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DESIGN OF AIR CONDITIONING SYSTEMS

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Abstract

Climate change is one of the most pressing global problems today. Today, global warming is observed throughout the earth. As a result, the design of the natural ventilation system in the rooms does not meet the sanitary and hygienic requirements for the ventilation system. Designing an air conditioning system, choosing the right air conditioners requires the necessary knowledge and skills. Today there are many types of air conditioners. What parameters are taken into account when choosing air conditioners, what calculations are made.

Keywords: *air temperature, humidity, air cooling, air heating, air conditioners, BTU, thermal unit.*

1. Introduction

Air conditioning is a system of providing optimal temperature, humidity and fresh air in rooms with the help of special devices and tools. It is used to ensure the good preservation of human health and mood, works of art and objects, to create the most comfortable conditions for managing the work of technological processes, equipment and tools. Air conditioning has automatic control systems. Each system consists of the following: a sensor (transmitter), a command device, an executive mechanism, a communication tool. The sensor records changes in the environment and transmits information about it to the commanding device. The commanding device, in turn, gives an impulse to the executive mechanism. Actuator moves the appropriate sources of water, air, etc. according to the given impulse.[2] Air conditioners are often used in air conditioning systems. Air conditioner consists of fan, air heater, air cooler and air filters.

The air conditioner has a cooling machine and an electric air heater, in addition to these, there are cooling compressors with an electric motor, an evaporative air cooler, a condenser, an air filter, fans with an electric motor, automatic adjustment of the operation of the cooling machine, and devices for keeping the indoor air at the same standard.[6] There are local and central air conditioning systems. In the central system, it supplies air to several buildings, and in the local system, it supplies air to one building or part of it. Air conditioning, air conditioning - providing optimal temperature, humidity and fresh air in rooms with the help of special devices and tools. it is used to ensure the health and mood of a person, to ensure the good preservation of works of art and objects, to create the most comfortable conditions for the performance of technological processes, equipment and tools. Air conditioning has automatic control systems. each system consists of the following: A transmitter (sensor) is a command device, an execution mechanism, a means of communication [4].

The sensor records changes in the environment. and transmits information about this to the commanding device. The commanding device, in turn, gives an impulse to the execution mechanism. the execution mechanism activates the relevant sources (water, air, etc.) according to the given impulse.[11] The most popular type of air conditioners are split systems. They can be installed in many places: in residential buildings, offices, shopping areas. Split system air conditioners consist of indoor and outdoor units. The second type of air conditioners is multisplit systems. In this type of air conditioner, several indoor units are connected to one outdoor unit. This type of air conditioner helps to create an air conditioning system in several rooms or a large building. Different rooms have specific air conditioning requirements. It is recommended to choose strong ones for the hall. In bedrooms, it is better to install equipment that works quietly with an inverter. Such devices effectively distribute cool air, reducing the risk of catching a cold.[2] An air conditioner with an oxygen purification function is required for the children's room to work without noise.

Air conditioners without filters are usually installed in kitchens, because all parts are quickly covered with a layer of oil. Therefore, it quickly becomes obsolete. Modern air conditioners have many additional functions. Each function has its own task.. For example, apartments where babies or elderly people live need special capabilities of the air conditioner. Therefore, when choosing a device model, it is necessary to take into account additional options. Air purification using "cold" plasma. The most modern method for cleaning the air in the air conditioner. Sterilizes incoming air flow, eliminates external odors, disinfects air masses. Electrostatic vacuum cleaner. Cleans the air from dust particles with a special vacuum cleaner set. The work process is carried out by the effect of electrostatic charge on dust. Self-cleaning system. Prevents the formation of moisture during heat exchange. This will reduce the pollution of the air conditioning internal blog mechanism. Protection against excessive temperature. The air conditioner does not allow ice to form inside the heat exchanger located in the internal block. It also reduces the pressure level of the coolant on the inner wall of the pipe. Sleep mode provides a comfortable temperature during sleep. The speed of the air conditioner fan is reduced to the required low level, and the noise of the indoor unit is also drastically reduced. And the swing function helps the cool air from the air conditioner to arrive uniformly.

