The Full-automatic Distributed Control System Design of CS-1-G Catalyst Alcohol-Synthesis and Synthesis Processes

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Abstract

Aiming at a CS-1-G gas phase catalyst project in a chemical plant, a fully automatic monitoring system for the synthesis and synthesis of CS-1-G catalysts was designed. Subject to the control requirements of the project, the process flow is analyzed in depth, and a control scheme based on distributed control system (DCS) is proposed. This system is mainly divided into the lower part of the machine and the upper machine part adopts MDCS intelligent module to complete the batch of alcohol and reaction in the process of temperature, pressure, flow, automatic control and other important parameters. The host computer realizes the communication through the network card and the lower computer, and realizes the man-machine interaction, real-time monitoring, fault alarm, historical curve and other functions by using the FIX configuration software. In addition, the staff can also realize the hand automatic switching of the production process, the parameter setting, the fault location and the printing report forms in the FIX monitoring interface.

Keywords

Catalyst; Distributed control system; MDCS intelligent measurement and control component; FIX; Configuration software.

1. Introduction

Catalysts are widely used in the production of many important petrochemical processes. If the catalyst is not used in the reaction process, the reaction rate will be very slow and may even lead to no industrial production at all. The use of suitable catalysts can speed up the chemical reaction, greatly reduce the cost of the product and improve the quality of the product[1]. The indirect effect of the catalyst on improving the industrial economic benefits is immeasurable. Speeding up the production efficiency of catalysts in the industry and realizing the automatic monitoring of production will bring great improvement to the output of industrial catalysts. At present, many chemical enterprises are at the low level of automation, and use in the chemical production process of raw materials and products are flammable and explosive, toxic or corrosive, in order to improve the efficiency of industrial production, for operators to provide a safe working environment, design a set of production monitoring system safe and reliable precision is very important.

The subject comes from the project of producing CS-1-G gas phase catalyst in a chemical plant[2]. The production process of CS-1-G catalyst is more complex, the alcohol reactor and synthesis reactor during the reaction temperature, pressure, flow and other reaction conditions demanding, at the same time the batch of raw materials also have strict restrictions. This subject adopts a series of intelligent control methods to design a set of production process of CS-1-G catalyst in alcohol and synthesis process of automatic distributed control system for production monitoring, the alcohol synthesis kettle kettle, the automatic control of the reaction process, collecting important data and monitoring the

production process, the system to achieve the goal is the accurate measurement, automatic control, real-time monitoring, fault, data processing and print statements and other functions[3].

Micro distributed control system has been applied to many chemical enterprises. Its cost is low, it is stable and easy to maintain, so the control requirements of this project can be realized completely. According to the characteristics and practice of the above MDCS, the project of using micro distributed control system to complete the production of CS-1-G gas phase catalyst in the factory is finally determined[4].

2. Organization of the Text

The whole system is mainly composed of five parts: host computer, network card, CAN bus network, slave computer and field instrument. The upper computer of the system adopts two industrial control computers, and the operating system is Windows XP. Through the FIX monitoring screen, real-time grasp of the scene, while monitoring data can be generated history curve. If there is a fault on the spot, you can locate the fault position through the upper computer and quickly eliminate the trouble. The data transmission between the host computer and the slave computer needs to complete the conversion between the serial port protocol and the CAN protocol through the network card, and the data transmission between the lower computer and the lower computer is completed through the CAN bus. The machine uses 14 MDCS intelligent module, including 5 sets of intelligent module complete raw material preparation area of each tank pressure PID control, the pump start and stop, the liquid level detection and other functions; intelligent module 2 complete alcohol reactor temperature control, PID octanol flow rate and batch control, alcohol tank the pressure control switch, mixing and other functions; intelligent module 6 to complete the synthesis reactor PID temperature control, electric heating (heating curve), four titanium chloride PID control flow and batch control, constant temperature time, timing and other functions; intelligent module 1 units completed low pressure steam pressure control and fault alarm function[5]. The relay is used in the system circuit, whose function is to accomplish the control of large current with small current and play the role of protective switch in the circuit. The circuit is also need to use the security gate, this design uses the GS5000-EX series of isolated safety barrier, this type of safety gate through the safe and reliable operation of control system of electromagnetic isolation technology, and ensure the safety of plant and equipment. The composition of the control system is shown in figure 1.

