PID Temperature Control System Based on PLC

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Abstract

In industrial production, temperature is a major controlled object in many processes. With the continuous development of automatic control technology, temperature control systems that can be automatically adjusted are increasingly used by people in industrial production. The prospects are more and more broad. However, in general temperature control systems, there is a problem that temperature detection lags behind temperature control, so it is easy to cause slow response of the temperature change of the controlled object and overshoot of temperature of the entire temperature control system. This randomly generated temperature change and unpredictable parameter control it directly increases the difficulty of high-precision temperature control. This article intends to use Delta DVP series of DVP-64EH3 programmable controller as the control core (lower machine), PC is the host computer, and programmable controller communicates with the host through a dedicated data line, and the use of which PID function instructions for the temperature control.

Keywords

PLC;PT module; PID control; sensor.

1. Introduction

As an important controlled variable in industrial production, temperature control is not only acts slowly, but also results in inaccurate control results and consumes a lot of time and effort due to gene the ral control methods. With the expansion of the application of automatic control technology in industrial production, the temperature control system has also been developed and applied. This paper designs an automatic temperature control system based on PLC control for small boilers.

The temperature control system uses the DVP04PT temperature module to measure the present value and send it to the PLC host. The DVP-64EH3 main unit uses the temperature auto-adjustment parameter function to make initial adjustments, and automatically calculates the optimal PID temperature control parameter. After the adjustment is completed, the action direction is automatically modified for the temperature control special function that has been adjusted, and the temperature of the boiler is controlled using the automatically calculated parameters.

2. Introduction of DVP-64EH Series PLC and DVP-04PT Module

2.1 Introduction of Delta DVP-64EH Series PLC

PLC (Programmable Logic Controller) is essentially an industrial control special computer. Its system composition is different from that of a microcomputer, but generally similar.The PLC is generally composed of a central processor CPU module, a memory, an input/output module, a power supply module, and a programmer (programming software).The control principle is shown in figure 1.

Delta EH series PLC adopt CPU + ASIC dual processor, support floating-point operations, the fastest execution speed of instructions is 0.24μs.Its motion control function is excellent; with program protection function,program automatic backup function, even the battery has no power, the program will not disappear,and there are up to 4 PLC password protection to protect user's intellectual property; with a variety of special expansion modules and function cards, it include analog output/input, temperature measurement, additional single-axis motion control and high-speed counting capabilities, and it also can add a third serial communication port or Ethernet communication card.

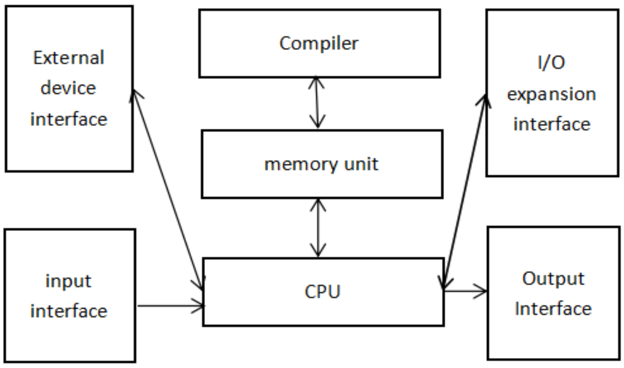

Fig 1.

2.2 Page Numbers

Platinum temperature sensing resistors offer high accuracy and stability, and good linearity between -200°Cand 600°C.In general, platinum PT100 temperature-resistance has a large temperature coefficient between -200°C and -100°C at low temperature, and has fairly good linearity at medium temperature between 100°C and 300°C, while it has a high temperature between 300°C and 500°C.

The DVP04PT temperature measurement module accepts an external 4-point platinum temperature sensor and converts it to a 14-bit digital signal. It read and write data in the module by instruction FROM/TO through the DVP-PLC host program with 49 CRs in the module.

3. Automatic Temperature Control Principle and System Design

3.1 Principle of Automatic Temperature PID Control

The basic principle of automatic temperature control instrument to control temperature is calculating the theoretical and actual measuring temperature at different times to obtain a control quantity, and then adjusting the output by this control quantity. The entire control can be considered to consist of three parts: proportional, integral, and derivative.

