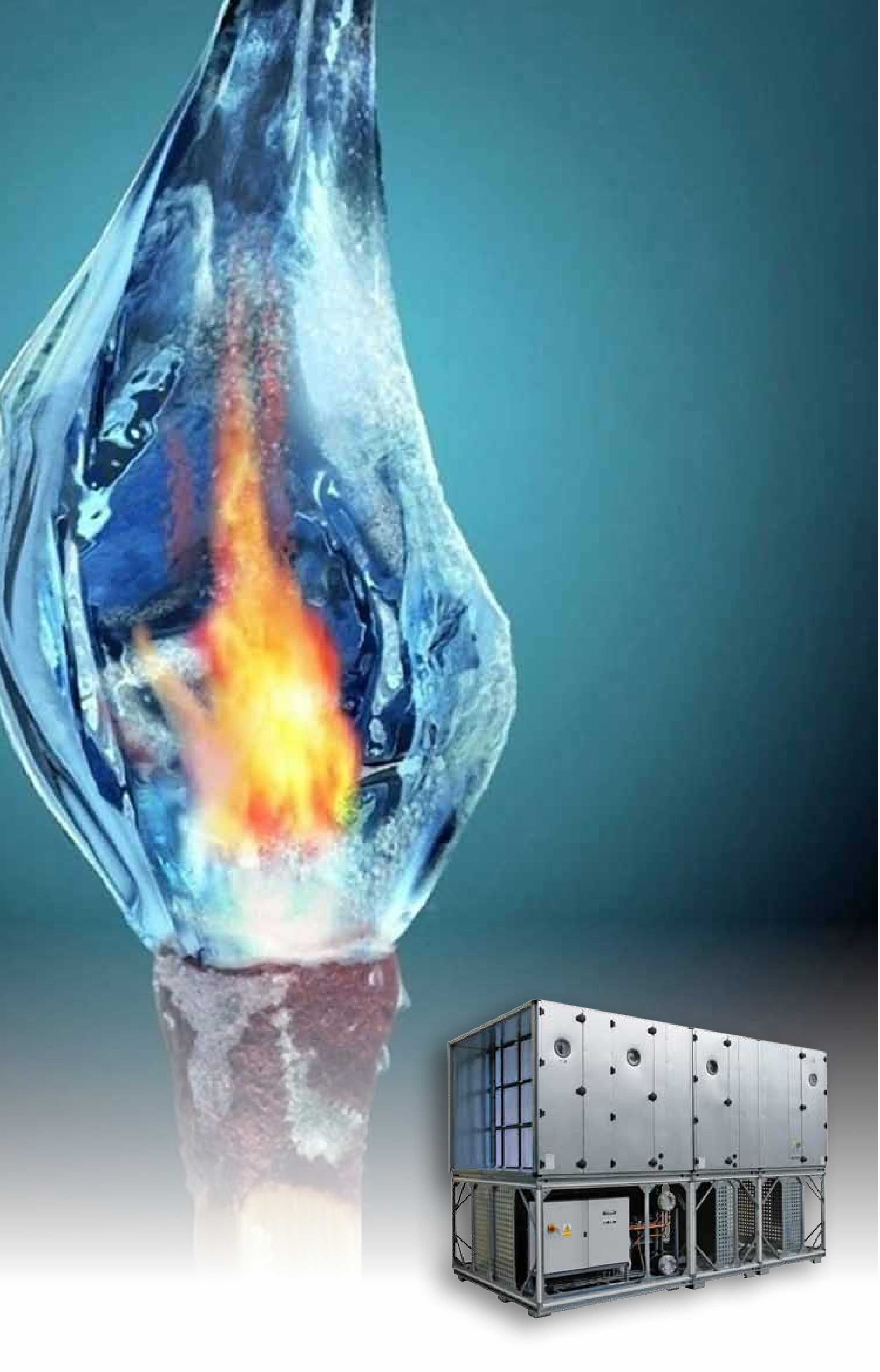


# COOLING AND HEATING FOR BUILDINGS WITH SPECIAL REQUIREMENTS

*The cooling equipment market offers a wealth of high-quality, effective and reliable equipment which can be used in normal construction conditions. However, technical problems – how to "graft" standard cooling elements onto buildings with non-standard requirements for the preservation of historical monuments, hygiene or architecture - arise when reconstructions or constructions take place in city centres. An improvised solution full of compromises and with greater installation and operating costs and other drawbacks is usually the result.*

## COOLING CONCEPT FOR BUILDINGS WITH SPECIAL REQUIREMENTS

These special requirements can be resolved by integration of the cooling technology into the centralized air-handling units inside the buildings. Thus, the cooling equipment is connected to the outdoor environment only via air ducts. This results in the building's appearance remaining unimpaired, and other floors can be used for relaxation/rest. Thanks to the possibility to fit effective attenuators, the noise can be reduced as low as to levels that cannot be achieved when using air-cooled condensers.

