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Analysis of the methodology for controlling heat loss in buildings

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Abstract: ***In order to minimize the heat loss of the building from maximum to minimum, the scientific article notes the main features of transferring a constant temperature to flow heaters at the same flow rate and transferring heat to a thermostatic valve. To minimize building heat losses, the installation of thermostatic valves in radiators is analyzed to compensate for the thermal effect caused by preventing excess temperature transfer.***
Key words: ***heat losses, heating equipment, heating system, thermostatic valves, heat energy saving.***

Humanity needs energy, and its needs are increasing every year. At the same time, the reserves of traditional fossil fuels (oil, coal, gas, etc.) are limited. Stocks of nuclear fuel - uranium and thorium - are also limited. The supply of fusion hydrogen fuel is virtually inexhaustible, but controlled fusion reactions have not yet been developed, and it is not clear when they will be used to produce clean industrial energy. In connection with these problems, the introduction of energy-saving technologies is becoming increasingly important.

It should be noted that the calculations of an economically advantageous (from the point of view of heat engineering) enclosing structure, due to the cheapness of fuel, led to the dominance in mass construction of light, low-inertia in the recent past. On the other hand, relatively cheap, obstacles, heat engineering shortcomings are currently designed to be solved using methods and means of regulating the operation of heating systems.

Over the past 15 years, this has caused a massive transition from centralized heating systems to local (decentralized) ones, on the one hand, filling the market with various heat generating equipment, and on the other hand, reducing the quality of heat supply. heat supply from centralized systems. That is, the massive use of decentralized systems is not associated with the desire of consumers to save energy, but to provide themselves with thermal energy.

In principle, it is necessary to minimize the heat loss of the building. The natural border is used in places where the need for comfort and convenience remains unsatisfied. In practical experiments, it can be seen that the heat loss of a one-room house should be maintained at the level of 80 W/m^2 only through optimal design and construction. Thus, the annual heat loss, the amount of liquid or gaseous fuel consumed corresponds to approximately 13 m^3/m^2 or 1950 m^3 for a room with a living area of 150 m^2. The amount of heat that the heat generator must produce will definitely exceed the specified value, since both the production and distribution of heat energy are subject to losses.

Basic principles of heating technology

The heat loss of a building is the sum of the heat flow from the building envelope (heat transfer losses) and air infiltration losses due to structural incompressibility (infiltration losses). Both values can be calculated based on DIN 4701 heat demand calculation. The amount of heat loss is mainly determined by the difference between the room temperature and the ambient temperature. Since the indoor temperature usually remains constant throughout the year, the ambient temperature is decisive (Fig. 1).

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If we move on to the fundamental phenomenon of environmental change (Fig. 1), it becomes clear that heat supply for heating occurs according to the same signs as heat transfer (Fig. 2).

Thus, it is possible to formulate the basic principles of heating technology:

a) The heat source must adequately cover variable heat losses.

b) The amount of heat generated by the heat generator must be transferred to the living quarters.

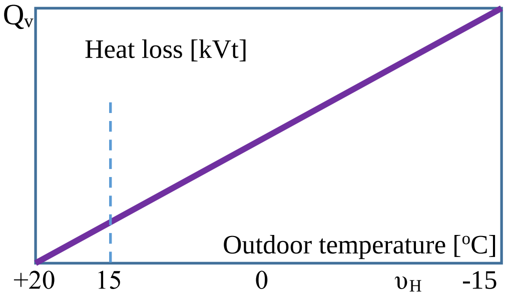


Figure 1. Heat loss at a constant temperature of buildings and a change in ambient temperature.

Q_V - maximum heat loss. Determined by calculation according to DIN 4701.

υ_H - the average state of the beginning of the heating period. Heat losses at high temperatures are compensated by sunlight, human heat, etc.