In this temperature control system, we use the PID instruction in the PLC to control the temperature, and use the DVP04PT temperature module to measure the current temperature of the boiler and send it to the PLC. The host first uses the automatic temperature adjustment parameter function (D204=K3) to make initial adjustments. After the adjustment is completed, the operation direction is automatically changed to the temperature control dedicated function (D204 = K4) that has been adjusted The output result is used as the input of the GPWM instruction and the Y0 output is executed after the GPWM instruction is executed, and then variable width pulse controls the heater devic.As it is shown in Figure2.

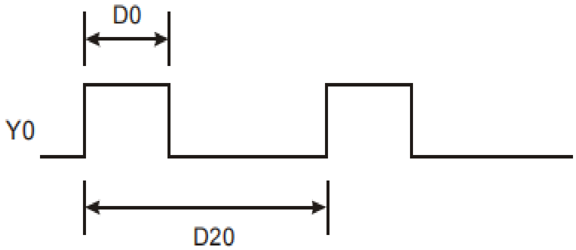

Fig 2.

3.2 Design of the System

In this case, we set the target temperature to 80°C so that the temperature in the container can be automatically adjusted through PLC control and stabilized at about 80 to ensure that the reaction in the container can be performed normally. The temperature feedback signal in the measurement circuit is transformed by the PT module and sent to the host for processing. After a certain algorithm, Output signals to control the on and off of the AC contactor and control the power obtained by the heating furnace to achieve temperature control. The specific control algorithm is to compare the simulated boiler water temperature measured by the measuring device with the set value and use PID to adjust the heating. If the measured water temperature exceeds or falls below the set temperature by 1°C or more after the adjustment completes one cycle of oscillation, the control Actuator automatically adjusts. The program flow chart is shown in Figure 3.

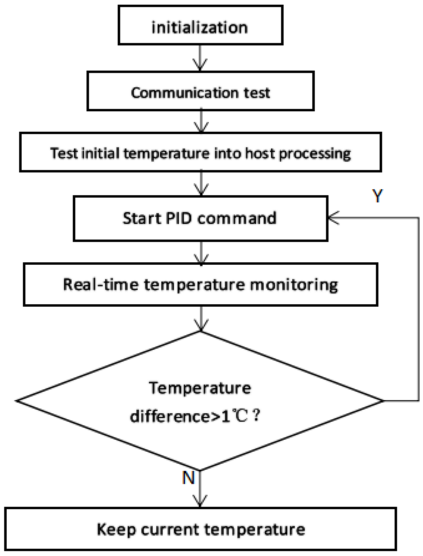

Fig 3.

4. Program Design and Result Analysis

We use Delta PLC programming software WPLSoft to write this program, the specific program block diagram and program description are as follows.

4.1 Program Description

We initialize the experiment before starting the experiment, and set the relevant parameters after the initialization is complete. Set the target temperature to 80, set the sampling time to 4s, set the GPWM instruction cycle to 4s, and set the average number of 04PT channel 1 temperatures to 2 time, which is shown in Figure4.

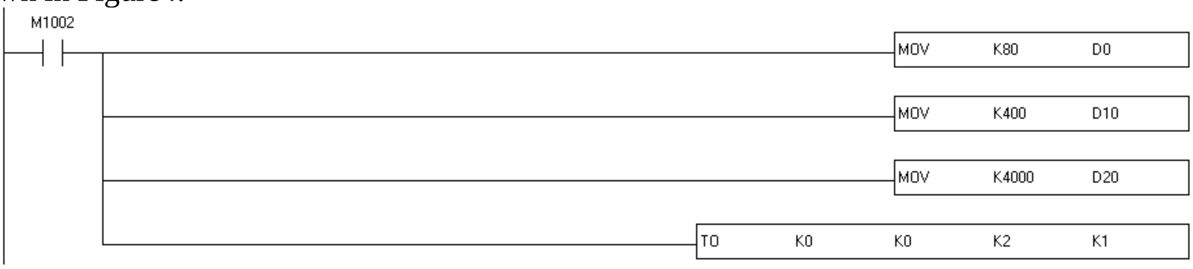

Fig 4.

Use the FROM instruction to read out the temperature detected in channel 1 of the PT module, sampling once every second, and storing the current temperature in degrees Celsius in D11.As is shown in Figure5.

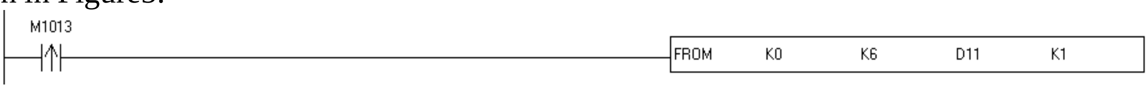

Fig 5.

