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Guidance on water conservation techniques of circulating cooling water in thermal power plants

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Guidance on water conservation techniques of circulating cooling water in thermal power plants

Lignes directrices pour les techniques de conservation de l'eau consistant à faire circuler l'eau de refroidissement dans les centrales électriques thermiques

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Introduction

Water plays an important role in transferring energy, cooling and cleaning in the process of thermal power generation. According to the statistics of the International Energy Agency (IEA) and China Water Resources Bulletin, fossil fuel power generation used approximately 189,6 billion cubic metres of freshwater in 2021, accounting for almost 50 % of global energy system freshwater withdrawals and 5 % of total global freshwater withdrawals. In China, water withdrawal for thermal power generation in 2021 accounted for approximately 17,7 % of the industrial water withdrawal, of which cooling water in thermal power plants accounted for approximately 50 %. To save water resources, improve circulating cooling water use efficiency and help thermal power plants to enhance water conservation, work efficiently and orderly, and thus improve the economic and social benefits of thermal power plants, it is important to formulate guidance for the conservation of water used as circulating cooling water in thermal power plants.

The quantity of circulating cooling water used in thermal power plants ranges from tens to hundreds of thousands of cubic metres based on their operating capacity. The reduction of circulating cooling water use should consider the water quality, pipe materials, water treatment, chemicals and other factors. Meanwhile, to achieve water conservation purposes, the use of residual heat of high temperature circulating water to reduce the temperature of circulating water in the cooling tower should be considered. Cycles of concentration is an important index for evaluating water conservation of circulating cooling water, while the amount of make-up water is closely related to the cycles of concentration of circulating cooling water. The higher the concentration, the better water conservation efficiency. However, with higher concentrations, the cost and difficulty of water treatment also increase exponentially.

Circulating cooling water quality control index and water conservation processes differ based on the quality of make-up water. Researchers and engineers should standardize the water conservation process of circulating cooling water in thermal power plants by fully considering the cycles of concentration and other relevant influencing factors, to provide standardized technical guidance for the targeted stake holders (policy makers, managers, technical consultants, designers, operators of water treatment systems, etc.).

Through analysis and research on the circulating cooling water conservation technology in thermal power plants, this document sets up a scientific and objective technical control index, management guidance and implementation methods that are helpful to improve the efficiency of circulating cooling water conservation and the standardization of technical transformation of thermal power plants.

Starting from the perspective of water conservation management and technology, this document provides acceptable operation control specifications for common processes of circulating cooling water conservation for most stakeholders, to improve the operation efficiency and management level of circulating cooling water conservation, which is conducive to guiding the development of specialization, normalization and standardization of circulating cooling water conservation.

This document establishes the technical guidance and recommendations for circulating cooling water conservation technology, provides research direction of circulating cooling water conservation technology, improves the water conservation efficiency, and promotes the transformation of circulating cooling water conservation technology to higher efficiency, lower energy consumption, environment friendly and resource saving, in the end realizing sustainable development.

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Guidance on water conservation techniques of circulating cooling water in thermal power plants

1 Scope

This document provides technical and management guidance for water conservation of indirect open recirculating cooling water systems in thermal power plants. It is applicable to circulating cooling systems that use surface water, underground water, reclaimed water, and treated domestic sewage from thermal power plant as the make-up water and use physicochemical treatment methods to increase cycles of concentration, thus realizing water conservation and increasing water use efficiency.

This document is applicable to recirculating cooling in thermal power plants fuelled by coal, oil, natural gas, and biomass.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
water conservation of circulating cooling water
process to increase *cycles of concentration* (3.1.2) thus increasing water use efficiency

3.1.2
cycles of concentration
ratio of the concentration of specific ions in the circulating cooling water to the concentration of the same ions in the make-up water

[SOURCE: ISO 16784-2:2006, 3.6]

3.2 Abbreviated terms

BOD_5	biochemical oxygen demand at five days
CFU	colony forming unit
COD	chemical oxygen demand
DO	dissolved oxygen
NH_3-N	ammonia-nitrogen

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NTU nephelometric turbidity unit

TDS total dissolved solids

TSS total suspended solids

4 General

The following principles should be followed for water conservation of circulating cooling water in thermal power plants:

— Users should develop efficient circulating cooling water treatment technology, improve the cycles of concentration under the premise of ensuring system safety and energy saving.

— Users should be aware of the requirements of local environment protection regulation.

— Water treatment chemicals with high efficiency, low toxicity and good chemical stability should be used; biodegradable water treatment chemicals should be given priority; toxic and harmful water treatment chemicals should be strictly restricted.

5 Circulating cooling water quality recommendations

5.1 Water quality recommendations of make-up water

When surface water, underground water, seawater, reclaimed water, and treated domestic sewage from thermal power plants are used as make-up water for circulating cooling water system in power plants, the quality of the source water and of the circulating cooling water and the working conditions should be analysed, and technical and economic comparison should be made to select the appropriate cycles of concentration. Table B.1 in Annex B contains water quality recommendations when surface water, underground water is used as make-up water for circulating cooling water system after pre-treatment. Table B.2 in Annex B contains water quality recommendations when reclaimed water is used as make-up water for circulating cooling water system after pre-treatment. When treated domestic sewage from thermal power plant is used as make-up water for circulating cooling water system, the water quality after treatment should not be lower than the recommendations in Table B.2 in Annex B. Table B.3 in Annex B contains water quality recommendations when seawater is used as make-up water of circulating cooling water system.

5.2 Water quality recommendations of circulating cooling water system

The water quality of circulating cooling water systems using surface water, underground water, reclaimed water, and domestic sewage from thermal power plants as make-up water should meet the recommendations of Table 1.

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