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Research on Energy-Saving Emission Reduction Control System Based on Information Technology

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Abstract

In order to solve the high energy consumption and high environmental pollution problem in high energy consumption enterprises, an energy-saving emission reduction control system based on information technology was presented .Based on studies about the characteristics of the production process, the research contents were discussed detailedly and the implemented architecture was established. Furthermore the key technologies for this system were proposed. These provided a good foundation for further researches on the design, development and implementation of this system.

Selection and/or peer-review under responsibility of Conference ESIAT2011 Organization Committee.

Keywords:energy-saving emission reduction; high energy consumption; information technology; implemented architecture;

1. Introduction

As China has entered the industrialization medium term, energy consumption is getting higher and higher and energy security is facing a serious and complex situation. With the oil imports have increased year by year, China has become the world's second largest net importer of crude oil. In addition, the coal-based energy production and consumption structure won't happen fundamental changes in the future for a long period of time. 30 years of reform and opening up, Chinese development has scored great achievements, and at the same time, energy consumption and environmental protection are facing more and more outstanding problems. China's energy consumption and carbon dioxide emissions will continue growing, which will bring our country and even the global ecological environment more pressure[1]. In 2006, for example, China's GDP reached about 5.5 percent of total world GDP while the energy

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consumption accounted for about 15%, steel consumption accounted for about 30% and cement consumption accounted for about 54% of the total. The economic growth mode which is completely at the cost of energy consumption, resources waste and environment pollution, is unsustainable and must be changed. Therefore, it is necessary to accelerate the research of energy-saving emission reduction technology and improve the popularization and application of the technology[2].

In recent years, there have been a considerable progress on the research and application of the energy-saving emission reduction technology in China under the governments' vigorously promote. The promote mainly displays in the following three aspects[3]:(1)The security system for the research and promotion of the technology has been basically established. In the Comprehensive energy conservation and emissions reduction plan which was published by the State Council, the research and promotion of the technology was programmed macroscopically. Meanwhile, the major cities are also introduced for the practical implementation of energy saving technology to promote the program. (2)The energy saving technology in the development and promotion depends on an industrial platform; it has begun to take shape. (3)In better development areas of technological innovation, for the development and promotion of the energy saving technology, a pattern as "government-led, business-oriented" has been basically formed.

Currently, the information technology has become a powerful support for the business management system and an important approach to accelerate the upgrade of traditional manufacturing processes. Although many Chinese petroleum and petrochemical industry and steel industry has taken information technology to raise the management level, improve resource utilization, save energy, reduce production costs, and furthermore create a systematic energy saving and emission reduction project, yet it is rarely come true that using information technology to achieve emission reduction[4]. High energy consumption enterprise is one of the main subjects of the energy consumption and pollutant emissions in our country. It is very important to research the energy saving control system based on the information technology of the high energy consumption enterprises to promote them transforming to resource-saving and environment-friendly development pattern, in order to realize the savings development, clean development, security and sustainable development.

2. Production characteristics research of high energy consumption enterprises

The production process is a complex input-output system. The input is the production resources while the output section includes products and emissions[5], as shown in Figure 1.

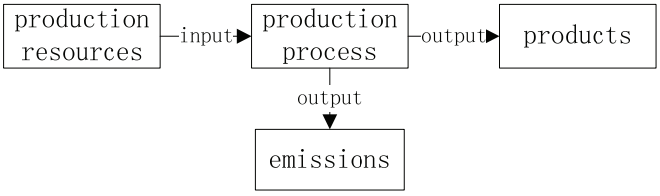

Figure 1 Production process input-output model

The input production resources can be divided into special production resources and generalized productive resources. The special production resources, as shown in Figure 2, have a direct relationship to social sustainable development strategy. Various types of production resources in high energy consumption enterprises, the energy sources account for a large share.

