Research and design of electronic control system based on automatic production line

Zhiqian Li, Fengxu Li, Dongling Pen

Wuchang University of Technology, Wuhan, Hubei Province, China, 430223

Keywords: electronic control system, automatic production line; mixing; control system

Abstract: the development of automation industry in China has made a qualitative leap today. As an important part of automatic production line, the design and application of electronic control system is directly related to the overall production quality and efficiency of the production line. In this paper, a mixed mixing control system of automatic production line is designed. The system takes PAC controller as the core, minihmi-1000 as the human-computer interaction platform, and carries out high-precision control through feedback and control algorithm, so as to realize high-precision active control of mixed mixing in automatic production line

1. Introduction

In recent years, with the rapid development of ready mixed concrete industry, the pressure of industry competition is also increasing. How to strengthen management and reduce costs has become the key to the development of ready mixed concrete enterprises. Ready mixed concrete is the key material to ensure the construction quality and progress of the project. It requires raw materials such as cement, water, sand and stone to be mixed in strict accordance with the preset proportion. Premixed concrete production has strong real-time and high quality requirements, so it must be "just in time production". As the core control equipment of the concrete production line, the mixed mixing control system of the production line should not only be able to receive the real-time tasks of the ERP system of the factory, but also meet the high-precision automatic control of the whole process, such as metering, feeding, mixing and discharging.

The traditional production line mixing and mixing system mainly relies on manual operation. The mixture proportion and mixing start-up also need to be set manually. The accuracy of the mixture proportion is poor, and the quality of the mixture is poor. In order to realize automation, batching controller + PLC (programmable controller) + PC (production management machine) has become the common mode of mixing control system in production line. However, there are still some limitations, including the single control method of overshoot in batching and metering, and the three parts of data communication are difficult to meet the effective sharing and seamless connection of data, unable to ensure the real-time production data. In view of the above problems, this paper designs a mixed mixing control system of automatic production line, which takes PAC controller as the core and minih-mi-1000 as the human-computer interaction platform. PAC (Programmable Automation Controller) has the dual characteristics of PLC and PC, and has good openness and network connection function, which can make up for the shortcomings of the control system based on PLC controller.

2. Overall structure of mixing control system of 1 automatic production line

2.1 PAC controller

PAC controller is an important development trend of automation industry, which not only meets the advantages of PC processor, RAM embedded software, but also has the robustness, reliability and distribution characteristics of PLC. PAC controller integration has multi-functional development platform, open interface and distributed architecture, which can meet the needs of a single user and a single platform. At the same time, the PAC controller can coexist with many kinds

  DOI: 10.25236/iiicec.2019.074

of application programs such as HMI Software and database software to realize real-time control. Industrial Ethernet technology is used for data transmission and system integration, which is convenient, fast and low cost. This paper uses Advantech PAC system adam-5550kw system.

2.2 General framework

The mixed mixing control system of the production line adopts the automatic control mode. First, the PAC is programmed by computer, and the configuration interface of the human-machine exchange platform is made and downloaded. The configuration proportion is transmitted to PAC through the man-machine exchange platform, and the weight display of raw materials for configuration can be monitored. The weight information is collected by the pull sensor and converted into a standard signal and transmitted to PAC, which controls the frequency converter to adjust the mixing speed of the blanking.

The system consists of human-computer interaction platform, frequency converter, PAC controller and other parts, as shown in Figure 1. The PAC controller adopts Advantech's adam-5550kw system; the human-computer interaction platform adopts minihmi-1000 human-computer interface, which is connected with PAC controller through double Ethernet.

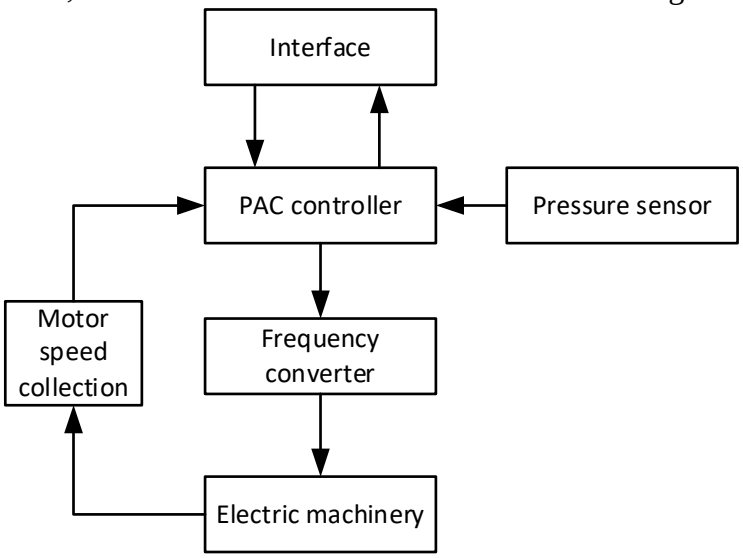

Figure 1 over structure of mixing control system

In order to achieve high-precision control of mixing speed, feedback and control algorithm are used. Specifically, the computer port is used for real-time acquisition of motor speed. PID algorithm

