Gas Pressure Control System for Air-assisted Extrusion Based on PLC

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Keywords: Gas pressure control, Air-assisted extrusion, PLC.

Abstract. A gas pressure control instrument for air-assisted extrusion has been manufactured by us. The principle, hardware connection and software design of this controller are introduced in this paper. The PLC micro controller is assembled in hard connection with pressure sensor and control valve. The 24V power supply is chosen as the main control power. Software design with codes is shown through the successful experimental tests. It is obtained that the gas pressure error controlled is less 2%. The design optimization with hard and soft item in the system will be carried out in the future research.

Introduction

Gas assisted extrusion is a kind of polymer processing technology [1]. In air-assisted extrusion of polymer, the controlling of the gas pressure is a very key problem. The precision of the pressure of gas directly affects the stability of extrusion process [2]. There are usually two control methods: one method is using the IPC (Industrial Personal Computer) as the control kernel, another is using the PLC (Programmable Logic Controller) [3-5]. The cost of the latter is lower and the stability is as well as the former. Thus, the PLC is selected as our control kernel.

In this paper, the principle, hardware and software of the controller is introduced. In section 1, the principle of the instrument is introduced. In section 2, the hardware connection is introduced. In section 3, the software design is introduced.

Principle of the Gas Pressure Controller

Fig. 1 shows the gas pressure controller's principle diagram. The controller is composed of the components in the dashed line box. It includes a touch screen, a PLC with AD/DA module, a gas pressure sensor and a electromagnetic pneumatic valve. The pressure sensor is mounted in a polymer extrusion die. In the process of plastic extrusion, if the gas pressure is not controlled, it will continue to change. Before the extruder begins to work, we first open the air pump and the gas pressure controller.

The pressure value and PID parameters can be set and adjusted by touch screen. When the pressure value detected by the sensor is different from the value set by touch screen, a PID control algorithm will be calculated in PLC, which will output an analog signal through the DA module to control the opening of the electropneum valve, thus to adjust the output gas pressure.
Hardware Connection of the Controller

Fig. 2 shows the gas pressure controller's hardware connection diagram. In order to facilitate future system expansion, the FX1N-24MT PLC, FX2N-4AD and FX2N-2DA are chose. The pressure sensor and the electro-pneumatic valve separately belong to current output type and current input type. An additional 24V power supply is used.

Software Design of the Controller

```
0    LD  M8000
1    MOV  D310  D200
6    MOV  D300  D100
11   MOV  H1   D101
16   MOV  D302  D102
21   MOV  D303  D103
26   MOV  D304  D104
31   MOV  D305  D105
36   MOV  D306  D106
41   MOV  K2000 D204
46   LD  M8002
47   FROM  K0 K30D4 K1
56   CMP K2010 D4 M0
63   LD  M1
```
The codes above show the software design of the controller. The parameters set by touch screen will be saved in the data registers such as D310, D300 and others. For example, the pressure value is saved in D310 that will be sent to D200. The initial output value (2000) is saved in D204. The detected value is saved in D202. The codes from 46 to 102 implement the signal acquisition from the pressure sensor. The code 108 implement the PID control. The codes from 117 to 177 implement the DA transmit and control of electro-pneumatic valve.

Summary

A gas pressure control instrument based on PLC and touch screen is designed for the air-assisted. The extrusion experiment shows that the gas pressure error is controlled within 2%.

Acknowledgements

This research was financially supported by the Industrial Support Project of Science and Technology Department of Jiangxi Province (20141BBE50014) and Science and Technology planning project of Education Department Jiangxi Province(GJJ14718).

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