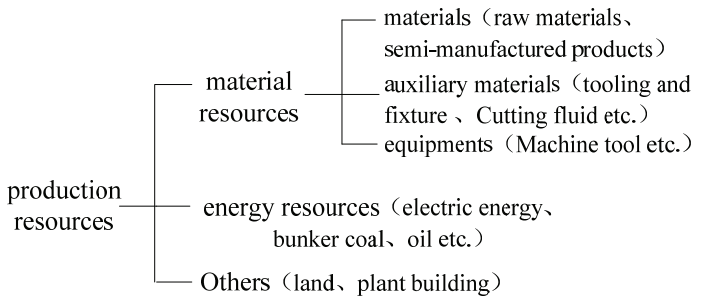

Figure 2 Production resources formation

The output emissions in high energy consumption enterprise cause serious damage to the environment directly. As shown in figure 3, emissions include "three wastes" pollution and physical rational emissions. "Three wastes" consist of waste gas, waste water and waste residue while the physical rational emissions include vibration and noise, high temperature and thermal radiation and so on.

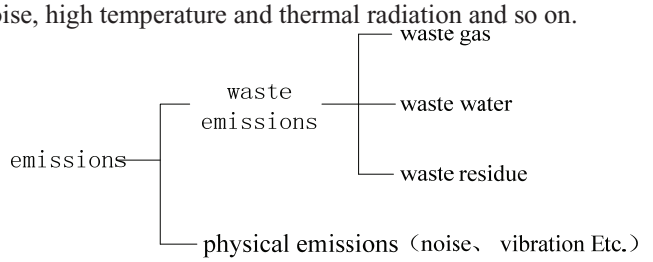

Figure 3 Composition of the environmental pollution emission

3. Structure research of the energy-saving emission reduction control system

For the above analysis of the production characteristics of the high energy enterprise, an energy saving and emission reduction control system needs to be built based on the information technology. From the requires of the energy saving and emissions reduction of the production and operational activities in the high energy consumption enterprise, research and analyze the main factors of the energy consumption and emissions, and the factors are different for each different enterprises. In this page, a typical high-energy Consumption enterprises - industrial forging industry has been the research object which consumes a large quantity of coal, the specific study is on the energy saving control system and control methods based on the information technology of the enterprise.

3.1. The research target of the system

The targets of the energy saving control system are maximizing the utilization of resources and minimizing the environmental pollution as follows: (1) combining the plan in advance of ERP project management ideas to research and design the control targets of energy consumption and waste emissions of high energy consumption enterprise.(2) based on the structure of the traditional ERP system, further research and design of ERP systems are needed for energy saving to make them own the monitoring capabilities supporting the energy-saving and emission reduction targets, and further strengthen the in control and after analysis of the energy saving. (3) Research related cost analysis system of the achievement on the energy saving and emission reduction targets. Research on the cost of realization on

the energy saving targets from the integration process of the business and production operations, establish the mathematical model on the relationship between the energy reduction targets and energy conservation-related costs, and minimize the funding for energy-saving emission reduction system through the optimizations achieving the targets.

Use the methods of information technology to improve the management level and resource utilization, establish the informatization control system of the energy-saving emission reduction targets in the enterprises with heavy energy consumption and emission, ensure the placement and implement of the plan for energy-saving emission reduction targets, and ensure the effective supervision of the targets. Eventually through the informatization of the production control, promote the process optimization, reduce energy consumption, improve energy efficiency and emission reduction results.

3.2. The study states and structure of the system

The study is divided to four sections: theoretical research, technology realization, system development & validation and technical summary. In the theoretical research phase, based on the collection of relevant information and the digestion and absorption of relevant ideas at home and abroad, specifically research and analyze the main factors of energy consumption and resulting emissions in the a forging company, then make three-tier energy saving control systems for energy-saving & emission reduction. Research and Design the monitoring capabilities of the ERP and MES systems supporting energy conservation and emission reduction targets, to promote the realization of the targets by information technology. In the technology realization stage, modelling and analysis the methods are needed, which are proposed in the theoretical research phase, then carry out the preliminary test. In the system development phase, corresponding modules of the ERP and MES monitoring systems need to be designed to support energy-saving and emission reduction targets, Through the implementation in a forging company verify that the effectiveness of the proposed energy saving control methods. Technical evaluation stage of the technology is to summarize the main results and lack of research, lay a more solid foundation for demonstration and promotion of the further research results. Based on the above, this paper establishes the control structure in Figure 4.

