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Application and Development of Green Chemical Environmental Protection Technology in Industrial Production

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Abstract: Against the backdrop of accelerating globalization and the rapid advancement of global carbon neutrality goals, green environmental protection has become a core requirement for the development of various industries. Green chemical technology is playing an increasingly important role in reducing pollution and carbon emissions in industrial production. Taking chemical production as an example, traditional chemical production relies on fossil raw materials and high-energy-consuming processes, which easily lead to environmental pollution and resource waste. Strengthening technological innovation to achieve low-carbon production is extremely urgent. Especially under the background of the implementation of China's "dual carbon" strategy (carbon peaking and carbon neutrality), the green transformation of the chemical industry has become an inevitable trend. In this context, this paper explores the effective application of green chemical technology in industrial production. Starting from the concept, it gradually delves into its application value and finally explores specific implementation paths. It is expected to contribute to energy conservation and consumption reduction in industrial production, promote green and low-carbon development, and provide valuable references for other researchers.

Keywords: Green chemical environmental protection technology; Industrial production; Practical application

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1. Introduction

In the process of rapid economic development, China is facing major challenges in environmental protection. How to achieve economic growth while taking into account ecological issues and realizing environmental protection has become an important era task for all entities. Especially in the new era context, the proposal and promotion of concepts such as the community with a shared future for mankind, sustainable development, and green environmental protection ecology have put forward higher requirements for environmental protection. Enterprises are important entities in economic development and key participants in environmental protection. They should maintain a high sense of social responsibility, actively explore the effective application of green chemical

environmental protection technology in production to achieve energy conservation and emission reduction, while ensuring production efficiency and quality, developing green technologies, optimizing resource allocation, and realizing the dual improvement of economic development and environmental protection.

2. Overview of the concept of green chemical environmental protection technology

Environmental protection green chemical technology refers to the adoption of environmentally harmless and sustainable chemical manufacturing methods. It strives to reduce waste generation throughout the entire process of chemical production, improve resource utilization efficiency, so as to mitigate the negative impact on the environment, and integrate economic benefits with social benefits. It can be said that the application of environmental protection green chemical technology in the chemical industry demonstrates its characteristics of environmental friendliness, innovation, economy, sustainability, and social responsibility commitment.

Green chemical environmental protection technology features safety and environmental protection, renewability, and low carbon. In terms of safety and environmental protection: Green chemical environmental protection technology can control pollution from the source of production, realize low-toxic, non-toxic production, or pollution-free production. On the one hand, it reduces harm to the environment and human body; on the other hand, it can achieve the goal of safety and environmental protection through recycling and secondary utilization. Regarding renewability: It means replacing part of the raw materials with renewable materials in the chemical production process, which greatly reduces energy consumption and improves economic benefits, making it a win-win choice for both environmental protection and economic benefits. Low-carbon property refers to the ability to significantly reduce carbon dioxide emissions during the production process, which can effectively alleviate the greenhouse effect and promote the sustainable development of industry [1].

3. Value of green chemical environmental protection technology in industrial production

3.1. Conducive to improving resource utilization efficiency

Green chemical technology has significant advantages in improving resource utilization efficiency. It can realize the maximum utilization of resources by means of effectively optimizing process flows and other measures, thereby greatly enhancing the resource utilization rate. Specifically, in chemical production, it reduces the excessive use of raw materials and achieves precise batching through the principle of reaction kinetics to improve resource utilization efficiency. In addition, technical means can be applied to realize the integration of production processes. By reducing energy consumption, shortening reaction paths, and other ways, it improves the conversion rate of product raw materials and further reduces resource waste. Improving resource utilization efficiency is not only a requirement for green and environmentally friendly production, but also can effectively reduce production costs, form a positive cycle, and help enterprises achieve sustainable development.

3.2. Conducive to enhancing environmental protection effects

Green chemical environmental protection technology is characterized by environmental friendliness, technological innovation, and so on. Its application in the chemical production process can significantly reduce pollutant emissions, lower environmental load, and effectively enhance environmental protection effects. For example, green chemical environmental protection technology has positive value in waste gas treatment: in the production

process, abandoning traditional fossil fuels and adopting clean energy can effectively reduce the emission of harmful gases. In terms of wastewater treatment, technical means such as membrane treatment can be applied in a coordinated manner to accelerate the degradation of organic pollutants, so as to realize the efficient purification of wastewater and its recycling. As for solid waste, it can be reused or transformed into other substances to reduce resource waste. It can be said that green chemical environmental protection technology reduces the negative impact of chemical production from multiple aspects, such as soil and air, effectively protects the ecological environment, and realizes the simultaneous improvement of environmental protection and economic benefits.

