Using high efficiency air-cooled chiller system for office buildings

The air conditioning (AC) system was first introduced in around 1920. The AC system was invented to create a favorable environment for people and establish suitable conditions for the technology of production, processing, preserving machinery, etc.

The air conditioning concept is categorized into 2 different application areas:

- Air regulating: establish environments suitable for the preservation of machinery and equipment, and meet the requirements of specific production and processing technologies, for example: air conditioning system for server rooms, clean rooms, etc.
- Air conditioning: create a favorable environment for human activities, for example: residential air conditioning system for household spaces, offices, cars, aircraft, etc.

It is worth noting that the temperature and humidity in the space where the air conditioner is required are not always adjusted in a decreasing direction (i.e. cooling) compared to the outdoor ambient temperature. Depending on outdoor conditions and specific requirements, it is sometimes necessary to increase the heat and humidity for the space that requires air conditioning.

1. Operation principle and structure of the AC system

Operating principle:

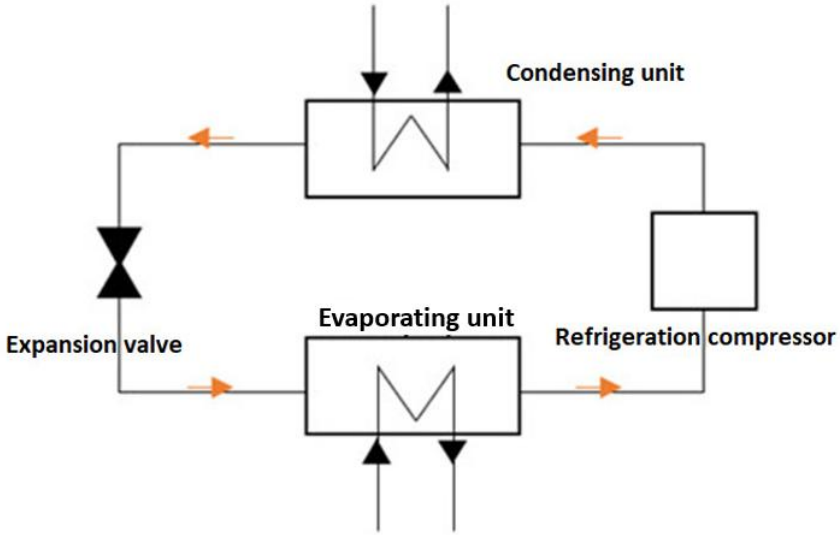
Air conditioning system absorbs heat from the air in its surroundings and transfers it to the refrigerant. Through a number of thermosetting processes, the refrigerant expels this heat. This cycle continuously creates the required atmosphere (the temperature is lower than the outdoor ambient temperature).

Structure:

The AC system usually includes the following components:

- Evaporator: it is a heat exchanger where the refrigerant process absorbs the heat and cools the air/water.
- Condenser: it is a heat exchanger where the cooling air/water absorbs and cools the refrigerant.
- Air compressor: provides energy to the refrigerant that performs the thermosetting processes.
- Expansion valve: reduces the pressure as the refrigerant approaches the evaporator.

In addition to the four main components as above mentioned, the system can also include heaters, humidifiers, air distribution systems, noise reduction systems, dust filters, self-sustaining regulators and monitors, cooling water systems, etc.



One-level cooling cycle

2. Efficiencyof AC equipment

Efficiency of AC equipment is quantified by the coefficient of performance (COP). The formula for calculating COP of the AC equipment:

$$\text{COP} = \frac{Q_0}{N} = \frac{\text{(Output) cooling capacity ofevaporating equipment Q (kW)}}{\text{Power input for refrigeration compressor (kW)}}$$

The higher the COP coefficient, the higher the energy efficiency.

The COP calculation of the AC system is slightly different from the COP of the equipment. In this case, the N value becomes the electricity supplied to all electrical equipment of the AC system, including refrigeration compressors, fans, pumps, etc.

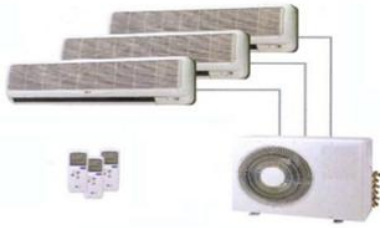
3. Classification of AC system

AC system is classified based on the criteria corresponding to the need to maintain and control the temperature, humidity, cleanliness of each different type of space. According to the size (area) of the space requiring air conditioning, the system is classified according to:

- Residential AC system: suitable for independent spaces; including popular types such as: window-type air conditioner, detachable air conditioner, multi-split air-conditioner, direct blowing air conditioner, etc.

Window-type AC

Detachable air conditioner



Multi-split air-conditioner

Direct blowing air conditioner

- Central AC system: is the optimal choice for large spaces such as buildings, offices, hotels, conference rooms, etc.

Air-cooled chiller

Water-cooled chiller

VRV/VRF central AC

4. Advantages and disadvantages of some AC systems

Criteria	Local AC	Central AC	
		Air-cooled chiller	Water-cooled chiller
Scope of application	☆☆☆☆	☆☆☆	☆☆☆
COP index	☆☆	☆☆☆	☆☆☆☆
Investment cost	☆	☆☆☆	☆☆☆☆
Ease of installation	☆☆☆☆☆	☆☆☆	☆☆
Ease of maintenance and repair	☆☆☆☆☆	☆☆☆	☆☆

5. Solution: Using high efficiency air-cooled chiller system for office buildings, hotels

The central AC chiller system is particularly suitable for use in office buildings and hotels with a large volume of space that requires large air conditioning. With the limited installation area and the investor's requirement of not interfering with the existing infrastructure, the solution of using high efficiency air-cooled chiller installed on the roof of the building is chosen to replace the old system of inefficient air conditioning systems.

Old chiller system

New chiller system

COP of the new and old air-cooled chiller systems

System	COP	% Increase in COP (compared to old chiller)
Old chiller	2.2	67%
New Chiller	3.67	

COP assessment is performed at the temperature of cold water return about 8 ° C - 12 ° C, outside temperature about 31 ° C - 35 ° C.

The solution's cost and benefit analysis table

Parameter	Unit	Old chiller	New Chiller
Electric used	kWh/day	2121	1,686
Electricity saved per day	kWh/day	435	
Savings rate	%	20.5%	
Electricity saved per year	kWh/year	158,775	
Cost savings	Million VND/yea	416.78	
Initial investment costs:	VND Million	2,790	
Payback time	Year(s)	6.7	