

Analysis of the Current Status and Measures of Industrial Boiler Water Treatment

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Abstract: Water treatment plays a decisive role in the safe, economic, and green operation of industrial boilers. If water treatment is not carried out properly, it can easily lead to boiler scaling, corrosion, and even tube rupture and shutdown, increasing energy consumption and directly affecting industrial production. By systematically studying new water treatment technologies, environmentally friendly agents, and online equipment, the development of industrial boiler water treatment technology can be further promoted to reduce the occurrence of scaling, corrosion, and even tube rupture and shutdown in boilers, thereby achieving the goal of safe, economic, and green operation of industrial boilers.

Keywords: Industrial Boiler; Water Treatment; Water Quality; Energy-Saving

1. Introduction

With the rapid development of the national economy, safe production and green operation have become necessary trends in domestic industrial development. Boilers play an important role in industrial production, and the safe, energy-saving, and environmentally friendly operation of boilers plays a decisive role in the safety of industrial production. Factors such as the design level of boiler designers, manufacturing process technology, installation qualification capabilities, boiler operator operation capabilities, feedwater quality control technology, and in-boiler dosing treatment affect the safe operation of boilers. At present, due to measures such as controlling the qualifications of boiler design units, reviewing the process level of manufacturing units, and supervising the certification of installation unit capabilities, boiler safety accidents caused by quality

problems such as design, manufacturing, and installation have gradually decreased, but accidents caused by improper water treatment control have shown an upward trend. Studies have found that the main factors affecting the safe operation of boilers include boiler operation management, water treatment operation management, raw water quality, selection of water treatment equipment, boiler operator water treatment operation procedures, selection of water treatment agents, and dosing control. Therefore, to ensure the safe, energy-saving, and economical operation of boilers, it is crucial to do a good job in supervising and managing the boiler water treatment system and supervising the safe operation of boilers.

As a key equipment for providing thermal energy, industrial boilers play an important role in many industrial fields. However, the quality of boiler water treatment is directly related to the safety, economy, and operating efficiency of the boiler. Therefore, the research on industrial boiler water treatment has important practical significance. This literature review aims to comprehensively analyze the current research progress on industrial boiler water treatment, including the operation status of water treatment systems, existing problems, and corresponding solutions. By summarizing and evaluating the existing research results, this paper aims to provide references and lessons for research and practical operations in related fields, promote the development and application of industrial boiler water treatment technology, and achieve safer, more economical, and more efficient energy utilization.

2. Research Status

The research on the practice and problems of industrial boiler water treatment in Zhangzhou City mainly focuses on the operation status

and existing problems of the water treatment system of industrial boilers in the city. Relevant studies have analyzed the current status of water quality treatment of industrial boilers in Zhangzhou City through field investigations and found that the water quality in Zhangzhou area is generally acidic, and the phenolphthalein alkalinity of untreated boiler water basically does not meet the standard, affecting the normal use of boiler water. Targeted measures to improve the water treatment management of boiler users are proposed to help prevent safety accidents and achieve energy-saving and emission reduction [1-5]. This study provides basic theoretical knowledge and practical guidance for the common problems in the use of industrial boilers (such as substandard water quality, scaling, corrosion, etc.) that affect the safe and economical operation of boilers, and improves the awareness of water treatment management among users. Niu [6] conducted an in-depth investigation and analysis of the water treatment status of industrial boilers in Anyang City. Due to poor water quality, boiler scaling, corrosion, and steam-water entrainment can occur, and corresponding solutions are proposed. By specifically analyzing water quality problems and summarizing the shortcomings of water treatment work in the city, practical guidance is provided for subsequent improvements. Industrial boiler water treatment is an important link to ensure the safe, economic, and environmentally friendly operation of boilers. Through the analysis and optimization of existing water treatment technologies, water treatment problems can be effectively solved, energy consumption and environmental pollution can be reduced, and it is of great significance to promote sustainable development.

The water treatment and energy-saving and emission reduction of industrial boilers is an important issue in the current application of industrial boilers. The research of Li et al. [7] in-depth explores the energy-saving and emission-reduction measures of industrial boiler water treatment. Through the analysis of actual cases, it is found that boiler scaling, corrosion, and substandard water quality problems exist, and provides operational methods and strategies for energy-saving and emission reduction, emphasizing the important role of water treatment work in improving

energy utilization efficiency and reducing environmental pollution. In addition, some studies have discussed the water treatment and energy-saving and emission-reduction methods of industrial boilers, analyzed the existing problems in current water treatment, and proposed suggestions for strengthening water treatment inspection, in order to reduce energy consumption and improve operating efficiency [8-12]. Through reasonable water treatment strategies and technological improvements, the goal of energy-saving and emission reduction of industrial boilers can be effectively achieved, which is of great significance for promoting the sustainable utilization of energy and environmental protection.