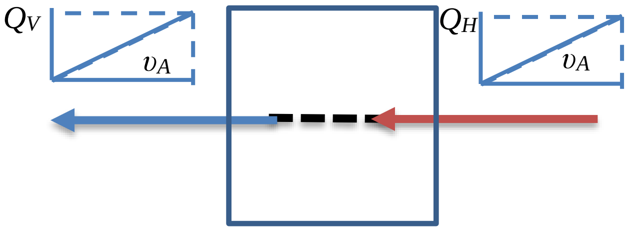


Figure 2. Heat loss Q_V and heat supply Q_H are the thermal characteristics that must be provided.

This requirement can be implemented in two ways: firstly, to change the amount of generated heat in accordance with the current value of heat losses of the heat generator (Fig. 2). At the same time, all load ranges from minimum to maximum work continuously. This "modulated" mode of operation is considered the most convenient option. But this creates significant technical difficulties, at least in the area of power reduction. Thus, in rooms with operating temperatures from -15 °C to (the coldest day) 20 °C, the required temperature control area is (20-15)/(20-(-15))=5/35=1/7. Equals Such a large working area places high demands on the boiler burners and the flue gas extraction system.

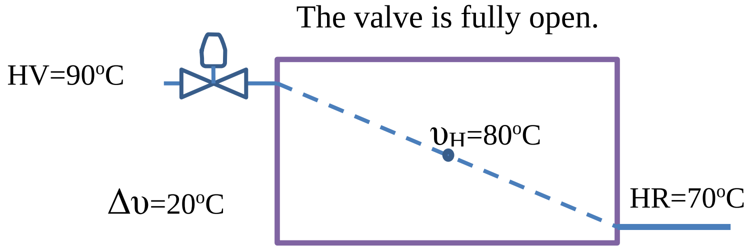
The heat generator operates with a constant heat load corresponding to the maximum heat loss of the building. It is carried out by regulating the operating time of the burner (burner) while coordinating variable heat losses. This mode of operation is called "intermediate" (periodic). For example, if the heat loss of a building is 20 kW at -15 °C, then during the day it loses 20 kW * 24 hours = 480 kWh of thermal energy. The 20 kW boiler firebox had to operate 24 hours a day to compensate for these heat losses. If the heat loss of the building is halved, i.e. up to 240 kW / h, then the burner service life will be halved, i.e. up to (240 kW)/(20 kW)=12 hours. Due to the fact that such control systems do not impose special requirements on the combustion or exhaust system, practical systems are being created. With conventional intermittent heating, high heat losses from the boiler are avoided, since in the example given, with 12 hours of fuel operation per day, the boiler power is not used for the remaining 12 hours, but the boiler must be maintained at operating temperature. The second requirement is fulfilled in practice, the water heated in the boiler is sent to the heating devices installed in the buildings, where it gives off the required amount of heat, and then returns to the boiler.

If a stream of water of constant temperature is supplied to the heating devices at the same flow rate, then the output of the transferred heat will be constant. There are two ways to change the heat output:

a) Changes in the area of heating surfaces. Previously, this method was often implemented by turning off and on some sections of heaters. Only this provides a very unsatisfactory and dependent unregulated mode of operation with significant heat losses.

b) Changes in the temperature of the heating surfaces. This is done by controlling the current at a constant temperature. Less water is cooled in the heater and the average temperature of the heating surface decreases (Fig. 3).

The valve is fully open.



The valve is partially open.