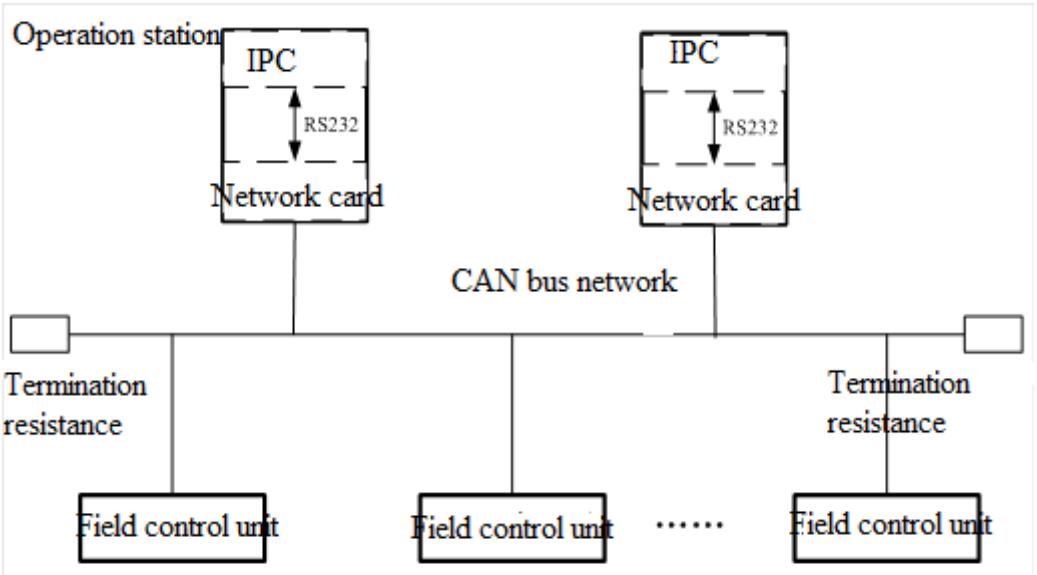

Fig. 1 Schematic diagram of the control system

When the PC to PC data transfer, PC card device according to the specified data unit to send data, and the host computer through the I/O driver, using the same card device, data read data in the specified unit. When the host computer to lower computer when the data transmission without card data unit,

directly through the I/O driver according to the slave device to the specified data unit to send data, the data through the real-time database configuration "receiving data" module into the MDCS, read the data in the data unit set[6].

3. Realization of Lower Computer in Control System

Subject to not only meet the control requirements in the production monitoring system intelligent control components, working environment, and the system of various types of field acquisition and control the amount of data to meet the above quantity, and has a certain margin. In the design, altogether selects 14 SHCAN6102 intelligent control components, 5 dual channel thermal resistance temperature transmitter SHCAN6502 components. The raw material preparation area using SHCAN6102 intelligent control module 5, a number are 000A, 000B, 000C, 000D, 000E; alcohol tank were used in SHCAN6102 intelligent control module 2, a number are 100A, 100B; synthesis reactor using SHCAN6102 intelligent control module 6, a number respectively. 200A, 200B, 200C, 200D, 200E, 200F; fault alarm device with low pressure steam pressure control using 1 SHCAN6102 intelligent control module, a number of 300H.

Double circuit diagram is shown with the wiring diagram of communication system, the design of each control loop of the object and the control function, in the double loop diagram can show the parameters of connected devices in intelligent control components of each of the slave system and the need to clear the acquisition and control. Through the allocation of hardware resources, the model and quantity of each measurement and control point and components can be clearly defined. Based on the technological process and control requirements, a dual loop circuit with intelligent measurement and control components as a unit can be designed. This design for alcohol synthesis reactor kettle and the production process of automatic distributed control system draw out 36 double loop diagram, because of its large number, only the specific description of 3 double loop diagram 100A two double circuit diagram and 200A.

