Research on Innovation of Water Saving and Emission Reduction in Sugar Enterprises

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Abstract: There are still some deficiencies in the whole industry, such as low level of equipment technology, low level of automatic control, low deep processing and comprehensive utilization rate of sugar products, short industrial chain and extensive production management. There is great potential for water saving and emission reduction in China's sugar industry. Facing the new technical development trend of sugar industry. While maintaining the total output advantage, sugar enterprises must also strengthen their independent innovation ability and improve the level of scientific and technological progress in the industry in order to further maintain and improve their market competitiveness. Energy saving in sugar enterprises is a systematic project, which involves enterprise management, optimization of existing technology and equipment, research, development and promotion of new technologies and equipment. This paper summarizes the existing problems of water saving and emission reduction in sugar enterprises and some innovative measures of water saving and emission reduction in sugar enterprises. Specifically, it includes: water-saving measures in sugar production: introducing new sugar-making equipment and optimizing biochemical treatment process of waste water. Innovative measures for reducing emissions in sugar enterprises: strengthen technological innovation, promote industrial optimization and upgrading with management innovation, and optimize sugar production processes. The purpose is to provide reference for water saving and emission reduction in sugar industry in the future.

1. Introduction

With the continuous expansion and transformation of sugar enterprises in recent years, many sugar enterprises, especially those built far away from water sources, have experienced water shortage to varying degrees[1]. Sugar enterprises consume more energy, water and pollutants, which is a typical enterprise with high energy consumption, high water consumption and high emission. If a new production line is added, the general plant design and equipment selection are all designed by the design institute, and the material balance, energy consumption equipment and pipelines are generally calculated and matched.

From another perspective, there is still great potential for water saving and emission reduction in China's sugar industry[2-3]. Facing the new technological development trend of sugar industry, sugar enterprises must strengthen their independent innovation ability and improve the level of scientific and technological progress in order to further maintain and improve their market competitiveness while maintaining their total output advantage.

2. Problems of Water Saving and Emission Reduction in Existing Sugar Enterprises

Although sugar-making enterprises have developed by leaps and bounds in recent years, and the output has continuously reached a record high, the deep processing and comprehensive utilization of sugar products are still in the primary product processing stage, lacking downstream products with high added value and high technology content, and the industrial chain is short; The comprehensive utilization rate is low, and most levels of recycling projects of by-products are relatively low. There are still some deficiencies in the whole industry, such as low level of

equipment technology, low level of automatic control, high production energy consumption, low labor productivity of all employees, high production cost, single product structure, less high-quality and high-grade sugar, low deep processing and comprehensive utilization rate of sugar products, short industrial chain and extensive production management[4].

The emphasis on environmental quality in the transformation of domestic economic structure has put forward more and more strict requirements for water saving and emission reduction in sugar industry. Compared with state-owned and state-controlled enterprises, private investment and holding ownership have obvious advantages in improving energy efficiency; Expanding the scale of sugar enterprises can bring about the improvement of energy efficiency of enterprises; Increasing the supply of raw sugar cane and improving the level of sugar production technology (total recovery rate) can also improve the energy efficiency of enterprises. In production management, energy consumption is not paid enough attention, and the understanding is not deep enough, and the key points cannot be grasped, which makes energy management not ideal. The automatic control level of sugar production process is low, the equipment level needs to be improved, the process energy consumption is high, the production cost is high, the product structure is single, the high-quality sugar is few, and the international competitiveness is lacking.

3. Innovation of Water Saving and Emission Reduction in Sugar Enterprises

3.1 Water-Saving Measures in Sugar Production Enterprises

(1)Introduce new sugar-making equipment

There are two main types of water used in sugar enterprises, namely, two circulation systems: one is internal water, such as furnace water and process water; The other is external water, such as jet vacuuming, mechanical cooling, ash flushing, cleaning equipment and ground water. The prerequisite is turbidity separation, because only a small part of sugary or oily sewage is easy to be treated centrally, sugary washing water and oily sewage can be treated by aerobic method for ash flushing, and most of condensed cooling water is cooled by adding ash and then reused repeatedly[5-6]. If the circulating water only supplements a small part of the discharged sewage, it can also reach the current limit standard for approval.

Introduce new energy-saving and environment-friendly sugar making equipment to reduce the increased water consumption due to the design defects of sugar machine equipment. For example, the smooth tube and heat-receiving tube of the boiler are replaced by membrane tubes, and even small boilers are eliminated in order to improve the thermal efficiency of the boiler; Using continuous sugar boiling tank can not only use low-pressure juice steam, but also reduce the fluctuation of steam consumption, which is beneficial to ensure the balanced and stable steam output of boiler and improve boiler efficiency. Replace water-cooled air compressor with air-cooled air compressor; Replacing the original steam seal heater of steam turbine with extraction ejector eliminates the use of cooling water of the original steam seal heater, and at the same time, all the waste steam discharged from the original steam seal heater is collected into the exhaust main pipe of steam turbine for refining.