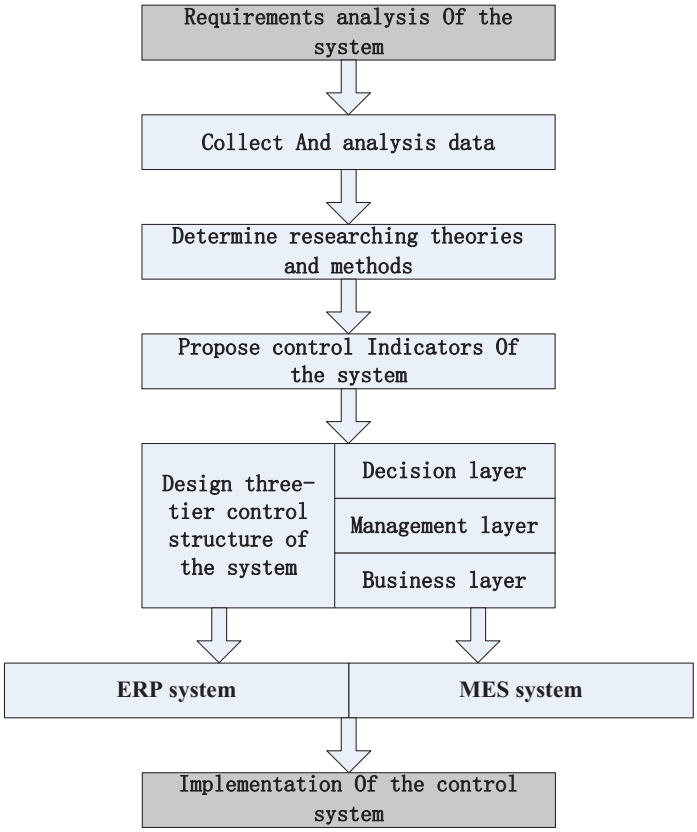

Figure4. Structure of the energy-saving emission reduction control system

4. Key technology research of the energy-saving emission reduction control system

According to the above structure, information technology is proposed as the key technology of the high energy consumption enterprises' energy-saving emission reduction control system.

4.1. The internal control system research

①Research and design three-tier energy conservation control system of high energy consumption enterprises including decision-making layer, management layer and business layer.② Research and design three-tier specific contents of high energy consumption enterprises including decision-making layer, management layer and business layer.

4.2. Research of the high energy-consuming enterprises' ERP system

① Based on the function structure in the traditional ERP system, further research and design of ERP systems are needed for energy saving and emission reduction in order to get the targets with the support of monitoring capabilities, and further strengthen the in control and after analysis of the energy saving.② Research related cost analysis system of the achievement on the energy saving and emission reduction

targets. Research on the cost of realization on the energy saving targets from the integration process of the business and production operations, establish the mathematical model on the relationship between the energy reduction targets and energy conservation-related costs, and minimize the funding for energy-saving emission reduction system through the optimizations achieving the targets.

4.3. The production control information technology research

① Research and design adding control module of energy saving and emission reduction in the traditional MES (manufacturing execution management) system.② Research production control systems, automatic adjustment and control the production process according to the achievement of energy saving and emission reduction targets.

4.4. The important and difficult aspects

According to the above key technologies, the important and difficult aspects include: (1) proposed three-tier energy conservation control system of high energy consumption enterprises including decision-making layer, management layer and business layer.(2) build the relational model between the production processes and energy saving & emission reduction in the forging enterprise.(3) proposed function structure of the ERP and MES system facing energy saving and emission reduction, design the corresponding function modules.

5. Conclusion

In this paper, according to the status of the enterprises with high energy consumption, low resource utilization and large environmental pollution emitters, an energy-saving and emission reduction control system has been proposed which is based on the information technology, in order to achieve the low power consumption, high resource utilization and minimize environmental pollution targets. On this basis, build the system structure and make key technologies to lay a good foundation for design, development and implementation of the energy saving and emission reduction control system in high energy consumption enterprises.

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