Manage the collected motor speed, and output the relevant parameters, control the motor speed through the frequency converter, and continue the real-time collection of motor speed through the computer port, so as to realize the closed-loop control of motor speed. See Figure 2 for details

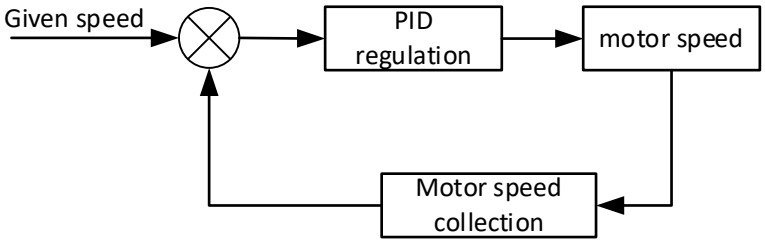

Figure 2 PID control diagram of motor

3. Hardware design of control system

3.1 Weighing Module

The weighing module is in the form of weighing scale. In the design process, the scale should

not only meet the function of analog signal processing, mix ratio setting, but also meet the function of adding thickness and fineness. At the same time, it should realize the correction ability of independent learning and the function of overshoot control. In addition, the weighing scale also has the functions of on-line compensation scale, buckle scale, nominal, etc. to meet the requirements of various parameter setting capabilities.

The main function of the weight collection component is to measure the weight of raw materials passing through the blanking valve efficiently and accurately according to the mix proportion setting of the weighing module, and to close or open the blanking valve quickly. Start the metering, set the weight information obtained to zero, open the blanking valve, compare the increased weight, and close the blanking valve through the thickness adding function and the overshoot of the last feeding; the purpose of the delay is to judge the error, if the error is too large, execute the jogging distribution function, otherwise, the overshoot will be automatically corrected and updated. The so-called Overshoot refers to the raw material that has passed the blanking valve but has not yet reached the scale body.

3.2 PAC controller

PAC controller adopts Advantech's adam-5550kw system, which has stable Procon OS kernel engine and powerful Multiprog kW, including 8 slot backplanes, 16 bit high-precision analog input module, 16 channel digital input module and 16 channel relay output module. Receive production instructions, complete the measurement, feeding, mixing and discharging process.

In addition, the wince operating system of adam-555okw controller has developed data acquisition, storage and system configuration software, so it can be connected with the human-computer interaction platform, and the generated data can be stored on the extended large capacity CF card, which is separated from the human-computer interaction platform to form a simple and reliable monitoring platform.

In the specific design, one RS ~ 485 bus of adam-5550kw is used as the host control frequency converter, one is used as the slave through dual Ethernet to communicate with the human-computer interface, receive the configuration and program set by the human-computer interface, and transmit the field data to the human-computer interface for display. In addition, the 12 bit ADC can collect the field analog data, capture the click speed through the timer, and adjust the PID speed through the feedback mode.

3.3 Power module

In order to realize safe and reliable operation of the power module, it is necessary to classify and process according to the function. The specific classification mode adopted by the system is: the supply scale transmitter adopts 12V linear excitation voltage signal; the adam-5550kw controller adopts 24V linear power supply; the on-site 24V solenoid valve and other actuators adopt switch power supply. This mode of power supply can effectively avoid a variety of interference, such as grid interference, power interference, motor start-up and stop interference, and ensure the safe and stable operation of the system.

3.4 system communication

The system adopts three-layer network structure of computer, PAC and frequency converter. The controller uses double Ethernet ports to form a reliable redundant Ethernet connection, which is connected with the human-computer interaction platform, making the control system more secure and reliable. The frequency converter and PLC communicate through RS-485 bus. As a kind of equipment level network, RS-485 bus has the advantages of high transmission speed and low transmission price. The high-speed response of DC speed regulation system can be achieved by using RS-48 bus communication between field controller and scattered I / O signal.

4. Control system software design

4.1 System main program flow

Adam-5550kw controller adopts modular programming mode, including initialization program, mixture ratio transmission program, metering scale program, batching, mixing logic control program, upper computer communication program and other modules, as shown in Figure 3 is the flow chart of system control mixing part.