Generally, heat is generated during mechanical refrigeration and large quantities of air (approx. 600 m3h-1 per 1 kW of cooling capacity) are needed for heat removal. Such quantities of air would cause a room problem when integrating high performance technology inside the building if we did not use adiabatic air cooling technology in combination with the serial multistage removal of condensation heat. This principle allows multiple use of the relief air and thus we are able to reduce the air quantity as low as to one-third.

## ENERGY

Consumption of energy is an important aspect of cooling equipment development. Optimized control algorithms, the application of high-tech technology and alternative technologies such as adiabatic cooling or relief air recycling are some of the ways to reduce energy consumption. Especially utilisation of the relief air potential and quality creates a foundation for energy economy of this technology.

Maintenance frequency and quality also significantly affects the cooling equipment's energy consumption. This mainly includes cleaning of the condensers' heat-exchanging surfaces, which have no protection against the ambient environment. Deposits of contaminants start to build up on their surfaces within a few weeks. These deposits prevent heat exchange, reduce equipment efficiency, increase energy consumption and reduce the maximum available capacity.

Therefore, it is more suitable to use equipment "wrapped" in an insulated casing and equipped with effective filters. When these conditions are met, the cooling efficiency will stay high throughout the service life of the equipment.

To make the energy balance complete, it is necessary to take into account the water consumption. Water consumption is controlled according to the actual cooling needs, and when compared to open cooling stacks is quite low. This is because the need for adiabatic cooling starts at an ambient temperature of +23 ºC, which saves for administrative buildings on average about 300 hours per year. Furthermore, there is no need to use drinking water; instead, water with low content of minerals can be used. For example, rain water or "grey" water can be used.

## KEEPING THE PRICE OF THE COMPLETED WORK UNDER CONTROL

The price for the integrated solution and the price for the separate system are similar. Though the figure on the "price tag" is higher, the prices will reach the same level when we take into account all the costs to put a conventional source of cold into operation – i.e. costs for connections, refrigerant charges, control, handling, construction adaptations, extra work, etc.

## SEVEN REASONS TO USE INTEGRATED COOLING AND HEATING SYSTEMS

1. The technical background does not impair the building's appearance
2. Attenuation of the cooling technology
3. Improvement in quality and faster delivery consisting of compact assemblies, not just intermediate products
4. Efficiency comparable to a conventional source of cold
5. Investment costs under control
6. Improvement in the service quality and longer service intervals
7. A clear network for warranty and post-warranty servicing

# COOLING WATER PREPARATION FOR 380 KW COOLING CAPACITY

*Example of the Remak integrated cooling application model*

## FEATURES

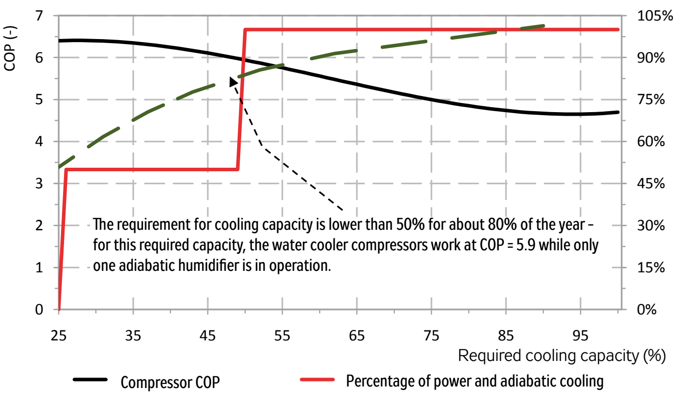
Only one compact unit situated inside the building which will provide production of cold water as well as exhaust vitiated air from the building. This was the order's specification, which is normally resolved using several devices in two or three separate systems delivered by different suppliers (air-cooled condensers, cooling unit, air-handling units, respectively outlet fans).

## DESIGN

The unit is equipped with four high-efficiency Scroll compressors from the renowned manufacturer Copeland, two I series connected air condensers, two adiabatic humidifiers and two output controlled fans. The circulated water is cooled by a high-performance evaporator. Its maximum efficiency is ensured by electronic injection valves.

