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Water Treatment Against Salt Accumulation for Circulating Water Supply System

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Abstract: *The purpose of this work is the scientific substantiation and industrial implementation of methods of protection against corrosion, biofouling and scaling of the equipment of circulating water supply systems while reducing water consumption and wastewater discharge.*

A method has been developed on the basis of the research, to protect the equipment of the circulating water supply system against salt deposition using caustic soda spontaneously entering the system to protect it.

Recommendations are given for pilot tests on the protection of metal structures and heat-exchange equipment of circulating water supply systems for conditionally pure water when operating on water with a mineralization of up to 4 g/l.

To protect against corrosion the equipment of circulating water supply systems, into the water of which copper salts enter, an effective inhibitory composition (mg/l) is recommended and implemented: sodium silicate - 25.50, sodium tripolyphosphate - 25.50, synthamide -0.5.1.5.

Keywords: *water supply, water circulation cycles, scale, corrosion, reagents, circulating water supply system.*

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Introduction

Recycled water supply is a closed system that allows you to reuse wastewater that has been treated at special treatment facilities of the enterprise. The concept of recycling water supply of the enterprise almost completely eliminates the discharge of industrial wastewater into water bodies or city sewers. The circulating water supply system is quite often used in heat exchangers in industries where cooling or heating of water is necessary.

The primary issues that develop during the operation of water cycles in industrial organizations are scale, corrosion, and biological deposits. These issues have a significant impact on the manufacturing process, resulting in higher energy consumption, lower heat transfer efficiency, and higher operating expenses.

These undesirable processes cause a sharp decrease in the intensity of equipment operation: the efficiency of heat transfer decreases, which leads to the need to increase the flow rate of the coolant; mechanical deposits on the walls of the equipment reduce the cross section of the passage, clog

pipelines, there are frequent cases of corrosion under the salt layer on the surface of metal walls, this leads to pipe punctures, the formation of through holes and reagent leaks. All this leads to higher production costs. With a competent engineering approach, these costs can be reduced by organizing an optimal water recycling scheme, using advanced cleaning methods and creating a single complex that combines water supply, sewerage and wastewater treatment (in order to reuse them and possibly dispose of the resulting waste).

To improve the efficiency of water circulation cycles, heat exchange equipment, and their protection, integrated reagent treatment programs must be used, which will provide:

- protection of heat exchange equipment and pipelines from corrosion and hardness salt deposits;
- Maintenance of microbiological contamination of recycled water at a level that meets the standards, excluding the formation of biofilms and biological deposits.

The wide use of water georesources as working bodies in hydro- and thermal power engineering, as well as in heat supply and cooling systems, determines the study's importance. In this instance, sophisticated water purification is frequently required before beginning the primary production cycle. Water must be free of colloidal, scale-forming, and gaseous contaminants in particular. The cleansing of water from hardness salts, or softening, is the most challenging task. Scale is formed when calcium and magnesium salts precipitate on heat exchange surfaces, resulting in a significant reduction in heat exchange equipment efficiency, high fuel use, and frequent cleaning stops. Scale is normally removed mechanically or by acid washing the internal heat exchange surfaces. All these methods are associated with the use of a large amount of chemicals and heavily pollute wastewater. In addition, this significantly increases operating costs.

When choosing a treatment mode, many factors should be taken into account: the required system performance, the degree of wastewater pollution, the need to extract valuable (useful) components for their reuse in production, different requirements for the quality of recycled water in different technological cycles, requirements for the quality of waste water, etc.

The data obtained allow us to assess the tendency of water to corrode or deposit. This is necessary for the competent development of a program of stabilization water treatment.

Mechanical, biological, and physico-chemical water purification technologies are now used in water circulation systems. Chemical reagent therapy is said to be the most successful and profitable option. It not only protects expensive equipment from premature failure, but also provides for significant cost savings and a reduction in the amount of water used for make-up. This mode is reduced to three processing stages:

The first stage is determining the aggressive qualities of water in the circulating water supply system and establishing quality standards.

The pH value, alkalinity, carbonate hardness, electrical conductivity (or salinity), and water temperature are used to evaluate the aggressive qualities of water. The information gathered allows us to determine corrosive water.

The second stage is the selection of chemical reagents and determination of their quantity for the stabilization treatment of recycled water

The selection of a program for the chemical treatment of circulating water should take into account the following factors: the composition of the source water and the requirements for its quality; operational parameters of the cycle (make-up, purge, system volume, evaporation coefficient); environmental standards and safety requirements.

The third stage is an experimental verification of the effectiveness of the program for the reagent treatment of recycled water.

At this stage, after installation and commissioning of the system for reagent treatment of recycled water, for, as a rule, 1-1.5 months, constant monitoring of water quality, the rate of corrosion processes, scaling and bio-overgrowth of structural elements is carried out.

The main reagents used in the treatment of circulating water supply can be divided into three main groups:

- Corrosion inhibitors;
- Scale inhibitors;
- Reagents aimed at combating biological pollution.

Corrosion inhibitor - a combination of phosphonocarboxylic acids and water-soluble polymers that inhibits corrosion and scale development in a specific ratio. It aids in the quick creation of a protective coating over the entire metal surface, preventing electrochemical corrosion processes. Because of the blockage of crystallization centers and very efficient dispersion, the reagent has an anti-scale effect.

Biodispersants are a type of detergent that is used to remove oil deposits and biofouling from the surfaces of heat exchangers and cooling tower parts.

Biocides - non-oxidizing biocide of a wide spectrum of action, highly effective for closed cooling systems, has a prolonged action. It is used at neutral and slightly alkaline pH values of the treated water up to 9.0. Compatible with oxidizing biocides, not degraded by chlorine.

Since micro-organisms quickly develop tolerance to a single active substance, the use of an oxidizing and non-oxidizing biocide together in the system is recommended to ensure maximum effectiveness.

Other reagents Antiscalants prevent the precipitation of carbonate, sulphate, silicon, iron-containing deposits, as well as organic contaminants on the internal surfaces of the circulating water supply system. Reagents have different compositions depending on which elements in the water are causing the precipitate to form. During the chemical reaction of antiscalants in water, the concentration threshold shifts, at which salt precipitation begins and crystal growth becomes impossible.

Deoxidants bind the oxygen dissolved in the circulating water (chemical deaeration). Due to this, corrosion protection of metal surfaces of equipment is provided, as well as an increase in the protective effect of inhibitors of carbon dioxide and hydrogen sulfide destruction of parts.

The principle of action of Defoamers (antifoamers) is to suppress the processes of foam formation in circulating water supply systems. They can consist of both organic and silicone materials.

The physico-chemical parameters of the reagents are presented in the respective safety data sheets.

Thus, measures for the purification and reuse of recycled water will reduce the volume of water consumption, wastewater disposal, as well as the volume of discharged effluents

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