This effect is realized by auto-oscillation (up-down) of the air conditioning blind when the additional Swing function is activated. Another additional function, Air Flow Direction, helps to strengthen the airfoils when necessary. Swing and Air Flow Direction functions are available in almost all modern air conditioner models. "Infrared motion sensor" (Smart Eye, Intelligent Eye) is an innovative additional function that detects the presence of people or pets in the room using an infrared motion sensor. If any movement is detected in the room, the split-system works in the usual set mode. However, if there is no one in the room for a certain period of time, the air conditioner will switch to economy mode.[1]

2.Method

Simple calculations allow you to find the power of the air conditioner for a small room: For buildings with an area of $50-70\,m^2$, the cooling capacity of the air conditioner can be calculated. The cooling capacity Q (in kilowatts) is calculated using the following method:

$$Q = Q_1 + Q_2 + Q_3$$

Q_1 - heat penetration from windows, walls, floors and ceilings.

$$Q_1 = \frac{S \cdot h \cdot q}{1000}$$

S – paint surface. h - building height, q– coefficient, $30-40\ \frac{W}{m^2}$.

$q = 30\ \frac{W}{m^2}$ - for shaded areas

$q = 35\ \frac{W}{m^2}$ - for a building located in average lighting.

$q = 40\ \frac{W}{m^2}$ - for rooms with a lot of sunlight.

Q_2 - the sum of the heat emitted from people.

Heat dissipation from an adult:

$0{,}1\ kW$ - at rest; $0{,}13\ kW$ - with light movement; $0{,}2\ kW$ - during physical activity;

Q_3 - sum of heat flows from household appliances.

Heat from household appliances: 0,3 kW - from the computer; 0,2 kW - from television;

For other devices, it can be assumed that they generate 30% of their maximum power consumption as heat (ie, the average power consumption is 30% of the maximum). The conditioner power should be within the Q range of –5% to +15% of the design power. Let's calculate the power of the air conditioner for a living room of 26 m² with a ceiling height of 2.75 m and a maximum power consumption computer, TV and small refrigerator for one person. The room is on the sunny side. The computer and the TV

cannot work at the same time, because they are used by one person. Heat flows from windows, walls, floor and ceiling are determined. The coefficient q is 40, because the room is on the sunny side:

$$Q_1 = \frac{S \cdot h \cdot q}{1000} = \frac{26 \cdot 2{,}75 \cdot 40}{1000} = 2{,}86\ kW.$$

The heat flow from one person at rest is 0.1 kW.

$$Q_2 = 0{,}1\ kW$$

Heat flows from household appliances are found. Since the computer and the TV do not work at the same time, only one of these devices should be taken into account in the calculations, that is, the device that produces more heat. This is a computer with a thermal power of 0.3 kW. The refrigerator emits approximately 30% of its maximum power consumption as heat, i.e

$$Q_{r=}\frac{0{,}165\ kVt \cdot 30\ \%}{100\ \%} = 0.05\ kW.$$
$$Q_3 = 0{,}3kVt + 0{,}05kVt = 0{,}35kW$$

The power of the air conditioner can be determined:

$$Q = Q_1 + Q_2 + Q_3 = 2{,}86\ kW + 0{,}1\ kW + 0{,}35\ kW = 3{,}31\ kW$$

The recommended power limit is -5% to +15%:

$$3{,}14\ kW < Q < 3{,}80\ kW$$

An air conditioner model suitable for this capacity is selected. Many manufacturers produce split systems with power close to the standard range: $2{,}0\ kW, 2{,}6\ kW, 3{,}5\ kW, 5{,}3\ kW, 7{,}0\ kW$ From this range, a model with a power of 3.5 kW is selected.

