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**WATER TREATMENT  
AND WATER CHEMISTRY**

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## **Water Chemistry of a Combined-Cycle Power Plant's Auxiliary Equipment Cooling System**

**B. M. Larin, A. N. Korotkov, M. Yu. Oparin, and A. B. Larin**

*Ivanovo State Power Engineering University, Rabfakovskaya ul. 34, Ivanovo, 153003 Russia*

**Abstract**—Results from an analysis of methods aimed at reducing the corrosion rate of structural metal used in heat-transfer systems with water coolant are presented. Data from examination of the closed-circuit system for cooling the auxiliary mechanisms of a combined-cycle plant-based power unit and the results from adjustment of its water chemistry are given. A conclusion is drawn about the possibility of using a reagent prepared on the basis of sodium sulfite for reducing the corrosion rate when the loss of coolant is replenished with nondeaerated water.

**Keywords:** water chemistry, heat-transfer equipment, thermal power stations, corrosion rate, chemical washing operations, corrosion inhibitors

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The closed-circuit cooling system (CLCS) of the auxiliary mechanisms of a power unit constructed on the basis of a combined-cycle plant (CCP) is a typical closed-loop water cooling system containing up to 300 m<sup>3</sup> of medium having a temperature of up to 40–45°C. The pipelines and some heat exchangers of such system are made of steel. Corrosion damage inflicted to the thermal equipment and pipelines of such systems is a serious problem so that constant attention should be paid to cope with it [1–4].

In 2004, the Water Treatment and Water Chemistry Subsection of the Scientific-Technical Council of RAO Unified Energy Systems of Russia discussed the document *Methodical Guidelines for Using OEDFK, AFON 200-60A, AFON 230-23A, PAF-13A, and IOMS-1 Antiscale Agents and Corrosion Inhibitors at Power Industry Enterprises* [3]. Application of phosphonates (organic compounds containing the phosphon group PO<sub>3</sub>H<sub>2</sub>) is a relatively new method for preventing scale formation. The following phosphonates are most frequently used at present: hydroxyethylidene diphosphon acid (OEDFK), zinc hydroxyethylidene diphosphonate (4), disodium salt (OEDF-zinc), mineral salt sedimentation inhibitor IOMS-1, and a PAF-13A reagent.

Clearly, oxygen and hydrogen ions are the main corrosion agents. The aim of this work is to generalize the experience gained with control of corrosion in return water utilization systems and to elaborate measures for reducing the corrosion rate of structural steel used in CLCSs based on an analysis of the technological features pertinent to the closed cooling circuit of a CCP-based power unit.

Below, the results of some investigations and industrial tests on preventing corrosion of return systems

with water coolant are presented. Thus, the authors of [5] carried out works for improving the water chemistry of the Kharkov heat supply networks during their startup stage, and the following was determined during the tests. Nondeaerated softened water behaves a highly corrosive medium due to a high content of dissolved oxygen and a low pH value (7.0–7.8) in it; therefore, each case of supplying nondeaerated water into heat networks must be regarded as an emergency one. If nondeaerated water is supplied into networks, measures must be taken for reducing the corrosiveness of nondeaerated water and for removing iron compounds from water entered into it as a result of corrosion.

In [6], data are presented from a study of the corrosiveness of natural water and water that passed treatment using different methods: ion-exchange treatment in a production plant's water-treatment structures and correction treatment by alkali or by a Hydro-X reagent produced by the Dutch company Hydro-XA/S.

An analysis of the obtained results allows us to draw certain conclusions and generalizations.

The effect groundwater from different locations in the Moscow region has on Grade St.3 steel gives rise to approximately the same corrosion rate corresponding to 5 points on the scale according to GOST (State Standard) 13819-68. The pitting corrosion rate differs from place to place and is determined by the anion composition of water.

Demineralization of water has an effect on its corrosiveness. Deep ion-exchange treatment slows down the corrosion rate by approximately a factor of 2.

The effect of reagent-assisted treatment depends on the established pH value. At pH ≤ 9.2, the initial