GOOD PRACTICES IN SME

Using free cooling

Designed by freepik

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Ministry of Climate and Environment

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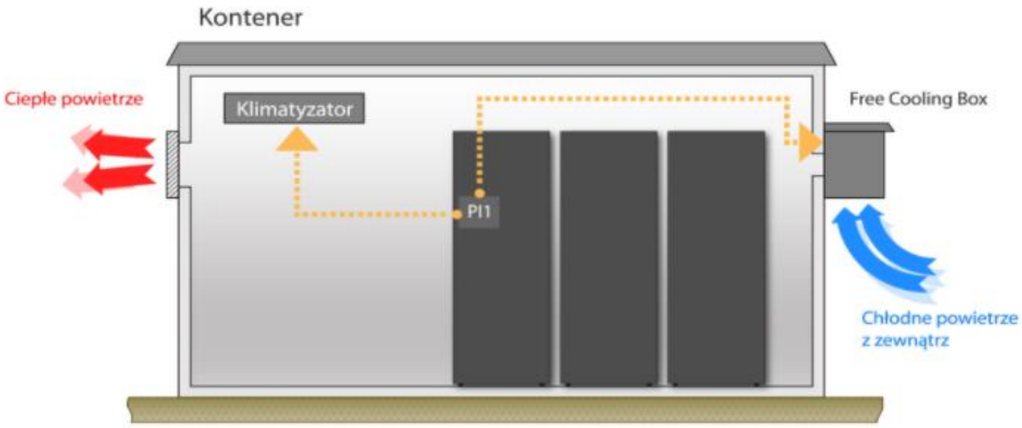
What is free?

Free cooling systems work by using the air outside to lower the temperature of a cooling medium (water-based glycol solution). The heat exchange process takes place in a chiller built directly in a compressor or a separate cooling unit. At sufficiently low external air temperatures the desired cooling power can be achieved without the compressor. In comparison to a classical compressor unit, the free cooling system allows for lower energy consumption by the climate control system, which lowers its operation costs.

Producers assure that free cooling systems can function efficiently when temperatures do not exceed 16°C. Poland is located in a climate zone suitable for free cooling as the average temperature throughout most of the year does not exceed 10 °C in spring and autumn months. In warmer periods the cooling system is supported by classical compressor chillers. A free cooling climate control system can decrease energy consumption by up to 80% in a year in comparison to classical climate control installations.

An example of using a free cooling system can be rooms containing IT equipment (server rooms), which require cooling (heat exchange from heating up CPUs) independently from the external environmental conditions. They are also used in shopping malls and industrial plants.



Pic. 1 telzas: free cooling system diagram
*From top left to bottom right: **Container**, Warm air, AC unit, Cool outside air*

fot. 2 telzas: free cooling box

fot. 3 telzas: free cooling box

Savings comparison between free cooling with three-way modulating valves and heat exchanger and a dry cooler solution

Assumptions:

The chiller uses its full capacity (380 kW) throughout the season (8761 hours). The number of work hours within the range of verified external temperature occurrences (meteorological data):

- 35÷-10°C: 3 879 h/season- chiller operation
- 10÷-8°C: 4 596 h/season- partial chiller operation/partial free-cooling operation
- -8÷-20°C: 286 h/season- free cooling operation

The analysis includes the energy consumption of the compressor and the fan.

Energy consumption

A. free cooling with three-way modulating valves and heat exchanger

Summer period: $El_1 = P_{el} \times t = (111\ kW + 13\ kW) \times 879\ h = 480\ 996\ kWh$

Transition period: $El_2 = P_{el} \times t = (55{,}5\ kW + 13\ kW) \times 4\ 596\ h = 314\ 826\ kWh$

Winter period: $El_3 = P_{el} \times t = 13\ kW \times 286h = 3\ 718\ kWh$

Year: $El_1 + El_2 + El_3 = 799\ 540\ kWh$

B. free cooling with a dry cooler

Operation in cooling mode:

$El_1 = P_{el} \times t = (118\ kW + 26\ kW + 3\ kW) \times 7\ 265\ h = 1\ 067\ 955\ kWh$

Free cooling: $El_2 = P_{el} \times t = 26\ kW \times 1\ 496\ h = 38\ 896\ kWh$

Year: $El_1 + El_2 = 1\ 106\ 851\ kWh$

Comparison

Energy savings with free cooling, three-way modulating valves and heat exchanger: $307\ 311\ kWh$

Operational cost savings with free cooling, three-way modulating valves and heat exchanger assuming the average electricity cost of 0,55 PLN/kWh: $169\ 021\ PLN/year$

Source: "Różne rozwiązania free-cooling, różne oszczędności energetyczne",mgr inż. Bartłomiej ADAMSKI - PZITS o/Kraków,2011