IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)
e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 2, Ver. VIII (Mar-Apr. 2014), PP 51-55
www.iosrjournals.org

A Temperature Control by Using PID Based Scr Control System

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Abstract: *This paper is based on the large scale heating systems employed in industries. The PID controller set up for monitoring and regulating the heating systems for maintaining the optimum temperature for melting of lead and also ensures minimum heat loss and low power consumption, thus saving power. In this paper we show the heating control application of the PID controller by using a thermocouple as a sensing element and a feedback to the PID controller. By setting a reference value in the PID controller and using the sensing element to measure a heat source, the operation of a PID controller and the firing of the SCR can be observed through the glowing of the lamp.*

Keywords: *PID Controller, SCR Control Card, Thermocouple.*

I. Introduction

The main objective of our paper is to eliminate the contactor-based ON/OFF control and using the PID controller for heating applications. In various heating system for several application as is required by the Industry. They were earlier using contactor based ON/OFF control for the heating applications which had the following disadvantages.

- Frequent failure
- More energy consumption
- Damage to equipment
- No regulation of power
- High deviations
- Production losses
- Repetitive breakdowns

In order to eliminate these disadvantages, we have recently started employing the PID based SCR control system for their heating application. The use of mechanical contacts is eliminated by using Thyristors and PID controllers.

- Ensures a longer life period for the equipment
- It reduces the energy losses
- Lesser breakdowns and stoppages

II. Block Diagram of PID Based Scr Control System

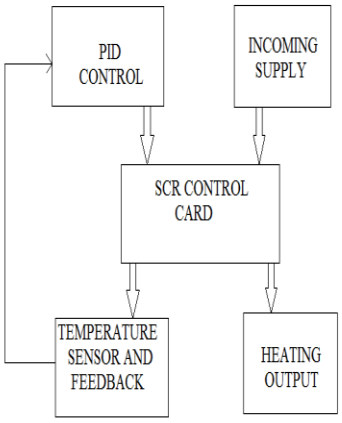

Fig:1.1 Block diagram of PID based SCR control system

III. Pid Controller Unit

A proportional-integral-derivative controller is a generic control loop feedback mechanism widely used in industrial control systems .A PID controller calculates an "error" value as the difference between a measured process variable and a desired set point. The controller attempts to minimize the error by adjusting the process control inputs.

3.1 Block Diagram Of Pid Controller

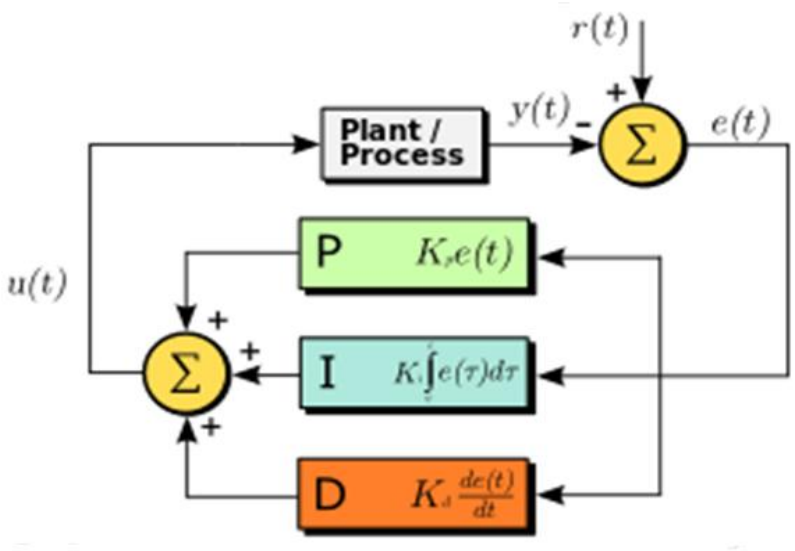

Fig1.2: Block diagram of PID controller

It is noticed that the lamp 1 which is controlled by the PID is also pulsating .However three is no do distinct frequency of pulsation. The operation of the PID is explained herewith.

If the ambient temperature chose on the PID controller is sufficiently larger then the current temperature being sensed by the temperature sensing element of the thermocouple, then the turn ON time of lamp1 is noticeably longer then the turn OFF time of the same. The glowing of the lamp indicated heating, which is say that when the lamp is glowing, heating is done and when the lamp is not glowing heating is not required. Basically the turn OFF period is the non heating period and turn ON period is the heating period. If the temperature difference between the ambient temperature set on the PID and current temperature being sensed is more, this means that heating is required to raise the current temperature so as to get closer to the temperature at which is to be maintained constant. Therefore, the glow lamp time or the turn ON time of the lamp is more then the turn OFF time as more heat is required to raise the temperature. As the temperature raises closer towards the ambient temperature, the turn ON or glow time of the lamp reduce and turn OFF time as the turn OFF time increases since the heat required to reach the set temperature gradually becomes lesser as the temperature gradient reduce.