3.3. Conducive to promoting the sustainable development of enterprises

The application of green chemical technology is beneficial for improving the economic benefits of enterprises. By optimizing the energy structure and building a recycling system, it reduces production costs. On this basis, enterprises can also rely on this system to coordinate industries in building a circular chain and extend the service life of resources. At the same time, the introduction of renewable clean energy reduces dependence on traditional energy, realizes the goal of energy conservation and emission reduction, and provides support for the sustainable development of the chemical industry. In addition, the application of green chemical environmental protection technology can also enhance the social image of enterprises, demonstrate their good sense of social responsibility and environmental protection awareness, thereby winning public recognition and trust, establishing a good brand image, and improving comprehensive competitiveness. In this way, it helps enterprises gain a firm foothold in the fierce market competition.

4. Application of green chemicals and environmental protection technology in industrial production

4.1. Optimizing the development steps of green chemical and environmental protection technology

First, screening of green chemical raw materials. For green chemical technology, the selection of raw materials is the first step in chemical production. It is necessary to investigate and analyze various factors that cause resource waste and environmental pollution during the processes of raw material extraction, processing, transportation, use, and waste gas treatment. Priority should be given to renewable resources, raw materials for water-based coatings, and other materials with strong degradability and low toxicity to replace traditional materials. This ensures the stability, economy, and environmental friendliness of raw materials, laying a solid foundation for the subsequent green chemical production processes. Second, emphasizing the selection of catalysts. In chemical production, catalysts play a crucial role in regulating the production process. Green chemical technology requires the selection or development of environmentally friendly catalysts, such as high-efficiency renewable enzyme catalysts, transition metal oxides, and non-metallic catalysts, to replace precious metal catalysts (e.g., biological catalysts). During production, relevant personnel should comprehensively consider the stability and activity of catalysts, as well as the practical needs for their recycling. For instance, designing magnetic separation catalysts facilitates the separation of catalysts after chemical reactions; these catalysts can also undergo activation treatment, reducing usage costs, lowering environmental risk, and improving the efficiency of chemical reactions, ultimately making chemical production more aligned with the concept of green environmental protection [2]. Third, precise control of reaction conditions is a key breakthrough in the development of green chemical technology. From condition simulation to design and trial application, it is essential to conduct in-depth research on how the control of

conditions (such as pressure, temperature, reaction time, and material ratio) affects the conversion rate of reactants, and select the optimal suitable conditions. Additionally, external field assistance (e.g., ultrasound and microwave) can be used to improve product quality, enhance resource utilization, and reduce the hazards of side reactions. Furthermore, inhibiting side reactions is also an effective means to enhance the efficiency of green chemical technology. Relevant technical researchers can analyze reaction kinetics and mechanisms to optimize the reaction pathways in chemical production. For example, pH control can be applied to acid-base catalytic side reactions to reduce their occurrence, and reaction temperature can be controlled to avoid thermal decomposition side reactions. In the process of applying green chemical technology, enterprises should always adhere to the concept of green environmental protection, focus on improving resource utilization, and attach importance to the recycling and treatment of waste [3]. The improvement of resource utilization can be achieved through energy-saving reaction methods, such as developing energy-saving process technologies, promoting new energy-saving equipment, and optimizing energy management to rationalize energy allocation. This not only enhances the resource utilization rate in chemical production but also reduces dependence on external energy sources. In terms of waste recycling and treatment, green chemical technology needs to adopt targeted and effective treatment technologies based on the characteristics and properties of the waste to ensure its harmless disposal [4].

4.2. Realizing the diversified application of green chemicals and environmental protection technology in chemical production

First, clean production technology. As a vital component of the technologies adopted by green chemical and environmental protection enterprises, clean production technology aims to achieve the greening of chemical production processes through measures such as reducing pollutants and optimizing process flows. It can effectively mitigate the hazards caused by the discharge of wastewater, waste gas, and solid waste resulting from chemical production, and to a certain extent, reduce economic losses as well. It is evident that clean production technology plays a crucial role [5]. For example, in chemical production, cleaner production technology can use water instead of organic solvents, greatly reducing the emission of harmful volatile gases from water-based coatings. Additionally, this technology focuses on optimizing production processes to minimize the generation of waste and wastewater at the source, thereby reducing environmental harm. It is also an effective way to meet market demand for green and environmentally friendly products. Second, biotechnology. Biotechnology also plays a highly important role in green chemical and environmental protection technologies. Utilizing biocatalysts such as microorganisms and enzymes to catalyze renewable raw materials enables the synthesis of degradable materials, thereby achieving green production [6]. Take the production in the food packaging field as an example: polylactic acid (PLA), with its strong degradability and biocompatibility, can be used to produce packaging products that decompose into harmless substances in the natural environment. This reduces the pollution caused by traditional plastics. Such products also have the advantage of low production costs and higher overall cost-effectiveness, indicating broad development prospects. Biotechnology is, therefore, a key approach to promoting the sustainable development of the chemical industry. Third, green catalysis technology. Green catalysis technology is mainly reflected in the selection of environmentally friendly and efficient catalysts, which improves conversion efficiency and selectivity, thereby reducing the generation of by-products, lowering energy consumption, and realizing green production. For instance, compared with traditional noble metal catalysts, green catalysis technology converts biomass into biofuels, minimizing carbon dioxide emissions to the greatest extent. This not only demonstrates environmentally friendly characteristics but also enhances the quality of produced fuels, laying a foundation for the

