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PREPARATION OF RAW WATER IN THERMAL POWER PLANTS

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ANNOTATION

Some modern possibilities for modernization of the water preparation in the heat power plants of metallurgical enterprises are presented. It is focused on the ecological and technological advantages of the methods for obtaining of ultra-pure water. This work is not intended to justify the need of usage of particular technology in an object. This is a separate task requiring in-depth consideration.

Keywords: raw water, technology, thermal power plant, method, innovation.

INTRODUCTION

Natural water can not be used in modern technological processes without pre-treatment. It needs to be softened and demineralized by ion exchange treatment in the industrial unit in heat power plants. In this way the necessary quality of the water circulating in the energy boilers is achieved, also the produced steam for technological needs is achieved. Some negative phenomena are preventing. They are causing:

- Deposition of salts on the heating surfaces of the steam generators;
- Deposition of salts on the blades, nozzles and guides of the steam turbines, which creates a risk of imbalance of the impeller, narrowing of the space between the blades, which leads to decreasing of the aggregates power;
- Decreasing the flow rate of the steam from steam generators, respectively their productivity;
- Creating conditions for overheating the heat exchange surfaces of the steam generators, etc

MATERIALS AND METHODS

The requirements for the quality of the treated water in the chemical treatment facilities for the heat power plants are shown in Table 1.

Table 1. Requirements for the quality of feed water for steam generators in industrial heat power plants

Parameter	Permissible norm
Specific conductivity	< 0,2 μSm/cm
Hardness	<5mg-eq/l
Sodium concentration	3-10mg/l
Silicone acid concentration	<0,2mg/l
Concentration of chlorides	<3mg/l
Concentration of organic carbon	100-300mg/l
Concentration of sulfates	<3mg/l

Conventional ion exchange systems shown in Fig.1 are not as complicated as construction and are reliable in operation. However, as mentioned, all their disadvantages are related to the need to use large quantities of ionic mass recovery reagents.

RESULTS AND DISCUSSION

Regenerative solutions are aggressive and contain components that go beyond environmental standards, and the process itself is not automated.

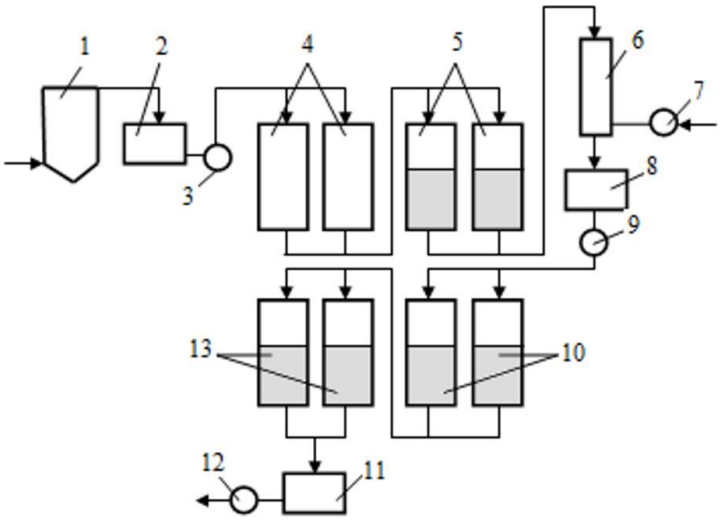

Fig. 1. Conventional ion-exchange installation: 1 - reactor-precipitator; 2 - clear water tank; 3 - clear water pump; 4 – sand filters; 5 - strong cationite filters; 6 - deaerator; 7 - air fan; 8 - cationic water tank; 9 - cationic water pump; 10 - weak anionic filters; 11 – demineralized water tank; - 12 - demineralized water pump; 13 - strong anionic filters

In some heat power plants these acidic and alkaline waters are mutually neutralized in the tanks in which they are mixed. Often, however, in the ion exchange plants the regenerations of the two types of filters do not take place simultaneously. In addition, sulfuric acid streams contain larger amounts of acid than the sodium hydroxide in the alkaline. For this reason, it is necessary to neutralize the waste water, which is collected in a common vessel and treated with a reagent [3]. A stock of chemicals is also needed, which is accompanied by additional costs.

In this connection, there is a need for increased control and monitoring of spent water, improvement of existing technologies or replacement with new more efficient ones.

Modern alternatives for ion exchange are ultrafiltration using mix-bad filters and compact layer membrane technologies including reverse osmosis and / or electro- deionization. They allow to improve the quality of treated water with minimal reagent consumption.

Water purification by reverse osmosis systems involves the forced passage of the treated water through a semipermeable membrane. In most cases they are not universal. Typically, the scheme is developed taking into account a number of factors, including the business itself, the required volumes of purified water, and so on [5].

High purified water can be obtained by two-stage osmosis, in which the water stream is purified from salts to 97% and a specific electrical conductivity of 1-5 µSm/cm before final purification in mix-bed filters or electro-deionization module (Fig.2).

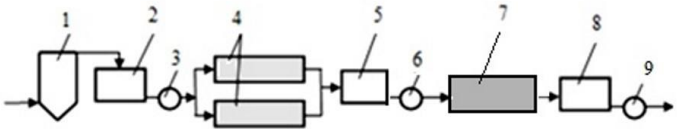

Fig.2. Scheme of an ion-exchange installation with reverse osmosis combined with electro-deionization system or mix-bed filters:1 - reactor-precipitator; 2 - clear water tank; 3 - clear water pump; 4 - reverse osmosis membranes; 5 - partial desalinated water tank; 6 - partial desalinated water pump; 7 – electro-deionization system or mix-bed filter; 8 – ultra demineralized water tank; 9 - ultra demineralized water pump

The advantages of membrane technologies based on reverse osmosis have been thoroughly studied. In [4,5] there are models for optimizing the consumption of chemicals and labor by adding a reverse osmosis module to existing installations.

CONCLUSION

Obtaining of ultra-demineralized water in power plants is one of the main tasks in steam production for technological needs. Although the ion exchange installations have been in operation for a long time, their modernization is necessary. This will leads to decreasing of capital and operating costs increasing of the ecological efficiency, incl.

- Decreasing the technological time for putting the equipment into operation;
- Reduction of the environmental risk in servicing the waste streams neutralization system;
- Decreasing the cost of resin regeneration reagents of the filters;
- Improvement of working conditions;
- Savings for servicing and repair due to automation of the process.

The presented article would be useful for designing of new or for reconstruction ofexisting schemes for water preparation.

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