(2)Optimize the biochemical treatment process of wastewater

Sugar wastewater from sugar enterprises is divided into low concentration wastewater and medium concentration wastewater according to pollution degree. Low-concentration wastewater includes condensed water from evaporation and sugar boiling, and cooling water from presses, steam turbines and other equipment. Its main process flow: the wastewater in the plant is pumped into the regulating tank. If the pH value of the wastewater is low, it can be adjusted by adding alkali liquor, and then the water is pressurized by the lifting pump and sent into the oxidation ditch reactor[7]. The sludge is pumped back to the oxidation ditch by a traveling mud scraper and a sludge reflux pump, and the excess sludge is pumped to a belt-type concentration and pressure filtration integrated machine for dehydration, and the sludge dried by a filter press is made into a biological fertilizer, and the filtrate is discharged to a sludge pond.

In the production process, the steam condensate water is treated by secondary cooling as the

make-up water for squeezing permeate water and boiler ash flushing water, and the surplus water is discharged to the sewage treatment station for treatment and then discharged up to the standard; Because cooling steam condensate is used for squeezing permeate water, fresh cold water and high-temperature steam condensate are no longer used for adjustment, thus saving the consumption of fresh water. The process flow of sewage treatment is shown in Figure 1. We discharge part of the condensed water to the sewage treatment station for reuse, so as to save water, at the same time, we can ensure the cleanliness and temperature of the vacuum water, and ensure the vacuum degree of evaporation and sugar boiling to a certain extent.

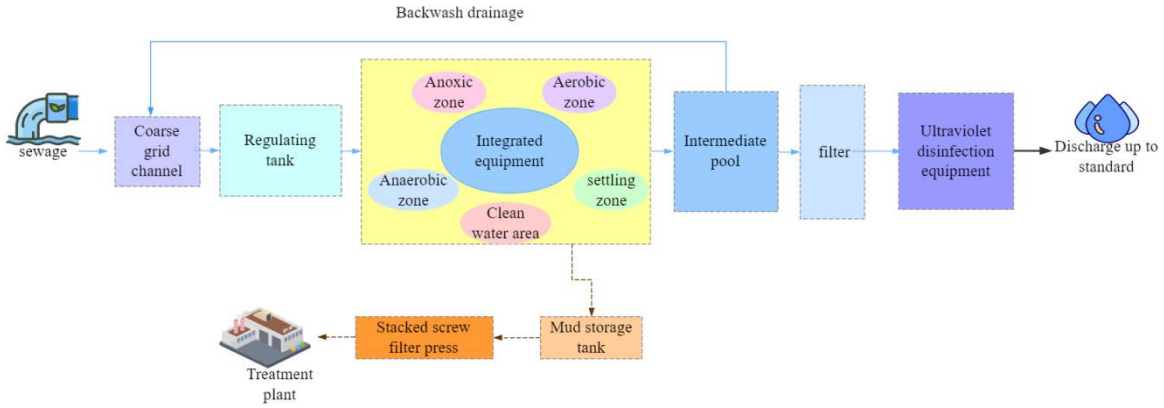

Fig.1 Sewage Treatment Process Flow

The cleaning and shunting system is used to clean and shunt the washing water of heater, evaporation tank and boiling tank. The separated clean water is used for washing water of filter press and squeezing permeate water, and the sewage is discharged into the ash flushing water circulation system of boiler. Reusable cooling water is sprayed in a tower body from top to bottom into water droplets or water films, and air moves in countercurrent with water flow from bottom to top, thus achieving heat transfer between water and air and reducing the temperature of reused cooling water.

3.2 Innovative Measures for Reducing Emissions in Sugar Enterprises

(1)Strengthen technological innovation

Encourage sugar enterprises to strengthen technological innovation and constantly upgrade and transform their technologies. We should speed up the transformation and optimization of various technological processes in sugar production, such as pressing sticks, clarification, evaporation and boiling sugar, eliminate backward production processes and equipment with small scale and low energy efficiency, increase technological innovation, optimize sugar production processes and improve the overall technological level. Strengthen the alliance between large sugar enterprises and small and medium-sized sugar enterprises[8]. On the one hand, it can enhance the discourse power of enterprises in the market and increase their market regulation ability; On the other hand, it can realize centralized treatment of industrial wastewater and improve the environmental efficiency of enterprises.