secondary utilization of relevant energy sources [7]. Fourth, electrochemical synthesis technology. Electrochemical synthesis technology drives chemical reactions with electrical energy and achieves the goal of reducing pollutant emissions by lowering energy consumption during chemical reactions. In the chemical production process, enterprises can select electrode materials with properties such as stability and high activity, while strengthening the control of reaction conditions like temperature to ensure the reaction process is efficient and environmentally friendly, and avoid the generation of unnecessary waste. Moreover, compared with traditional chemical synthesis methods, this technology has more advantages in selectivity, and its reaction conditions are relatively mild. It can be widely applied in various fields, and thus also has extremely broad development prospects [8].

5. Development of green chemical and environmental protection technologies in industrial production

5.1. Strengthen scientific and technological innovation

Industrial enterprises should uphold the concept of keeping pace with the times, correctly understand green chemicals and environmental protection technologies, and enhance the promotion and application of these technologies, starting from their own operations. Specifically, enterprises should provide financial support for the innovation of green production technologies, actively introduce high-quality talents, establish specialized R&D institutions, and invite professional R&D teams. By combining their actual conditions and production needs, enterprises should develop higher-quality green chemical and environmental protection technologies, promote the transformation of technological achievements, effectively improve production efficiency, and implement the concept of green environmental protection. Enterprises must attach great importance to the training of in-service technical personnel, and provide them with opportunities for further study outside the company to learn from the successful experience of other enterprises. At the same time, they should strengthen the management of hardware facilities, provide advanced production equipment and R&D sites, and conduct timely optimization, updating, and maintenance to support technological innovation.

5.2. Provide policy guarantees

In recent years, the state has paid more attention to ecological and environmental protection work. Relevant government departments should perform their duties, guide local enterprises to apply green chemical and environmental protection technologies, and advocate green production [9]. Specifically, competent authorities should give full play to their functions, formulate targeted support policies based on the actual situation of local enterprises, and provide fiscal and tax preferential policies to assist enterprises in green production. Meanwhile, heads of government departments should conduct in-depth communication with enterprise managers to change their concepts, exchange opinions on technology promotion, and do a good job in internal publicity of enterprises. This will help more managers and employees recognize the value of green chemicals and environmental protection technologies and ensure the widespread application of these technologies.

5.3. Intensify technology application

In the process of applying green chemical and environmental protection technologies, the concept of ecological environmental protection should be implemented in practice, rather than being superficial or formalistic. Ecological environmental protection should be integrated into all links of industrial production. In production practice, enterprises should first select environmentally friendly materials to fundamentally reduce pollution.

Secondly, they should strengthen the monitoring link to ensure that every production process complies with environmental protection standards. Finally, they should do a good job in waste treatment, realize resource recycling, and form a complete closed-loop of green chemical production [10].

6. Conclusion

To sum up, against the backdrop of the new era, people's requirements for environmental protection and ecological friendliness have been further raised. For enterprises, strengthening the application of green chemicals and environmental protection technologies has become an important choice to conform to the pace of the times and meet the expectations of the era. The application of green chemicals and environmental protection technologies in industrial production has extremely high epochal value. It is not only conducive to realizing the efficient application of resources but also demonstrates a positive role in reducing pollution and promoting the sustainable development of the chemical industry, thus becoming an important technical support for the upgrading and transformation of the industry. In the process of practical application, enterprises should combine their actual production conditions and needs, select appropriate technologies, and achieve flexible application to realize clean chemical production and maximize economic benefits while ensuring environmental protection. At the same time, enterprises should also attach importance to the development of green chemicals and environmental protection technologies. Through optimizing application processes and promoting technological innovation, they can maximize the potential of green chemical and environmental protection technologies and drive the green development of the industry [11]. Looking forward to the future, green chemical and environmental protection technologies will continue to develop, showing higher application value and broader application prospects. Closely following the development trend of the chemical industry, these technologies will help enterprises achieve a win-win situation of improved economic benefits and ecological benefits, and promote the coordinated development of chemical production and ecological progress.

Disclosure statement

The author declares no conflict of interest.

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