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FEEDWATER TREATMENT AT THERMAL POWER PLANT

Abstract**:** *As a rule, water is used as the working fluid of thermal power equipment, which undergoes a series of phase transformations in steam cycles. Water is useful for its properties and as a result gained such wide popularity. It is important to consider that water is the most accessible, widespread and environmentally friendly substance on Earth. Water has low viscosity, high density, good heat transfer coefficient, low cost, and water does not require disposal. In addition to these properties, water also has a high heat capacity, which makes it an efficient heat transfer medium. This means that it is able to absorb and transfer large amounts of heat without a significant change in temperature. This is especially important in heat transfer systems where heat transfer efficiency plays a key role. It worth noting that water is responsive to temperature regulating. Natural water also has disadvantages, such as the possibility of corrosion processes with the formation of metal oxides (rust) and thus destruction of equipment surfaces, limescale formation on heating surfaces when heated to temperatures above 80 degrees Celsius. Therefore, it is necessary to carry out appropriate physical and chemical treatment of water to ensure all the requirements that applied to the water coolant. Certain quality indicators, processing methods and schemes, as well as equipment protection methods have been established for water. The article presents data on determining the dependence of a number of indicators of water quality taken from the water of the Irtysh River for use at Semey CHPP-1.*

Key words*: feed water, water treatment, pH value, water hardness, Semey CHPP-1, Irtysh River, filter.*

Introduction

The operation of the power station largely depends on the quality of the feed water; the better the physical and chemical preparation of the water, the longer the entire water supply system will operate. Using water that does not meet the quality requirements can lead to an emergency situations. Table 1 shows the requirements of the water treatment task [1, 2].

Table 1 – Objectives of physical and chemical water treatment

Requirements for water treatment and tasks for its implementation	
Preventing the limescale formation and various oxides on the heating surfaces of boilers and heating systems	Corrosion protection of structural metals of main and auxiliary equipment of heating systems

Special laboratories are organized in boiler houses that monitor water quality according to several indicators:

– transparency, alkalinity, hardness;

– the amount of chlorides, phosphates, iron compounds, nitrates, other salts, as well as dry residue contained;

– concentration of ammonia, free carbon dioxide, dissolved oxygen;

– indicators of acid-base balance pH [2].

The pH level characterizes the concentration of hydrogen ions. The concentration of hydrogen ions (H+) is the most important indicator for all types of water treatment, as it determines the reaction of the water (is it alkaline or acidic): neutral – pH = 7; slightly acidic – pH = (4÷6); slightly alkaline – pH = (8÷10).

Water hardness characterizes the content of Mg2+ and Ca2+ cations. Total hardness is the most important indicator of water quality. The content of scale-forming cations calcium Ca2+ and magnesium Mg2+ determines water hardness [3].

A large number of works are devoted to improving the quality of feed water and improving water treatment methods [4-9].

Measures taken to reduce deposits on heating surfaces and prevent the formation of corrosion are given in Table 2 [10]. Water quality requirements are standardized by relevant documents.

Table 2 – Measures to improve the quality of feed water [10]

Measures taken to reduce deposits on heating surfaces	Measures taken to prevent the formation of corrosion on heating surfaces
removal of mechanical impurities using mesh filters	adjusting the pH value of water acidity
removal of iron and manganese using catalytic filters	dosing corrosion inhibitors into water
water softening using ion exchange equipments	removing oxygen from water by adding agents that bind excess oxygen, or by subjecting the water to degassing in special devices
Carrying out water desalination using reverse osmosis units	

Formulation of the problem

The feed water of Thermal Power Plant-1 (TPP-1) of the city of Semey was considered as the object of study.

The purpose of the work is to study the efficiency of water treatment at TPP-1 in Semey.

The research method is experimental-theoretical.

Research results

The work was carried out on the basis of analysis data that is carried out daily by the enterprise laboratory. Water intake for TPP-1 is carried out from a dam, which is located on the Irtysh River. The water immediately enters the chemical water treatment plant.