GS5038 type and GS5036 type safety gate belongs to GS5000-EX series isolated batviers limit circuit, high efficiency energy conversion circuit and the precision of signal transmission circuit technology can ensure the safe and reliable operation of control systems through the security gate security need energy, independent power supply, the power supply, input and output three isolation. The main function of GS5038 simulation output is from safety grid security zone 4~20mA current signal isolation is transmitted to the danger zone, security zone here refers to the site control unit of each intelligent component, the danger zone refers to the scene of the instrument (such as electrical converter, valve positioning device, display device and control valve) region[7]. The main function of the GS5036 analog input safety barrier is to provide isolated power to the transmitter in the danger zone and transmit the 4~20mA current signal from the transmitter or current source to the safety side separately from the dangerous side. When the feeding process is completed, the component is sent to the mixing switch in the kettle, and the switch signal is controlled, opened and closed by the relay. The two double loop circuits of the 100A are shown in figures 2 and 3.

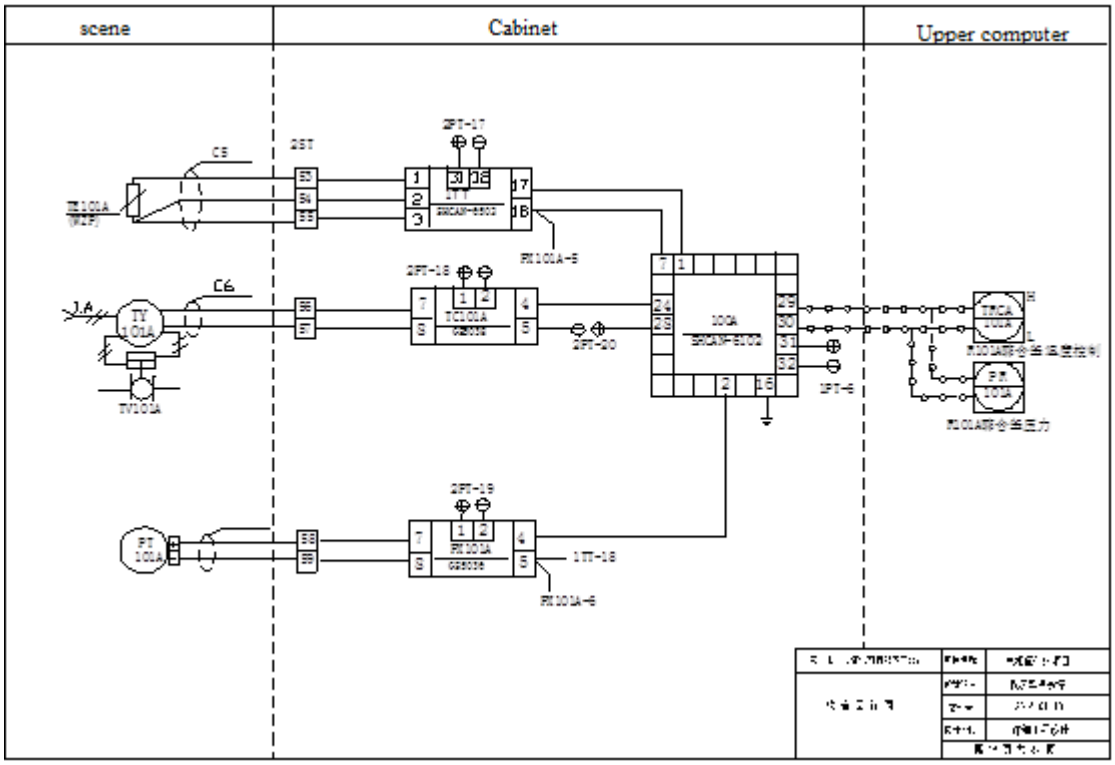

Fig. 2 100A two-wire loop figure 1

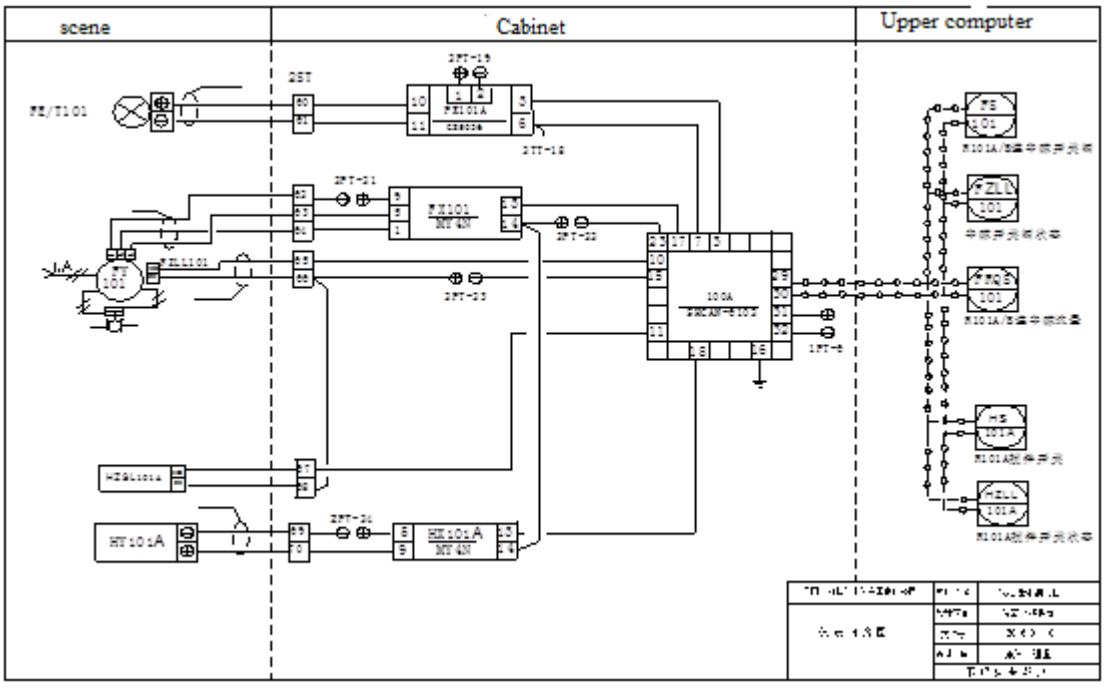

Fig. 3 100A two-wire loop figure 2

4. Realization of Upper Computer in Control System