At present, it is generally believed in the world that enterprises whose R&D expenditure accounts for less than 1% of their product sales are difficult to survive, and enterprises whose R&D expenditure reaches 2% can be maintained, and enterprises whose R&D expenditure accounts for 5% are competitive[9]. Enterprises should be market-oriented, directly participate in technology research and development, increase investment in R&D funds, organically combine the role of the government with the market mechanism, form a more perfect and efficient technological innovation system as soon as possible, and build a faster and more open technological innovation platform. Raise funds from various sources and broaden financing channels, especially the investment of private capital in research and development. We should also enrich the funds for technological innovation of enterprises through various channels, such as loans, striving for government financial subsidies, applying for national innovation funds, and absorbing private funds, and gradually form a

good situation in which enterprises, governments and financial departments jointly support technological development and multi-channel funds support technological innovation of enterprises.

(2)Promoting industrial optimization and upgrading with management innovation

The optimization and upgrading of industrial structure mainly depends on independent innovation. Building an innovative country has been promoted to the national strategic level, and efforts have been made to realize the transformation from “Made in China” to “Created in China”. In recent years, China's sugar-making enterprises have invested a lot in technological transformation such as pressing automation, technological transformation of sugar-making and honey-separating, bagasse pulping and papermaking, but little in management informationization and brand marketing. In view of the shortage of management innovation, we should incorporate enterprise management innovation into enterprise development planning as soon as possible, adopt the policy of “paying equal attention to technology and management”, make great efforts to promote the effective combination of technological innovation and management innovation, form an all-round independent innovation system of enterprises, and promote the optimization and upgrading of enterprises' industries.

Informatization is a new round of enterprise management revolution. With the application and penetration of information technology in all levels of enterprise management, its influence will inevitably affect the strategic development, organizational structure, planning, management system, coordination and control, corporate culture and so on, and become an important promoter of enterprise system innovation, organizational innovation, technological innovation, management innovation and corporate culture construction. We should continue to increase investment in management informatization, regard management informatization as the engine of management innovation, focus on improving the depth and breadth of management informatization application, promote the wide application of information technology in all aspects of procurement, production and sales, effectively integrate information technology means with scientific management, promote the reorganization and optimization of business processes and organizational structure, and strive to form a unique enterprise management model in sugar industry.

(3)Optimize sugar production process

According to the characteristics of sugar-making process, the amount of steam entering the vacuum condenser is about 25%. Using multi-stage high-efficiency heaters to heat clean sugar juice can save more than 100 tons of standard coal in each cropping season. If the multi-effect evaporation system is composed of plate evaporators, on the basis of adding spare plate evaporators, the tank can be washed all the time without stopping, and the automatic control can be realized more easily through pumping, which can reduce the steam consumption by more than 10% [10]. It can be seen that controlling the amount of water added in the production process is also very important for energy saving. To control the amount of water, we must first control the osmotic water of squeezing, then control the amount of water added in the process of boiling sugar and honey, then control the amount of water pumped by filtering mud, and finally control the concentration of lime milk, and try to reduce the unnecessary amount of water added in the production process.

According to the characteristics of the medium, choose the diameter of the steam pipe and try to keep the medium velocity at the low value of the range. As can be seen from Figure 2, the larger the pipe diameter, the heavier the pipe, and the smaller the flow rate and the smaller the pressure drop. Therefore, it is very important for sugar-making enterprises to select an appropriate flow rate for steam pipeline.