Usually, the capacity of air conditioners is called "7" (seven), "9" (nine), "12", "18" "24", and even the marking of air conditioners is done using these numbers. Displays the power of the air conditioner in a different way than the usual kilowatts and in BTU/hour. This is due to the fact that the first air conditioners appeared in the United States, where the British system of units (inches, pounds) is still used. "7" air conditioner - 7000 BTU/h, "9" air conditioner - 9000 BTU/h, etc. The same numbers are used to label the air conditioner so that its capacity can be easily identified by its name. BTU (British thermal unit).

$$1000\ \frac{BTU}{h} = 293\ watts.$$
$$1\ \frac{BTU}{h} = 0{,}293\ watts.$$

According to the results of the calculation, an air conditioner with a capacity of 3.5 kW is suitable for the apartment. An air conditioner with this capacity needs to be converted to BTUs.

$$\frac{3500\ vatt}{0{,}293\ vatt} = 11931\ BTU \approx 12000\ \text{BTU}$$

12000 BTU corresponds to a "12" air conditioner. Usually, when choosing an air conditioner for a building, the surface of the room is taken into account. You may need to convert BTU to kW. To convert 12,000 BTU to kW, divide 12,000 by 3412:

$$1000\ Watts\ = 3412\ \frac{BTU}{h}$$
$$\frac{12000BTU}{3412\ Watts} = 3{,}517\ kW$$

3. Result and Discussion

Usually, when choosing an air conditioner, the surface of the room is taken into account. But this is a mistake. For the room where the air conditioning system is being designed, it is necessary to know the parameters of the air in the room. In order to provide the air conditioning system with coldness, it is necessary to know exactly the amount of excess heat and moisture released into the room. Also, it is necessary to know exactly the amount of heat contained in the air in the room. It is necessary to choose the capacity of the air conditioner for the cold and hot mode based on an accurate calculation. In the case discussed above, the amount of heat released from people into the room was 0.1 kW, the amount of heat released from electrical equipment in the room was 0.35 kW, and the amount of heat coming from solar radiation was 2.86 kW.

The total amount of excess heat allocated to the room was 3.31 kW. The capacity of air conditioners is usually. BTU is given in units. The room needs an air conditioner with a capacity of 3.31 kW. Therefore, it is necessary to convert the air conditioner with a power of 3.31 kW into the BTU system. As mentioned above, 1 BTU/hour is equal to 0.293 watts. To convert 3.31 kW to BTU/hour, divide 3310 watts by 0.293 watts.

$$\frac{3310\ W}{0{,}293\ W} = 11296\ BTU \approx 12000\ \text{BTU}$$

. 12000 BTU corresponds to a "12" air conditioner

The most common symbols for the power of air conditioners in British thermal units and their correspondence in kW:

Table 1. The most common symbols for the power of air conditioners in British thermal units

BTU	to be named	kW
7000 BTU	7	2.1 kW
9000 BTU	9	2.6 kW
12000 BTU	12	3.5 kW
18000 BTU	18	5.3 kW
24000 BTU	24	7.0 kW
30000 BTU	30	8.8 kW
36000 BTU	36	10.6 kW
48000 BTU	48	14.0 kW

Choosing the right air conditioners, creating optimal conditions in the room, has a great impact on the quality and productivity of people's normal rest, education and production processes.

4. Conclusion

Choosing the right air conditioners, creating optimal conditions in the room, has a great impact on the quality and productivity of people's normal rest, education and production processes. The correct selection of special devices and equipment in air conditioning systems can not only create optimal conditions, but also achieve efficiency in terms of energy saving. Usually, when buying an air conditioner, it is selected based on the room area and BTU. The amount of additional heat released into the room is not taken into account. This has a negative effect on the efficiency of the system. The system chosen based on the results of the exact calculation gives the expected resultто Therefore, it is advisable to

choose an air conditioner based on the results of the calculation, after calculating the amount of all the damages allocated to the room.

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