The process database is created based on FIX communication variable table on the contents of the database entry is FIX communication variables table of the content, including monitoring the roll call, description, data type, number, quantity, scope, quantity of bridge address slave address and database address etc.. The basic work of the PC software is to create the process database, and other applications of FIX have to obtain data from the process database. During the creation of a process database, its scan cycle is greater than or equal to the polling time in the I/O driver. A friendly human-computer interaction interface is a huge improvement in the control function of a monitoring

system [8]. For on-site production personnel, an interface is clear, intuitive, and can display in real-time each need to control the precise location and status of the equipment, it is important to improve the efficiency of work. The design of the host computer monitoring screen makes full use of the powerful function of FIX software, and uses its drawing tool DRAW to edit the picture. At the same time, FIX has a bitmap interface on the screen editing interface, so you can download or use advanced graphics tools to draw and then import it at design time. The design of the automatic monitoring system of the main tasks are: temperature, flow, pressure and other parameters, including the parameters of the response increments, while the host computer can control the state of the hand automatically. The monitoring system also has functions such as setting parameters, printing reports, generating historical curves and fault alarm, etc. each monitoring interface is introduced below. The design process includes: raw material preparation process, alcohol reactor reaction process and synthesis reactor reaction process, respectively, as shown in figures 4, 5 and 6.

