

Discussion on Blast Furnace Temperature Control System based on Internet of Things

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Abstract

For blast furnace control systems, the traditional control programs are centralized controls based on PLC; there are too many cables, complex circuit, strong interference, hard maintenance, so we present the application of FCS programs. With distributed control system to put the control method on site which can not only save a lot of cables, ensure self-diagnosis capability of node equipment, but also when the control center or bus fails, it can start semi-automatic mode to ensure smooth production. The practice shows that the control system can save costs for enterprises and improve the informatization level of enterprises.

Keywords

Terms - Fieldbus, PLC, FCS, Blast Furnace.

1. Introduction

Fieldbus Control System (Fieldbus Control System, FCS) is the fifth generation of process control system which is used among on-site instrumentation, control systems and control room. It is a communication system which is widely-spread, all-digital, intelligent, bi-directional, multi-variable, multi-point and multi-station. It has features such as high reliability, good stability, strong anti-interference ability, fast communication speed, low cost and low maintenance cost [1].

FCS has been developing into meter level at abroad. It adopts open and standardized solutions and truly achieves fully distributed structure; it releases controlling function onsite and makes the control system orienting more towards distribution, flat, networked, integrated and intelligent trend. Between the nodes onsite it can achieve mutual communication with each other and achieve interoperability. The on-site nodes can also send their own diagnostic data to host computer which is conducive to equipment management. Control system only processes with the collected signals and provides human-machine interface and logic control.

2. Current Status of Blast Furnace Control System

Blast furnace control system is the fault-tolerant system which is highly integrated with powerful messaging and processing power. As DCS follows the principle of "centralized information, centralized control, decentralized control", it is widely adopted. And FCS is a further manifestation of this principle; it can further distribute control functions to the field instrument level, while it can make centralized monitoring and management on entire production process. On the overall structure FCS is the inheritance and development of DCS. As FCS can give full play of onsite intelligent instrument's functions and make diversified controls, thus, it has higher reliability than DCS.

Blast furnace control system itself has complex mechanism and the model is difficult to establish. The object is uncertain and variable. In the system there are relations and coupling between various parameters. The new controlling technologies for resolving the complex control problems, such as predictive control, robust control, adaptive control and fuzzy control, requires that the hardware should have very strong information processing capacity. Optimal control based on system can often bring significant economic benefits. The implementation of advanced control, optimization control and CIMS programs are based on analyzing centralized information processing. This poses higher requirements on FCS information collection, transmission, processing and application.

Since power, size, harsh environmental conditions and other reasons, field instruments' ability to process information will not be quite strong. Although the intelligent instruments basing on field bus have control function module, the function block under current definition has limited capabilities, so it can not afford all controlling tasks. In FCS make use of controller site to realize senior control, system optimization, scheduling and other tasks, rather than take control of the basic task of real-time level [2].

Modern industry needs a computer integrated manufacturing system, that is, CIMS or CIPS. The focus of CIMS lies in information integration. Intelligent instrument is connected to enterprise network through field bus which can provide "none-control information" in addition to delivery of variables. It also can make diagnosis, remote configuration, calibration to make the forecasting maintenance become possible. Communication bus directly extends to the industrial field provides two-way digital communication to make the abilities of field devices of communication a qualitative leap. The equipment management system is established on this basis, make comprehensive integration of all information of plant equipment on site, and make analysis and processing of all management information, send information and processing results to any place where needs it. Plant maintenance and project management personnel can understand each intelligent instrument's status information through network, reducing on-site inspections. Because it can make predictive maintenance, the possibility of unexpected shutoff of the system is reduced and the repair time for shutoff is shorten.

3. The Application Status of Fcs Technology

FCS technology makes an enterprise's field control network can make more convenient and effective communication with office information networks. The integration of both parties is of great significance to improve enterprise's information infrastructure, so that automation systems and equipment can join in the information network of enterprise and become the bottom layer of enterprise information network. Because of that, the coverage of enterprise communication can be extended to the production site to meet the development requirements of enterprise information developments.

FCS control manner enhances the ability of field-level information integration which makes it is easier to complete the remote control and remote parameterization work; FCS system is open, allowing other vendors to integrate their own control technology into general-purpose system, which makes the system interoperable, interchangeable and integrating. The distributed control system can release control to field which can reduce data processing volumes in the control center. This makes the data transmission volume decreasing correspondingly and improves reliability and stability of data transmission. Each node can work independently and have a certain self-diagnostic capabilities. When there are failures in control center or bus, it can start semi-automatic mode to ensure the smooth production [3].

