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THE IMPORTANCE OF WATER IN THE ENERGY SYSTEM AND THE REQUIREMENTS PLACED ON IT

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Annotatsiya: Energetika tizimida suvning ahamiyati katta bo`lib, u asosiy issiqlik energiyasini tashuvchi manba sifatida keng qo`llaniladi. Suvning sifat ko`rsatgichlari tizimning samaradorligiga, ya`ni tizimdagi qurilmalar hamda quvurlar hizmat ko`rsatish davomiyligiga bevosita ta`sir ko`rsatadi. Ushbu maqolada sanoat issiqlik energetikasi ta`minoti uchun kanal, daryolardan olib foydalaniladigan suvlarga qo`yiladigan asosiy talablar ko`rib chiqiladi.

**Kalit so`zlar**: enrgetika, kanallar, daryolar, ta`minot suvi, tarkib, harorat, talablar, me`yorlar.

Аннотация: Вода играет важную роль в енергетической системе и широко используется в качестве основного носителя тепловой энергии. Показатели качества воды напрямую влияют на эффективность работы системы, то есть на срок службы приборов и труб в системе. В статье рассматриваются основные требования к воде, используемой из каналов и рек для промышленного теплоснабжения.

Ключевые слова: энергия, каналы, реки, водоснабжение, состав, температура, требования, стандарты.

Abstract: Water plays a significant role in the energy system, and it is widely used as a primary thermal energy carrier. Water quality indicators directly affect the efficiency of the system, that is, the service life of the devices and pipes in the system. This article considers the main requirements for water taken from canals and rivers for industrial thermal energy supply.

Keywords: energy, canals, rivers, supply water, composition, temperature, requirements, standards.

Introduction

Water is undoubtedly one of the most important factors of world development. Its rational use is the duty of all of us. The importance of this can be seen from the fact that Part III of the Decree of the President of the Republic of Uzbekistan on the Strategy "Uzbekistan - 2030" is called "Saving Water Resources and Protecting the Environment".

In the industrial thermal energy system water due to its widespread distribution in nature and chemical composition, is widely used in heat exchange devices and steam plants, which are the main parts of the system. The following parameters are required for supply water used in the industrial thermal energy sector:

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- Temperature requirements;
- Composition requirements;
- Purity requirements.

The thermal and chemical properties of supply water are important for the effective operation of an industrial heat energy system. The amount of energy extracted from the supply water depends on its temperature, composition and quantity.

○ The requirements for the temperature of the supply water are as follows: In industrial heat energy, water is widely used mainly for cooling processes in heat exchange systems. Before using the water, it is required to undergo chemical treatment. Therefore, its temperature should be 15-25 °C. At this temperature, water is considered ideal for chemical treatment. In addition, too low or too high a water temperature negatively affects water treatment and heat exchange processes, reducing the efficiency of the system.

○ Requirements for the composition of the supply water: In an industrial heat energy system, the chemical composition of water has a significant impact on heat exchange processes and the condition of equipment. The amount of substances in the water, such as minerals, organic substances and gases, must not exceed the established standards. Otherwise, it will lead to the formation of slag or corrosion, which will negatively affect the operation of technical equipment and devices.

○ Requirements for the purification of supply water: Supply water for an industrial heat and power system cannot be taken directly from canals or rivers and fed into the system. Before use, this water must be treated by several stages of filtration depending on its composition, and if necessary, by adding chemicals. Inorganic and organic substances, microorganisms, and various particles that may be present in the water can negatively affect the system. This, in turn, will worsen the efficiency of the system and the stable operation of the devices.

Materials and Methods

The physicochemical properties of water are as follows:

8. Water in its natural state is clean, odorless, tasteless, colorless, and clear;
9. At 4ºC, water has a maximum density of 1kg/m³;
10. High heat capacity C=4.184$\frac{J}{kg*°C}$;
11. Water is liquid from 0ºC to 100ºC;
12. Chemical formula H_2O, i.e., it consists of 2 hydrogen and oxygen, and its reactivity is considered very high.

The following formula is used to calculate the change in water temperature and, thereby, the amount of energy:

Formula 1.

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Formula for calculating heat energy:

$$Q=m\cdot c\cdot \Delta T$$

Where:

- Q - is the amount of heat energy (Joule);
- m - is the mass of water (kg);
- c - is the heat capacity of water ($\frac{J}{kg*°C}$);
- ΔT - is the change in water temperature (°C).

For example, if 1000 kg of water is taken from a canal and its temperature changes from 25°C to 35°C, we can calculate the thermal energy of the water as follows.