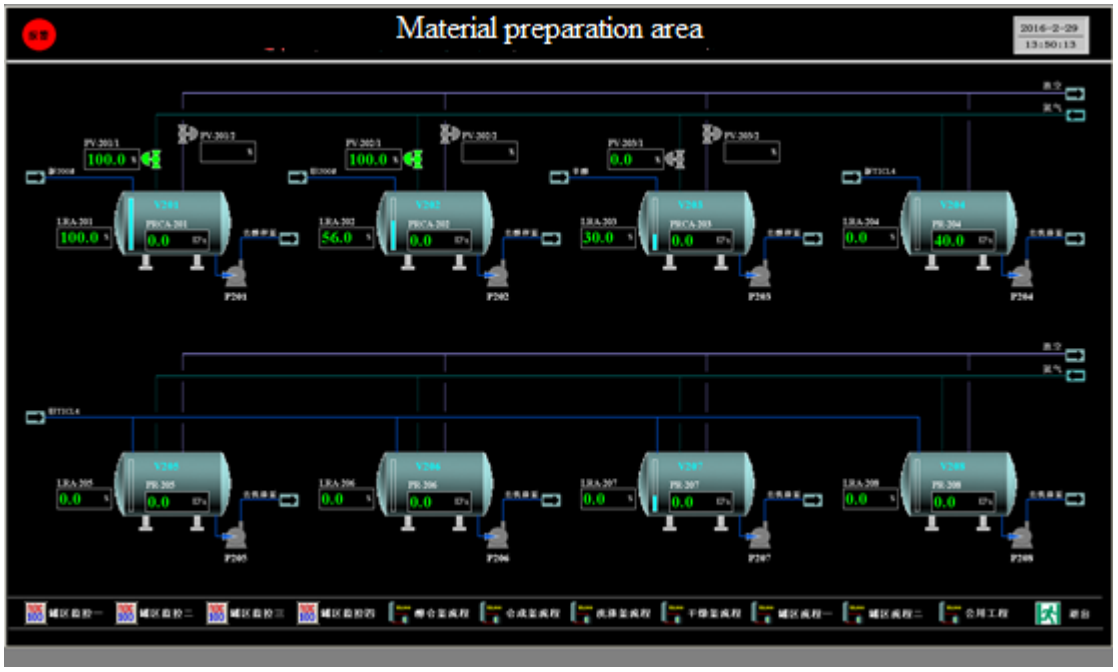

Fig. 4 Material preparation area

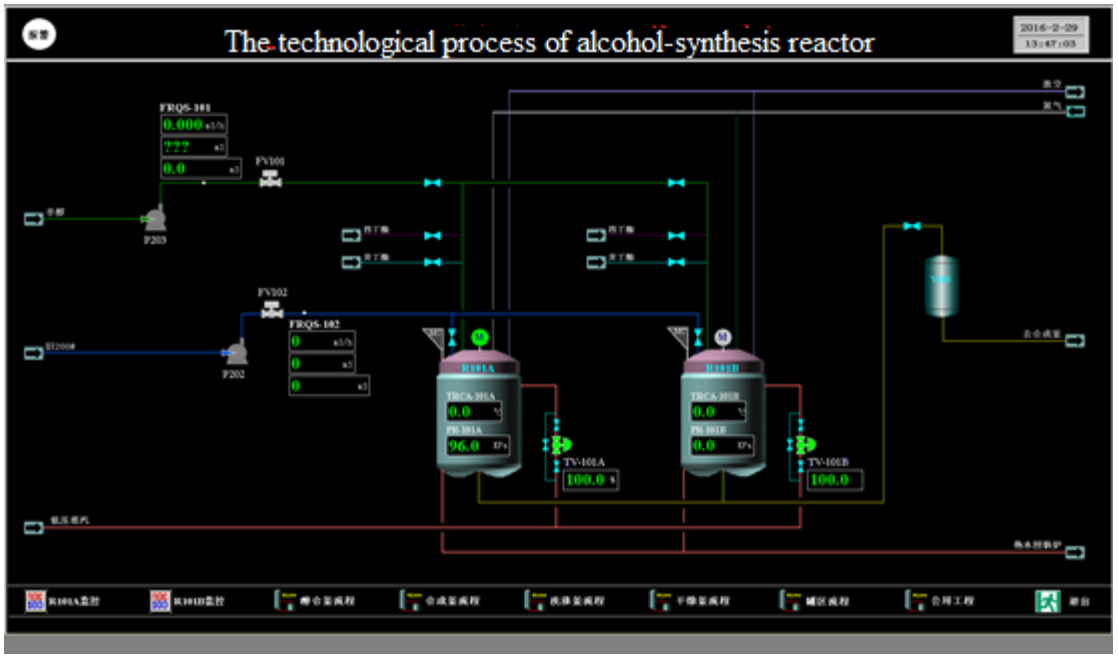

Fig. 5 The technological process of alcohol-synthesis reactor

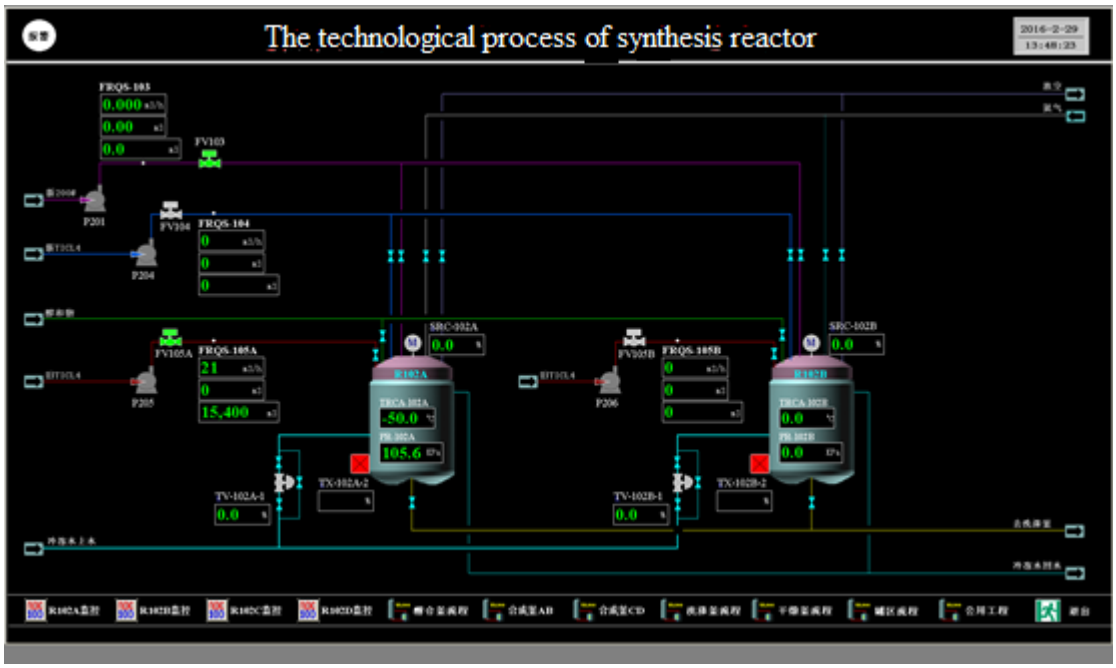

Fig. 6 The technological process of synthesis reactor

The raw material preparation area need to monitor pressure and flow of new TICL4, old TICL4, nitrogen, new 200#, old 200#, fresh hexane, recycling C6 tank at the same time, the corresponding valve and valve closing state real-time monitoring. The working state of the pump can be determined by the color recognition of each pump in the figure [9]. When the pump is gray, it indicates that the pump stops working. If the pump is green, it indicates normal operation. In the process of reaction, the temperature and the temperature of the alcohol mixing vessel and the regulating state of the low-pressure steam valve can be observed directly in the pressure vessel and the PID temperature. First, for each autoclave, the whole hand can be automatically switched, that is, automatic and total manual. In the automatic mode, the machine according to the automatic control of each reactor program reaction, if the total manual state, need to input in the computer after the parameters of the control point, the "start" button to start work with alcohol tank. The process flow of the alcohol mixing kettle is also marked in the diagram, and the operator can visually determine what step the alcohol kettle is working on. In the same way, the temperature and flow of the alcohol mixing kettle can also be automatically switched by the local hand. The temperature detection value, the given value and the operation output value of the R101A alcohol mixing kettle are also displayed in the interface. The pressure of the R101A alcohol mixing kettle is numerically displayed and the percentage is displayed. In the monitoring interface, if the tank, reactor, alcohol or the kettle pump monitoring failure caused the process problems, will monitor interface in PC alarm, each host computer monitoring interface of the upper left corner of a warning light, when a monitoring point in the interface when a fault occurs, the signal light will turn red, through the host computer can determine the specific location of the fault, when the fault alarm signal will resume normal termination.

5. System Debugging

CS-1-G catalyst and alcohol synthesis process of the automatic control system in the system before officially put into operation, although the design has been completed, but in order to ensure the safety and stability of the system can be sent to the factory after the operation, we need to conduct a comprehensive debugging of the whole system [10]. The debugging tools include MDCS-CFG software, debugging programmer, multimeter, signal generator, including the main contents of the debugging of control cabinet wiring is correct, the device is working properly, the alarm and the alarm signal is normal, download and debug configuration, system function testing, precision control, precision control, AI AO, the precision is plus or minus 2/1000, signal on each pass through the