In the chemical water treatment workshop of TPP-1 there is:

– chemical water treatment equipment;
– management of chemical reagents;
– salt farming;
– tank farm;
– equipment and instruments of the chemical laboratory and express laboratory.

Figure 1 shows a chemical water treatment workshop.

Figure 1 – Chemical water treatment workshop of TPP-1 in Semey

The following was installed at TPP-1:

– 2 illuminators;
–5 mechanical filters;
–5 stage 1 Na-cation exchange filters;
–5 Na-cation exchange filters of the second stage.

A storage tank is located on the territory of the company (Figure 2).

Figure 2 – Storage tank

For thermal power equipment, the following stages of water treatment are distinguished:

– preliminary;

– pre-boiler;

– intra-boiler.

Water treatment methods, depending on the operating principles used in them, are divided into four groups:

– chemical;

– physical;

– physical and chemical;

– biological [3].

As a result of the research, the pH value and hardness were determined for feed water taken from the Irtysh River during the heating season from October to November 2022-2023. (Figures 3, 4). dm3

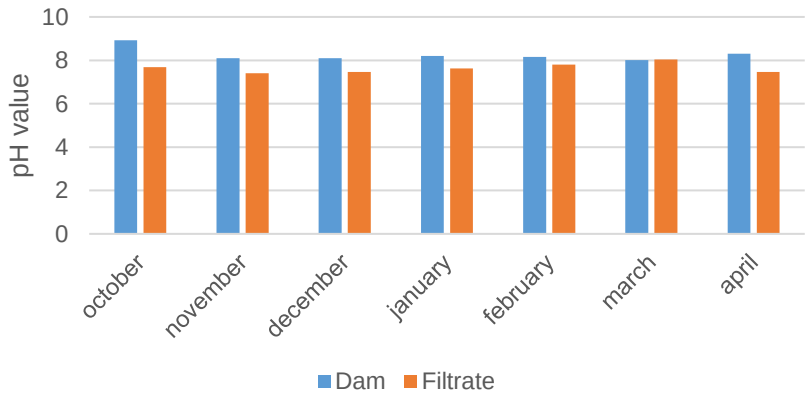

Figure 3 – Hydrogen indicator of feed water during the heating season

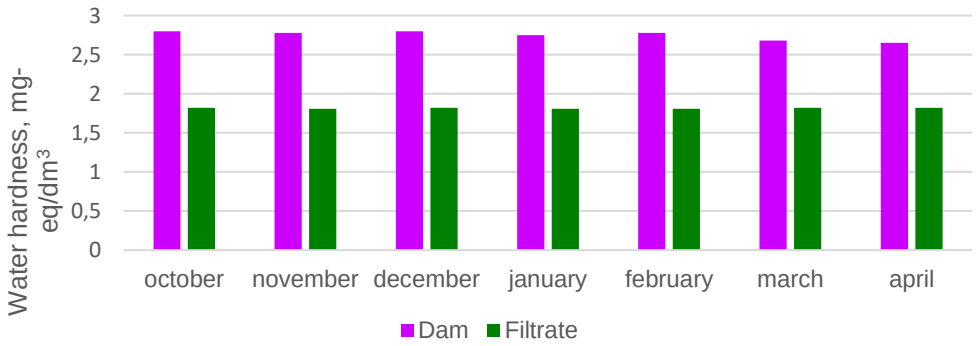

Figure 4 – Feedwater hardness during the heating season

Analysis of the data presented in Figures 3,4 showed that the pH value throughout the year (heating season) has stable values for both natural and filtered water and differs little from each other. The overall hardness of natural water decreases in March and April, which can be explained by the beginning of snow melting; in other months these indicators are stable.

Conclusions

Monitoring of the water of the Irtysh River, which is used at TPP-1, showed that there is a seasonal dependence of the pH value and total hardness, which is caused by floods. As a result of the preliminary purification of river water (treatment in clarifiers and mechanical filtration), the pH value and overall hardness decrease. According to these indicators, the water meets the standard data.