4. Design Program of Blast Furnace Control System

FCS control center adopts a large Siemens PLC (S7-416- 2DP), hanging a small number of Siemens PLC (224XP/226) and applying Siemens Profibus-DP field bus connection. 416- 2DP is responsible for the overall operation, coordination and part controlling functions. 224XP/226 is responsible for specific I/ O and other control functions. When 416-2DP (or bus) fails, the following 224XP/226 can achieve independent manual or semi-independent operation. Structure is shown in Fig.1:

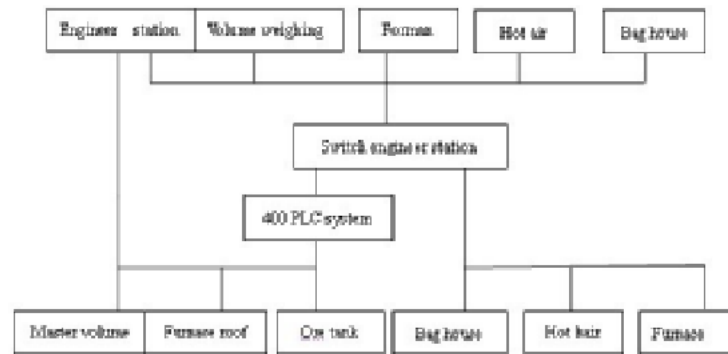


Fig. 1 Diagram of control system structure

The control system is divided into six nodes: master volume control node, furnace roof node control, ore tank control node, baghouse node, hot air stove node and furnace body node[4,5].

Master volume control node: The core of control is Siemens 200PLC/224XP + EM277, the main devices which are controlled are two main volume inverters, master encoders of two volume MODBUS interface, limit switches, rope switch and a local control box (for manual local operation).

Furnace roof control node: 224XP connect MODBUS to conduct remote controls on I / O modules and 5 MODBUS encoders. Put remote DI modules on the roof of furnace, place remote DO modules on hydraulic station and connect to the 224XP in the middle by the MODBUS bus connection.

Ore tank control node: The core of the node is weighing control; 400PLC sends the settings values to ore tank nodes by DP for each scale (224XP). 224XP (PLC) shall be based on a calculation by the inertia of the parking spots this time. Through 485 bus communication protocol it can send on-site parking spots to the corresponding weighing instrument. 224XP starts corresponding vibrating screen that from this point the ratio of the two nodes are lower than 224XP FCS nodes: a SIMOD-16DO module to drive [6,7].

Baghouse nodes: The system consists of five components: public discharging part, valve / discharging components on each box, cleaning parts, public valves and instrumentation systems. The core of automatic control system is a Siemens small PLC-226DC/DC/DC; it controls all equipment in baghouse system. Operating system is a computer which monitors all baghouse systems on the equipment. The computer has display of the working status of all equipment and instrument parameters. Make use of mouse to control all the mechanical equipment, display and record the fault and alarm information. Computer and PLC are connected by Ethernet; this PLC is also connected to all computers in hot air, volume scale and blast furnace body. All data can be shared. When it is necessary, on the other computer I can conduct remote controls on the baghouse system and it just like operating on this computer[8,9].

Hot-air furnace nodes: Hot air furnace control system consists of four components: three hot gas valve controls, public valve control, combustion air fan and instrument systems. The core of control system adopts Siemens 226PLC.

DI adopts matrix scanning technology which can be operated on one computer. Via Ethernet it can connects with 226, while it can be connected to other computers (bag house, volume scale, foreman). All data can be shared. If necessary, hot air furnace can be operated from other computers (you can also use hot air computer to operate other parts).

Blast furnace body node: This node is the most suitable one to apply FCS nodes. The application of FCS can significantly reduce cost, maintain difficulty, and improve reliability and accuracy. BF body monitoring is the core of the blast furnace and it is operated by the foreman and furnace director. The main function of this system is to monitor more than 100 parameters of all the instruments in the blast furnace body.

5. Brief Summary

In the blast furnace control system, application of FCS technology can reduce enterprises' costs, reduce the application of transmission cable. As there are too many interferences and more complicated situations on industrial field, FCS control method can further improve the reliability and accuracy of information which is transmitted among equipment. And it is easy to conduct maintenance. Through intelligent management of all nodes it has certain self- diagnostic function, making production control more stable and reliable [10].

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