alignment accuracy whether meet the requirements, the calibration parameters of MDCS intelligent adjustment over the range of needs corresponding to the control component of the. The first step is to debug the control cabinet of the device after installation check to see whether the device damage confirmed after installation of the cabinet wiring diagram and circuit diagram of measuring circuit, testing all the wiring connection is reliable and accurate, the host computer through the debug configuration software MDCS-CFG download configuration, PC monitoring function detection whether the normal and test the accuracy of the signal. After the assembly of the lower machine, the system physical diagram as shown in Figure 7 and figure 8. First open the MDCS-CFG software will enter the first interface, in order to ensure the standardization work, to prevent the non-operation of the staff, then enter the password authentication before download and debug interface, enter the password will enter the port and the network interface is set correctly in the operator interface, you need to select the appropriate network baud rate and serial number, set up after entering the MDCS and parameter setting interface, set MDCS set is the corresponding lower machine component number, the total use of 14 sets of MDCS control component is corresponding to the 14 device settings. After all configurations have been downloaded and verified, if the operating parameters are changed during the operation of the system, the bridge can be automatically reset by the bridge reset of the real-time monitoring interface.

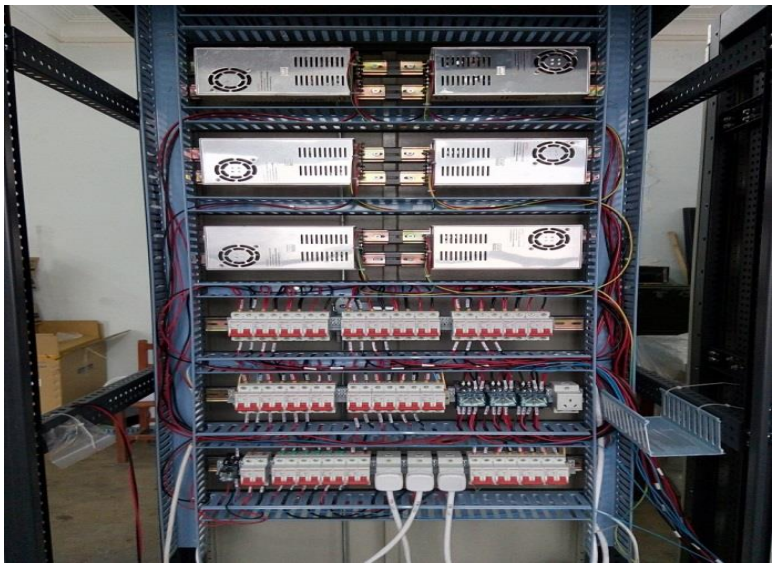

Fig. 7 The No.1 control cabinet

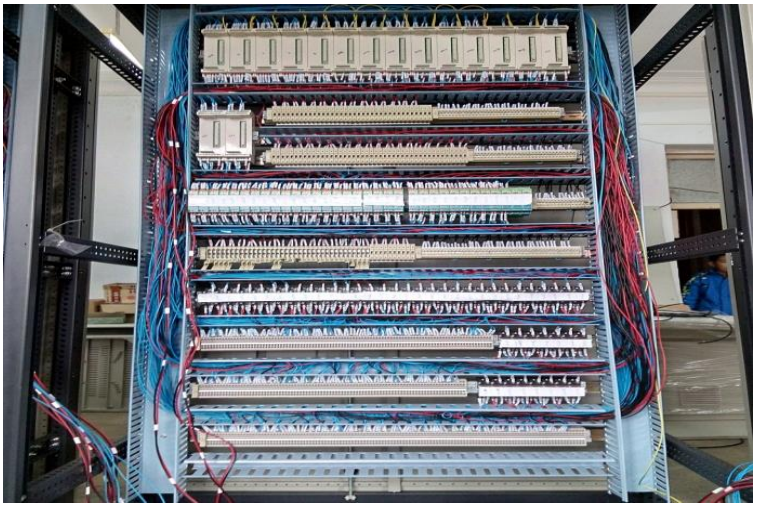

Fig. 8 The No.2 control cabinet

6. Conclusion

This paper first introduces the CS-1-G catalyst for alcohol and process and control synthesis process, and introduces the hardware and software design of this system includes the contents of the detailed description of the specific function design steps with PC computer and the steps. The total design process including: according to technology flow chart of statistical control points and lower computer hardware selection, hardware design, resource allocation, application of double circuit diagram design of lower computer configuration, FIX communication design variables, set the I/O driver, the process of creating the database, design process and PC monitoring interface, finally through the configuration debugging and debugging for the system to work properly.

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