The research and application of phosphorus-free boiler water treatment agents is an innovation in the current water treatment field. The research of Jia et al. [13] developed a new type of phosphorus-free agent for a specific industrial boiler water treatment problem to control boiler water indicators, reduce discharge rate, and improve boiler thermal efficiency, providing a new solution for solving water treatment problems under environmental requirements. In terms of the application of phosphorus-free water treatment agents, Shi's research also provides important practical and theoretical support. By improving the existing water treatment technology, the energy-saving and emission reduction effect of industrial boilers is further optimized [14]. In summary, the development and application of phosphorus-free boiler water treatment agents mark the development of industrial boiler water treatment technology towards a more environmentally friendly and sustainable direction, which is of great practical significance for protecting water ecosystems and promoting green production.

Effective supervision and management is the key to ensuring the quality of industrial boiler water treatment. Lin [15] conducted a sampling survey of industrial boilers in Quanzhou area, analyzed the existing problems in water treatment, and proposed effective solutions for a new management model framework, which helps to comprehensively improve the quality of water treatment and operating efficiency. Liu [16] also conducted a research analysis on the current status of water treatment work in

enterprises using industrial boilers, summarized the existing problems in water treatment work, and proposed solutions, providing a reference for improving the production efficiency and economic efficiency of enterprises. Comprehensive analysis shows that a good supervision and management mechanism is the foundation to ensure the quality of industrial boiler water treatment. By continuously optimizing management strategies and technology applications, the safety and operating efficiency of industrial boilers can be effectively improved, while reducing energy and resource waste.

Deoxygenation of industrial boiler feedwater is an important measure to improve combustion efficiency and reduce energy consumption. Qu [17] in-depth explored the impact of feedwater deoxygenation on improving boiler energy efficiency, and proposed improved water treatment processes and energy-saving and emission-reduction measures, providing a practical and feasible technical route for industrial boiler energy-saving and emission reduction. In the application research of industrial boiler feedwater deoxygenation, Zheng [18] also provided in-depth analysis and practical suggestions. By innovating control technology and water treatment processes, the operating energy efficiency of industrial boilers is further optimized. In general, the research and application of industrial boiler feedwater deoxygenation is an effective way to improve energy efficiency and reduce environmental pollution, and has important value for promoting the sustainable development of industrial boilers [19-20].

3. Existing Problems

Currently, the research on industrial boiler water treatment mainly focuses on the operation status of water treatment systems, existing problems, solutions, and how to improve boiler energy efficiency and reduce environmental pollution through water treatment. Industrial boiler water treatment plays an important role in ensuring the safe and economical operation of boilers, reducing energy consumption, and reducing environmental pollution. However, existing studies only reveal some common problems, such as insufficient enterprise management awareness, insufficient enterprise attention to

water treatment work, unqualified water treatment operators, weak theoretical knowledge of water treatment operators, water treatment operators unable to operate experimental equipment or inaccurate monitoring, insufficient or no water quality monitoring frequency, high water quality failure rate, unreasonable selection and application of water treatment agents, water treatment agent failure, test reagent failure or incorrect concentration, ineffective implementation of energy-saving and emission-reduction measures, blind discharge, non-reuse of steam condensate, low boiler thermal efficiency, etc. Under the requirements of TSG 11-2020 "Boiler Safety Technical Regulations", it is required to test at least once per shift, which has high requirements for enterprise management and operators. The current solutions mainly focus on strengthening enterprise management awareness, improving the professional quality of operators, and strengthening testing capabilities, which cannot effectively and quickly solve the fundamental problems of current industrial boiler water treatment.

4. Outlook

In view of the shortcomings of the above research, future research directions can be achieved through in-depth research and development of new and environmentally friendly water treatment agents to reduce the impact on the environment and improve treatment efficiency; optimize existing water treatment processes to reduce energy consumption and improve boiler operation efficiency; and in-depth exploration of new technologies and methods for energy-saving and emission reduction to promote the sustainable development of industrial boilers. In addition, strengthening the training of water treatment operators, improving their awareness of the importance of water treatment and operational skills, is also an important direction for future research; developing new automated monitoring equipment to reduce human judgment errors, real-time update data, scientifically control dosing, real-time monitoring data, and scientifically guide discharge to fundamentally solve the problem of improper water treatment control. Through these studies, the development of industrial boiler water treatment technology can be

further promoted to reduce the occurrence of scaling, corrosion, and even tube rupture and shutdown in boilers, reduce fuel consumption, reduce boiler discharge rate, improve boiler thermal efficiency, reduce environmental thermal pollution, and ensure that the unit achieves safe, economical, and green operation.

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