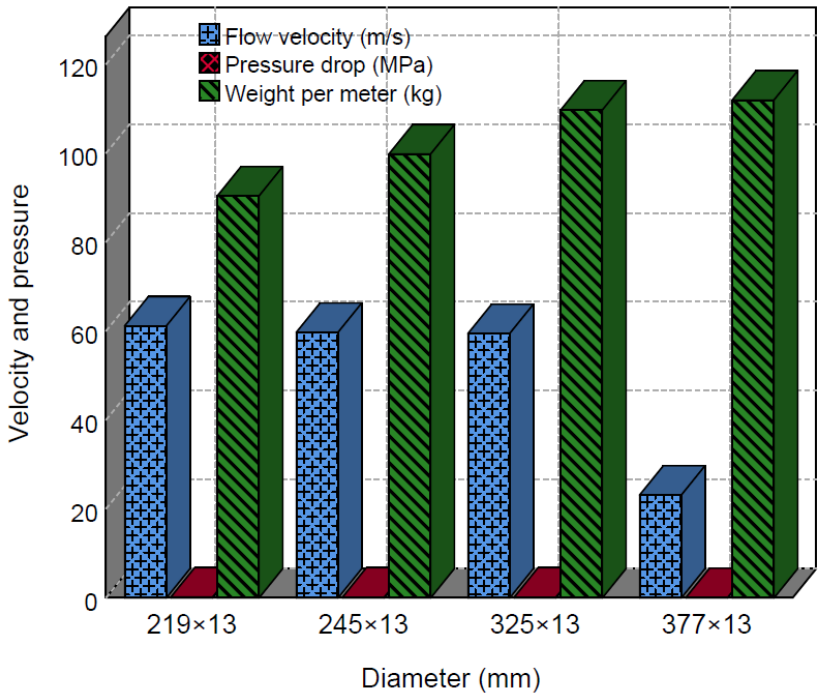

Fig.2 Flow Velocity and Pressure Loss of Several Pipe Diameters

Improve the thermal efficiency of the boiler and reduce the excessive air in the boiler, and adopt the sub-high pressure boiler. The method of discharging steam condensate from isobaric cascade box is adopted to reduce the pressure of steam condensate step by step, so that it can fully evaporate itself and make rational use of waste heat. At the same time, according to the different water quality of various steam condensate, reasonable discharge, high quality and optimal use can meet the needs of hot water recycling to the maximum extent, and the production practice can save energy, reduce the sugarcane ratio by 1% ~ 2% and improve the production capacity by 5% ~ 10%. Conditionally use a thermal compressor (heat pump) to compress the final juice steam of evaporation tank and the juice steam of sugar boiling tank, and then use it as a heat source to improve the grade.

Most power workshops of sugar enterprises use a combination of chain boilers and circulating fluidized bed boilers to provide steam and electricity for production. Due to different furnace types, the carbon content of combustion ash is different. Chain boiler slag contains carbon and has combustion utilization value. It can be mixed with fluidized bed boiler for combustion, which not only utilizes the calorific value of chain boiler slag containing carbon, but also gives full play to the characteristics of circulating combustion of fluidized bed boiler, improves the overall boiler combustion efficiency and achieves the effect of coal saving. Mixed combustion of pulverized plant straw and raw coal can not only reduce coal consumption and pollutant emission, but also increase farmers' income and comprehensively utilize renewable resources, which is an energy-saving method with multiple goals.

4. Conclusions

Sugar enterprises consume more energy, water and pollutants, which is a typical enterprise with high energy consumption, high water consumption and high emission. If a new production line is added, the general plant design and equipment selection are all designed by the design institute, and the material balance, energy consumption equipment and pipelines are generally calculated and matched. The emphasis on environmental quality in the transformation of domestic economic structure has put forward more and more strict requirements for water saving and emission reduction in sugar industry. For sugar enterprises, environmental governance is an opportunity for the structural transformation of the sugar industry. Through technical transformation, upgrading of technical level, mergers and acquisitions among enterprises, a win-win situation can be achieved in

which the competition of the sugar industry and the environmental quality are significantly improved.

References

[1] Ge Jingfang, Si Wei, Meng Ting. Study on the influence mechanism of environmental regulation on enterprise profit rate-based on the microscopic data of sugar factories in Guangxi Zhuang Autonomous Region. Management Review, vol. 033, no. 008, pp. 66-77,138, 2021.

[2] Wang Hongyang, Wang Haiyan, Zhang Lihong, et al. Analysis of wastewater emission reduction in China's sugar industry and its enlightenment. Industrial Water Treatment, vol. 2018, no. 10, pp. 5, 2018.

[3] Xu Wen, Dong Liming, Dong Li, et al. Analysis and suggestions on the reduction potential of water pollutants in China's sugar industry. Modern Chemical Industry, vol. 2020, no. 012, pp. 040, 2020.

[4] Xu Wen, Dong Liming, Dong Li, Sun Xiaoming, Bi Yingying, Liu Jingyang. Analysis and Suggestions on Water Pollutant Reduction Potential of China's Sugar Industry. Modern Chemical Industry, vol. 40, no. 12, pp. 4, 2020.

[5] Li Wen, Zhu Xuan, Qi Hong, et al. Purification of sugar juice from lime by ceramic membrane ultrafiltration. Food Science, vol. 40, no. 2, pp. 7, 2019.

[6] Liang Yi-yi, Wang Hailing, Tan Fang-xiang, et al. Analysis of the status quo of patents in sugar processing industry in Guangxi and countermeasures for technological innovation. Journal of south china agriculture, vol. 47, no. 9, pp. 6, 2016.

[7] Li Yangying, Chen Zhijun, Zhang Zihao, et al. Raw sugar demand forecasting model of sugar enterprises based on improved Elman neural network. Computer Application, vol. 41, no. 7, pp. 8, 2021.

[8] Yang Liu, Wang Zhi-hui, Yang Ting, et al. Research progress on treatment technology of sugar waste gas and alcohol waste liquid. Food Industry, vol. 43, no. 7, pp. 5, 2022.

[9] Lv Jinwei. Evolution of China's sugar trade policy and suggestions for adjustment. Agricultural Economy, vol. 2022, no. 6, pp. 2, 2022.

[10] Zhang Pingjun, Hu Biao, Huang Kai, et al. Study on the effect of dextran on calcium carbonate produced by lime milk filled with flue gas. Inorganic salt industry, vol. 47, no. 9, pp. 5, 2015.