Optimization Simulation Technology of Cement Packaging System Based On YL-235A Equipment

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Abstract. Cement packaging is an important part of cement production and sales. This research is based on the automatic control of the cement packaging system, using the YL-235A automatic production line equipment to optimization and simulation the automatic control system of the process flow of cement packaging. The simulation study of cement packaging production line of a cement factory was carried out. Achieve the goal of optimizing production control, solving technical problems, improving equipment efficiency and continuously improving production capacity. The application of equipment simulation can greatly shorten the development cycle of the cement packaging control system, find problems in operation, save running cost. In order to solve some technical problems existing in the cement packaging control, an effective approach is provided.

1. Research Background
Cement packaging system is an important link in cement production line. Mainly completed the control links of feeding, conveying and packaging, etc. Speediness and reliability are important indicators to evaluate the quality of a packaging system. At present, most small and medium-sized cement production enterprises still use traditional cement packaging technology and production equipment. There are many problems, such as low degree of automation, poor precision, high labor intensity and low production efficiency. Although some cement production enterprises have reformed the cement packaging technology and packaging equipment, the degree of automation and production efficiency have not been significantly improved. The process of cement packaging involves such problems as the qualified rate of bag weight, bag stability, counting accuracy and operating strength. If the control process of cement packaging system can be further optimized, the automation degree of the system can be effectively improved, so as to improve the work efficiency, improve the working environment, reduce labor intensity and improve the competitiveness of the enterprise.

In order to make the optimized control system with high precision, low error and high reliability, various influencing factors must be considered in hardware design and control scheme selection. In view of practical difficulties, we selected YL-235A optical-mechatronics automatic production line equipment to optimize and simulate the automatic control system of cement packaging process.
running experiment period can be shortened and the running experiment cost can be saved by using equipment simulation.

2. Research Contents
The project mainly includes two parts: hardware equipment and control scheme.

2.1. Hardware Devices
The hardware equipment consists of the YL-235A optical-mechatronics automatic production line equipment: mechanical components, touch screen, PLC module, inverter module, button module, power module, simulation production equipment training module, terminal block and various sensors. The main control part of the system adopts the Mitsubishi FX3U-48MR PLC of YL-235A equipment to improve the automation level of the system. PLC program is completed by Mitsubishi PLC programming software GX+Developer. We use the Mitsubishi E740 frequency converter in the equipment to realize frequency conversion speed regulation to adapt to the speed and energy saving required by the control system. Kunlun TPC7062KX touch screen module is used to display the system's operation process control and state. The various sensors and mechanical components in the device make the control process finally possible. The control method of optical-mechatronics technology and the combination of software and hardware are integrated in the simulation of the equipment, which significantly improves the advanced nature and reliability of the control system.

![Figure 1. YL-235A optical-mechatronics automatic production line equipment](image)

2.2. Control Scheme
This paper introduces the automatic control process of material level control, raw material supply, conveying system and packaging control of cement packaging system. Finished cement packaging system is the last important link in cement production line. In the technical transformation, the application of PLC control packaging system to ensure the quality of cement stability, ensure the safety of the production of machinery and reliable, reduce labor intensity has a very obvious effect. The running results show that the control system can improve the efficiency of cement packaging with high automation and stable operation.
According to the requirements of cement packaging system production process for the control system, the design control process is as follows: Before the system starts, the three types of cement are in the storage tank A, B and C respectively. The display device of the material level system shows the status of the material level meter, that is, whether there is cement in the material level meter. When the system starts, whether the screw machine starts or not is determined according to the status of the material level meter: When the material level is calculated as low material level, the reversible screw machine starts automatically and starts feeding. When the material level meter displays the state of high material level, the reversible screw meter automatically stops and the feeding is completed. The running state of each motor has a display signal. When the material level meter shows the high material level, the cement of the small warehouse goes directly into the packaging machine for packaging. In order to ensure the safety, the system must give an early warning signal before the operation, and leave a certain pre-start time to ensure the safety of production personnel leave.

We use the feed mechanism of YL-235A optical-mechatronics automatic production line equipment to simulate the bucket elevator of cement packaging system. Using manipulator handling mechanism to simulate reversible screw conveyor, The material level control mechanism, material detection, supply, transportation, transportation and production control of cement packaging system are simulated by material transfer and sorting mechanism. The black block, white block and metal block represent 425, 525 and 625 types of Portland cement respectively stored in the warehouse A, B and C respectively, the weight of cement represented by each material is 10kg.

First, we reset the device through the start button on the touch screen, after the reset is completed, the system will automatically generate the order number according to the time. Format for: If the current time is 13:1:30 on October 1, 2019, the order number generated is "20191001130130". That is, the first four digits are the year, followed by two digits for month, day, time, minute, and second. After generating the order number, set the order parameters. Mainly including "cement model", "sub-assembly workshop", "quality specification", "required quantity" and other parts. (as shown). When setting order parameters, first set the cement model: Group 1 (425), Group 2 (525), Group 3 (625), click ok key to complete cement model setting. There are three sub-assembly plants, by touching the three buttons of "workshop 1", "workshop 2" and "workshop 3", select which workshop
will complete the production of this batch of cement. The quality of bagged cement can be chosen, enter the quality of each bag of cement by "quality specification". "Required quantity" is how many bags of cement shall be produced, set by entering a number in the required number input box. After all the Settings are completed, click the "Settings are finished" button, and the device will start after 3 seconds delay.

![Cement Packaging Control Control System](image)

**Figure 3.** Schematic diagram of order setting of cement packaging control system

After the equipment is started, check whether there is cement in the bin first. If there is no material in the hopper, the screw conveyor will send a certain type of cement into the bucket elevator according to the setting requirements. If there is enough cement in the bin, the screw conveyor will stop conveying. The bucket elevator runs continuously to transfer the cement to the vibrating screen (running continuously at the frequency of 50Hz), after arriving at the corresponding packaging workshop, the packaging is transferred into the packaging bag via cement. When the packaging of each bag of cement is completed, a buzzer will sound to indicate that the bag of cement is full. After the whole order is completed, the equipment will stop running automatically.

3. Application Effect

Simulation of YL-235A optical-mechatronics automatic production line equipment, we conducted debugging and optimization of material level control, reversible screw machine start-up and operation, bagging control conditions, order counting and other links. The early warning system in the device is used to ensure the safe and stable operation of the system. It also provides an effective way to solve some technical problems in actual production.

With the "Made in China 2025" action plan, comprehensively improving the quality and level of China's manufacturing industry has become the direction of development. With the rapid development of mechanization and automation industry, high efficiency, energy saving and environmental protection have become the consensus. At present, many cement manufacturers urgently need to complete the mechanization and automation of cement packaging line. The simulation study of cement packaging control system by the research group is of great practical significance for improving the efficiency of cement packaging, reducing labor intensity, saving energy consumption, reducing production cost and improving competitiveness of enterprises.

Research group based on the development of YL-235A equipment cement packaging system optimization simulation technology, further improves the working environment of the operator and improves the production efficiency of the enterprise. The simulation optimization technology is applied to the cement packaging production line of a cement production enterprise. The application
results show that, the flexibility of the control link system after the optimization of FX3U-48MR PLC and E740 inverter is obviously improved. Packaging efficiency and reliability have also been greatly improved. The bag weight of 97.6% is better than 50kg±0.3, the average bag weight of 10 consecutive bags is 50kg±0.22, and the total weight of 20 consecutive bags is 1000kg-1003kg, fully meets the requirements of national standards.

4. References

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