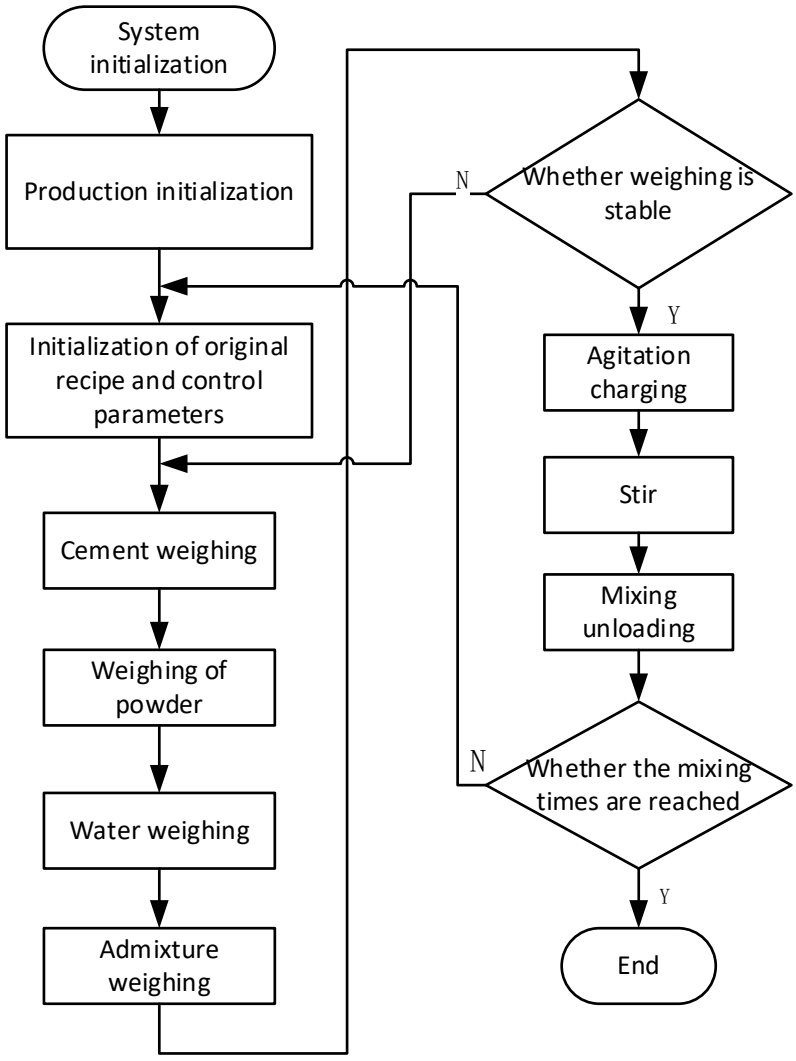

Figure 3 overall structure of mixing control system

4.2 minihmi-1000 human machine interface

Minihmi-1000 is a high-performance management and control integrated human-machine interface, which is produced by Guangzhou Zhiyuan Electronic Co., Ltd. and meets the following characteristics:

(1) The microprocessor adopts industrial 32bit embedded RSIC with the main frequency up to 400MHz;

(2) The input interface adopts 4-channel CVBS video interface, which can present the working area picture in real time;

(3) The display adopts industrial LCD with high brightness, high contrast, size of 10.4 inches and 260000 colors;

(4) It can support many kinds of industrial fieldbus communication protocols such as Ican, DeviceNet and VGA extended display interface;

(5) It can be connected with mass storage device to effectively save key historical data and

product formula.

As shown in Figure 4, it is the actual figure of minihmi-1000 human-machine interface. It includes two parts: operation monitoring and setting page. Among them, the staff can know the operation status and mixing situation of the system in real time through operation monitoring;

Figure 4 actual figure of minihmi-1000 human machine interface

5. Conclusion

In conclusion, as an important part of the automatic production line, the design of electronic control system can effectively improve the stability and reliability of system control by continuously strengthening the optimal design of electronic control system, so as to help enterprises to maximize the quality and efficiency of product production and ensure that enterprises can create the maximum economic benefits at the lowest cost. Therefore, enterprises should actively introduce and apply DCS control system, optimize and upgrade the system according to the actual situation of their own production line, and promote the stable and sustainable development of China's automation industry.

References

[1] Wang Yu. Discussion on quality control measures for raw materials of ready mixed concrete. Sichuan Cement, 2018(1): 325.

[2] Li Guanglin. Control system application technology of asphalt mixture mixing equipment[J]. Journal of Shenyang University of technology, 2005, 27 (4):446 - 449.

[3] Xue Wei, Wang Qiang, Zhang Xin, et alR & D [J]. Electrical automation, 2002,24 (6): 26 - 27.

[4] Nie Jing, Wang Hongkun. A variety of fertilizer liquid self controlled by PLC and frequency converter Dynamic hybrid monitoring system [J]. Water saving irrigation, 2013(10): 74 - 76