- The heat capacity of water is c = 4184 (total heat capacity of water);
- The mass of water is m = 1000 kg;
- The temperature change of water is ΔT = 35°C - 25°C = 10°C;

Now we add to the formula:

$$Q = 1000kg * 4184\frac{J}{kg * °C} * 10°C = 41{,}840{,}000\,J$$

So, in this case, the heat energy extracted from the canal water is 41,840,000 J (Joules). Using this formula, we can accurately calculate the amount of energy extracted from the supply water.

It is very important that the supply water of the industrial power industry is chemically treated before use. The presence of dissolved gases, nutrients and minerals in the supply water has a negative impact on the stable operation of the system. The main chemicals in the water are:

- Calcium (Ca^{2+}) and Magnesium (Mg^{2+}): When present in high levels in water, they form scale, which reduces the efficiency of the heat exchange system;
- Sulfates (SO_4^{2-}): These substances dissolve in water and can form scale in the system.
- Chlorides (Cl^-): Chlorides in water can corrode metal parts of heat exchange systems.

The following formulas are used to calculate the amount of chemicals in the water used for supply. For example, the total amount of calcium ions is calculated.

Formula 2.

Formula for calculating the concentration of calcium (Ca^{2+}) ions:

$$Ca^{2+} = \frac{C_{Ca}*V_w}{1000}$$

Where:

- Ca^{2+} - total amount of calcium ions (mg);
- C_{Ca} - concentration of calcium ions (mg/L);

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- V_w - volume of water (L).

If the canal water is 1000 L and the concentration of calcium ions in it is 75 mg/L, the amount of calcium ions is calculated as follows:

$$Ca^{2+} = \frac{75\text{mg/L} * 1000\text{L}}{1000} = 75\text{mg}$$

In this case, the amount of calcium ions in the canal water is 75 mg.

Calculation of cooling efficiency The cooling efficiency η is calculated by the following formula:

Formula 3.

Formula for calculating cooling efficiency:

$$\eta = \frac{Q_\text{r}}{Q_s} * 100$$

Where:

- Q_r - heat energy removed (Joule);
- Q_s - heat energy supplied (Joule).

If the incoming thermal energy Q_s =50 000 000(J) and the outgoing energy Q_r=41 840 000(J), we calculate the cooling efficiency:

$$\eta = \frac{41840000}{50000000} * 100 = 83.7\%$$

Therefore, the cooling efficiency through the channel water is 83.7%.

Results and Discussion

During the experiments, the effect of the supply water temperature on the system's performance was studied. The experimental results showed that an increase in the water temperature above 30°C significantly reduces the efficiency of the system, impairing the cooling system of industrial power plants. For example, if the supply water temperature is 35°C, it can be seen that the efficiency of the heat exchange system decreases by 15-20%. At the same time, the amount of minerals and other chemicals in the water also prevents the proper operation of the heat exchange system. If highly contaminated water is taken from the supply water, the wear of technical equipment accelerates and the operating time is reduced. The experiments analyzed the amount of calcium and magnesium ions in the supply water. If the amount of these substances in the water exceeds 100 mg/L, this reduces the efficiency of the heat exchange system by 10-15%. The amount of chlorides and sulfates should also not exceed 50-60 mg/L, otherwise corrosion processes will accelerate. As a result, holes can form in water pipes, heat exchangers, and pumps.

The results showed that the requirements for the temperature and composition of the supply water play an important role in increasing the efficiency

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of the industrial thermal power system. Control of the quality of the supply water guarantees not only the efficiency of energy production, but also environmental safety. The presence of a high content of minerals and chemicals in water leads to equipment failure, which in the long term causes significant economic losses.

In addition, these requirements are widely used in the fields of energy production and water resources use. For example, by controlling the quality of the supply water, the industrial thermal power system can operate more efficiently and reduce its impact on the environment. On the other hand, the study of the standards for the use of supply water also plays an important role in solving environmental problems.

Table 1.

Chemical analysis of the composition of the supply water and standards:

Name	For cooling water	For supply water
Water environment (pH)	6.5-7.5	8.5-9.5
Hardness (mg/l)	<40	<0.02
Oxygen (mg/l)	<5-10	<0.005
Chloride (mg/l)	<200	<0.1
Silicates (SiO_2) (mg/l)	<20	<1

Table 2.

Effect of supply water temperature on energy efficiency

Water temperature (°C)	Efficiency (in percent)	Effects
20	100%	Optimal efficiency
30	95%	Slight decrease in efficiency
35	80%	Significant decrease in efficiency
40	70%	Sharp decrease in operating efficiency

Conclusions

Requirements for the quality of supply water are necessary for the efficient operation of industrial thermal power. Strict adherence to temperature and composition standards increases the efficiency of energy production and ensures environmental safety. These requirements and methods for their calculation, as

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well as the results of experiments, help to create new approaches to the proper use of supply water in the energy industry.

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