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ЖЭО-ДА ҚОРЕКТІК СУДЫ ӨҢДЕУ

Су әдетте жылу энергетикалық жабдықтың жұмыс сұйықтығы ретінде пайдаланылады, ол бу циклдерінде бірқатар фазалық өзгерістерге ұшырайды. Судың өзінің артықшылықтарын көрсететін көптеген қасиеттері бар, нәтижесінде ол оны пайдалануда осындай кең танымалдыққа ие болды. Судың жер бетіндегі ең қолжетімді, кең таралған және экологиялық таза зат екенін ескеру қажет. Судың тұтқырлығы төмен, тығыздығы жоғары, жылу беру коэффициенті жақсы, құны төмен, суды қоқысқа тастау қажет емес. Суды жұмыс сұйықтығы ретінде пайдаланған кезде қыздыру температурасын реттеу үшін жақсы жағдайларды атап өту керек. Әрине, табиғи судың да кемшіліктері бар, мысалы, металл оксидтерінің (тот) пайда болуымен және жабдық беттерінің бұзылуымен және 80 градус Цельсийден жоғары температураға дейін қыздыру кезінде қыздыру беттерінде қақтардың пайда болуымен коррозия процестерінің болуы. Сондықтан суды

салқындату сұйықтығына қойылатын барлық талаптарды қамтамасыз ету үшін суды тиісті физикалық және химиялық өңдеуді жүргізу қажет. Су үшін белгілі бір сапа көрсеткіштері, өңдеу әдістері мен схемалары, сондай-ақ жабдықты қорғау әдістері белгіленген. Мақалада Семей қаласындағы ЖЭО-1 пайдалану үшін Ертіс өзенінің суынан алынатын су сапасының бірқатар көрсеткіштерінің тәуелділігін анықтау деректері келтірілген.

Түйін сөздер: *азық суы, суды тазарту, pH мәні, су кермектігі, сүзгі.*

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ОБРАБОТКА ПИТАТЕЛЬНОЙ ВОДЫ НА ТЭЦ

В качестве рабочего теплотеплоэнергетического оборудования как правило используется вода, которая претерпевает ряд фазовых превращений в паровых циклах. Вода имеет много свойств, которые демонстрируют ее преимущество, в результате которых она получила такую широкую популярность в ее использовании. Важно учитывать, что вода является самым доступным, распространенным и экологически безопасным веществом на Земле. У воды низкая вязкость, высокая плотность, хороший коэффициент передачи тепла, низкая стоимость, а также вода не требует утилизации. При использовании воды в качестве рабочего тела следует отметить хорошие условия для регулирования температуры нагрева. Конечно, у природной воды есть и недостатки, такие как возможность возникновения коррозионных процессов с образованием оксидов металлов (ржавчины) и разрушением поверхностей оборудования, образование накипи на поверхностях нагрева при нагревании до температуры свыше 80 градусов Цельсия. Поэтому необходимо проведение соответствующей физико-химической обработки воды для обеспечения всех требований, которые предъявляются к водному теплоносителю. Для воды установлены определенные показатели качества, методы и схемы обработки, а также методы защиты оборудования. В статье представлены данные по установлению зависимости ряда показателей качества воды, отбираемой из воды реки Иртыш для использования на ТЭЦ-1 города Семей.

Ключевые слова: *питательная вода, водоподготовка, водородный показатель pH, жесткость воды, фильтр.*

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UTILIZING DETONATION SPRAYING IN THE PROCESS OF FORTIFYING COMPONENTS WITHIN POWER PLANT TECHNOLOGY

Abstract: *The article addresses challenges related to enhancing the performance characteristics of power plant components. Research conducted by different authors demonstrates that when aiming to enhance the operational qualities of these parts, detonation spraying yields superior outcomes owing to its low porosity, high strength, and strong adhesion of the coatings produced. Also benefits of employing Ni-Cr-Al-based coatings as high oxidation resistant coating. The study involves the acquisition of Ni-Cr-Al-based gradient structured coatings using detonation*