## DESCRIPTION OF CONTROL

The control and power distribution board is integrated into the unit, which makes the unit even more integrated. Control of the unit is based on the energy balance which results in an algorithm optimizing the utilization of the condensation area and adiabatic humidification (see the graph). Anti-freeze protection of the evaporator is ensured by a discharge switch, an additional thermal sensor and low-pressure pressostat. The communication with the master system is limited to the logic status signals "Run" and "Failure".



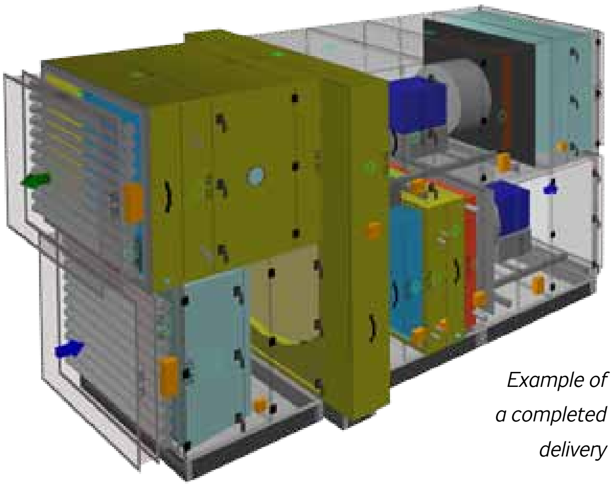

*Example of a completed delivery – Karlín Hall (Czech Republic)*

## BASIC TECHNICAL DATA

| | | |
|---|---|---|
| **Air output** | 50,000 [m3/h] | – |
| **Cooling capacity** | 378 [kW] | – |
| **Cooled water parameters** | +12 / +6 [°C] | – |
| **COP** | (see the graph) | As the fans ensure exhaust of vitiated air from the building, their power input is not included in the cooling factor. |
| **SCOP (seasonal factor)** | 5.7 [-] | |
| **Output stages** | 0-25-50-75-100 [%] | – |
| **Coolant** | R407C | – |

# DIRECT EXPANSION EVAPORATION USING SORPTION HEAT RECOVERY

*Example of the Remak integrated cooling application model*



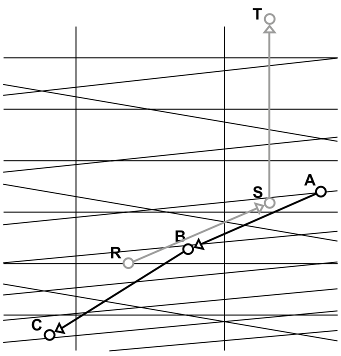
*Example of a completed delivery*

## DESIGN

The integrated cooling system of this application consists of two high-performance Copeland Scroll compressors, electronically controlled injection, two laminated exchangers and a sorption rotor..

## FEATURES

he task was to design a unit which will ensure ventilation and cooling of an exhibition hall, service water heating, including the necessary cooling capacity while ensuring minimum energy consumption. As the hall has no significant humidity source, we were able to apply the principle of drying and pre-cooling the inlet air using a sorption regeneration rotor, thus reducing energy consumption for cooling by 40% (compared to a system with mechanical heat and humidity exchange). The advantages of this concept are enhanced by the fact that the sorption rotor significantly reduces operating costs related to air-conditioning for the required humidity in the winter.




*A-B course on the sorption rotor, B-C cooling on the evaporator, R-S course on the sorption rotor, S-T condensation heat removal*

## DESCRIPTION OF CONTROL

All the control, protection and safety features are ensured by the autonomous control unit connected to the master BMS.

## BASIC TECHNICAL DATA

| | | |
|---|---|---|
| **Air output** | přívod 18 000 [m³/h]<br>odvod 17 000 [m³/h] | – |
| **Total cooling capacity** | 92 [kW] | Sorption rotor capacity included |
| **Service water heating** | 30 [kW] | – |
| **COP1** | 6,8 | Including increased power input of the outlet fan due to the condenser being situated in the relief air flow and power input of the regeneration rotor drive |
| **COP2** | 9,0 | Including increased power input of the outlet fan due to the condenser being situated in the relief air flow, power input of the regeneration rotor drive and utilization of the waste heat to heat up the service water |
| **Output stages** | 0/50/100 [%] | Ensured by an integrated controller |
| **Coolant** | R407C | – |

solution for a better environment

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