The direction of action is selected as the temperature-controlled auto-adjustment parameter function, so that the PLC uses the temperature auto-adjustment parameter function (D204=K3) to make preliminary adjustments and automatically calculate the optimal PID temperature control parameter, which is shown in Figure6.

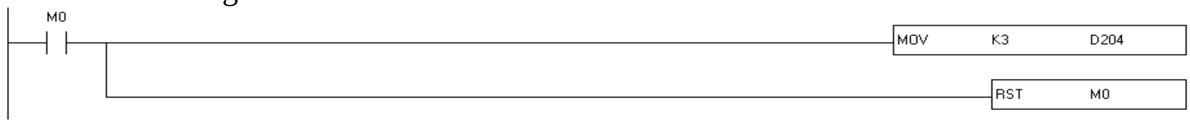

Fig.6.

After the adjustment is completed, the operation direction is automatically modified to the temperature control special function that has been adjusted, and the PID control is implemented using the automatically calculated parameters. The calculation result of the PID instruction is stored in the D30.Finally, the GPWM instruction is used. After the execution, Y0 outputs a variable-width pulse (width determined by D40) to control the heater device, so that the PID control is automatically implemented.

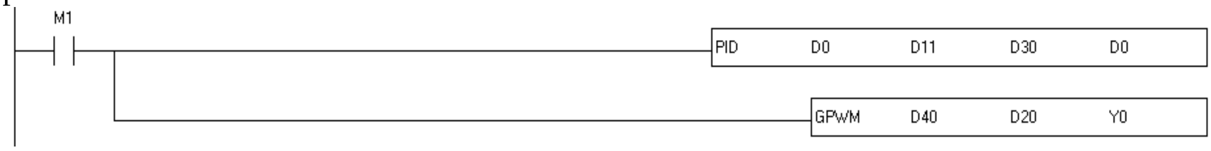

Fig 7.

4.2 Result Analysis

In the process of automatic temperature adjustment in this paper, let the PLC automatically adjust first, then calculate the ideal PID operation parameters, and use this parameter for temperature control. The result is shown in Figure8.The time is only about 20 minutes and the effect is ideal.

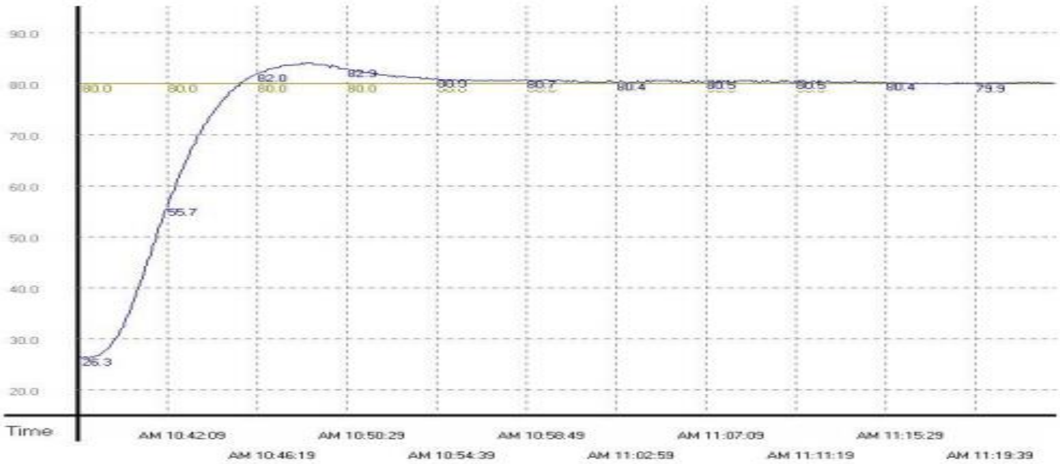

Fig 8.

5. Conclusion

Through the above program and result analysis, we can see that the system adopts the PID function command of Delta DVP-64EH3 model PLC to control the temperature in real time, which ideally reduces the overshoot of the system and shortens the adjustment process. At the same time, the control accuracy can be basically satisfied, and the basic satisfactory control effect can be obtained. Therefore, if the actual engineering problems can be further improved according to different working conditions, the control system has a certain promotion value.

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