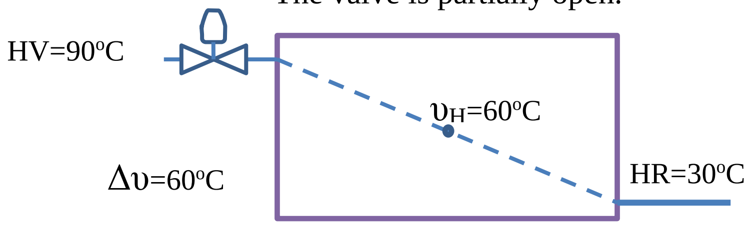


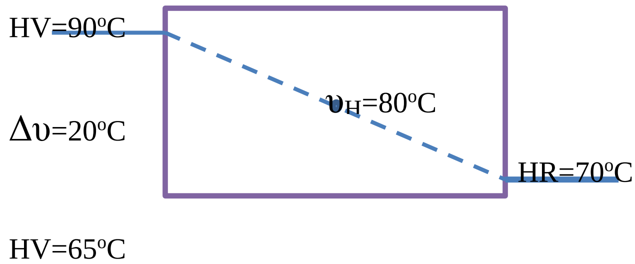
Figure 3. Regulation of heat transfer by changing the average temperature of the heat exchange surface υ_H by controlling the flow of water.

HV is the transmitting current QV. HR return flow.

υ_H = (HV + HR)/2, e.g. υ_H = (90 + 70)/2 = 80ºC

Δυ = temperature difference between heat transfer and return = HV-HR e.g. 90-70 = 20 ºC.

For example, heating appliances have thermostatic valves. These valves can, in principle, regulate heat transfer relatively accurately over a medium temperature range. However, along with a number of other significant disadvantages, this leads to a large temperature difference in the heater (for example, 90°C-30°C=60ºC in Fig. 3), which subsequently leads to a loss of comfort.



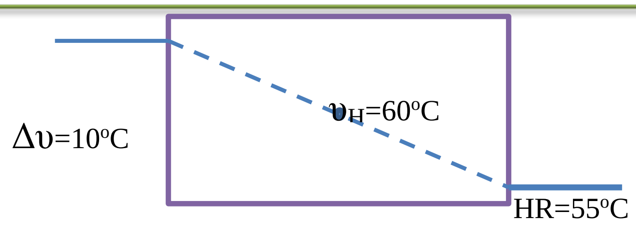
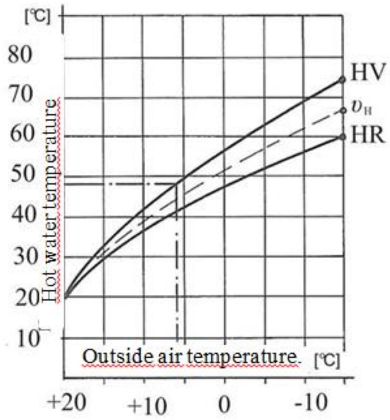


Figure 4. Heat transfer control by changing the average temperature on the heat exchange surface to the flow temperature.

If possible, it is better not to compress the flow and change its temperature (Fig. 4). From a comparison with Fig. 3 it can be seen that at the same average temperature of the heating surfaces (60°C), the temperature difference equal to 65-55=10°C is much smaller, and this is significant due to the more comfortable microclimate in the room. However, radiators must additionally have thermostatic valves to compensate for the thermal effects caused by external temperatures (eg people and equipment). It is possible to determine the required temperature in the supply line on the basis of physical and mathematical values for any outdoor temperature. The graphical representation of the corresponding function is called the heating curve. On fig. 5 shows the heating curve of typical radiators.



Outside air temperature.

Figure 5. Depending on the outside temperature (heating curve) the required amount of heat in the heating cycle. The dashed curve represents the average value of the heating period.

Variable operating mode, "sliding" flow temperature is currently the best implementation of the second principle of heat engineering.

A modern heating system consists of the following components.

a) heat transfer to the heating system at a maximum supply temperature of 75 °C.

b) a weather-compensated low-temperature or ultra-low-temperature boiler and an integrated water heating system for hot water supply needs.

c) thermostatic valves in heating appliances to exclude the influence of heat sources in the room.

g) technical and construction mea[illegible]ovide the possibility of additional use of additional energy sources, for example, solid fuel in an additional or combined mode. The last point is of particular importance in terms of a reliable and economical energy supply. Undoubtedly, energy sources that do not require a pipeline system for transportation will be of particular importance in the future, as there is no pressure on pricing and base price according to the laws of a market economy.

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