If the ambient temperature chosen on the PID controller is reached, then the heating process has to be stopped and hence the lamp turns OFF as the requisite temperature as be in achieved. This process allows flexible control and maintains the temperature band of as low as within 1 degree Celsius. If the current temperature rises beyond the set ambient temperature, then also the heating is stopped and the lamp turns OFF as no more heating is required as the system temperature has overshoot. It stays turn OFF till then temperature of the system temperature of the system drops to set temperature. This process cycle is repeated and thus the system temperature is maintained at a particular value with high accuracy.
Another important feature of the PID controller is that is also calculates the rate of rise of temperature. For instant, if the current temperature being sensed is rising too rapidly, the PID calculates rate of rise of temperature and predicts if at that rate of rise the ambient temperature will be achieved. If yes, then the heating is stopped and the lamp is turned OFF. This saves energy as the fast rate of rise in temperature indicates availability if sample amount of heat and thus more heat is not required, hence the lamp remains OFF.

3.2 Response Of Various Controller

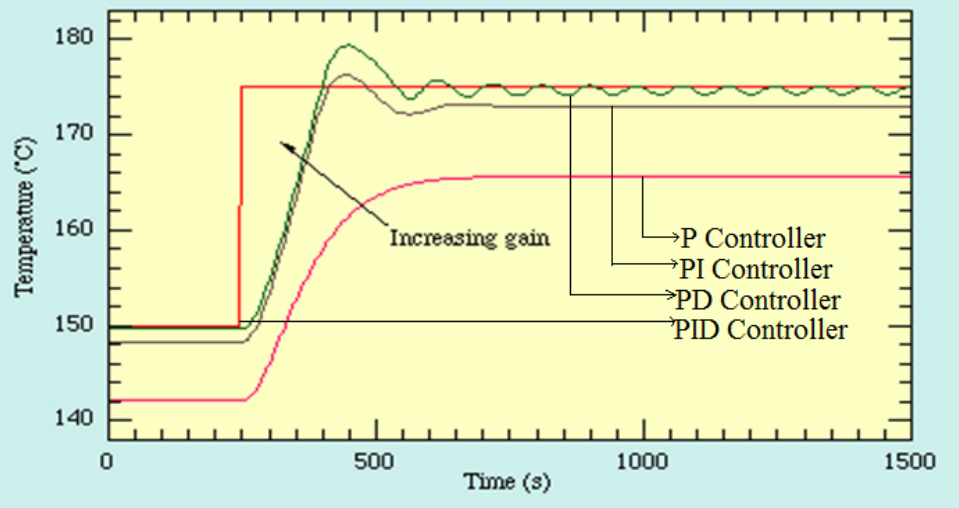

Fig1.3: Waveform of PID controller

IV. SCR Control Card

A SCR control card or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. All PCB manufactured today can be built using the following three items are:

- Laminates
- Copper-clad laminates
- Copper foil

4.1 Characteristics Of Scr

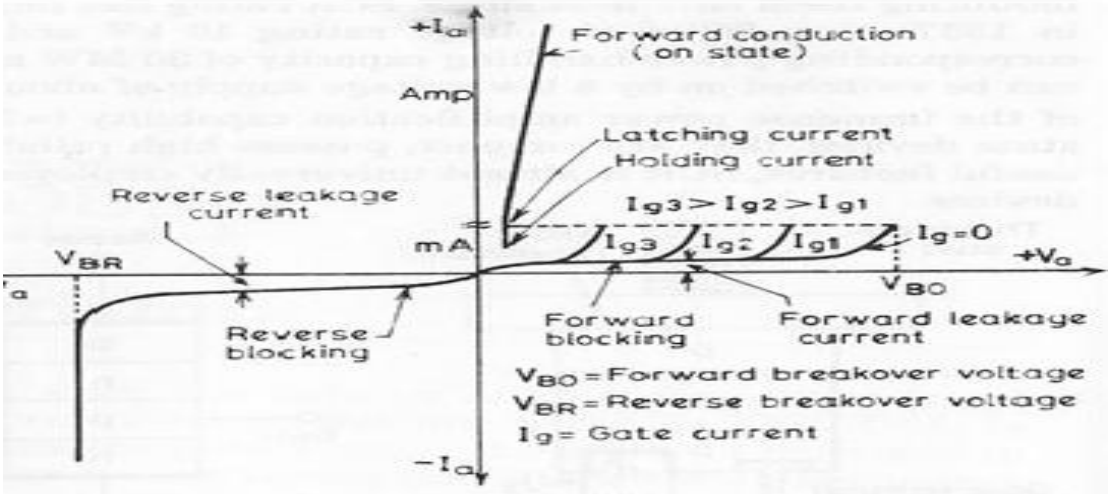

Fig1.4: Characteristics of SCR

V. Thermocouple

A thermocouple consists of two dissimilar conductors in contact, which produce a voltage when heated. The size of the voltage is dependent on the difference of temperature of the junction to other parts of the circuit. Thermocouples are a widely used type of temperature sensor for measurement and control and can also be used to convert a temperature gradient into electricity. Commercial thermocouples are inexpensive, interchangeable, are supplied with standard connectors, and can measure a wide range of temperatures. In contrast to most methods of temperature measurement, thermocouples are self powered and require no external

form of excitation. The main limitation with thermocouples is accuracy; system errors of less than one degree Celsius can be difficult to achieve.

Thermocouples are widely used in science and industry; applications include temperature measurement for kilns, gas turbine exhaust, diesel engines, and other industrial processors.

VI. Figures And Tables

6.1 Simulink Module of PID Controller

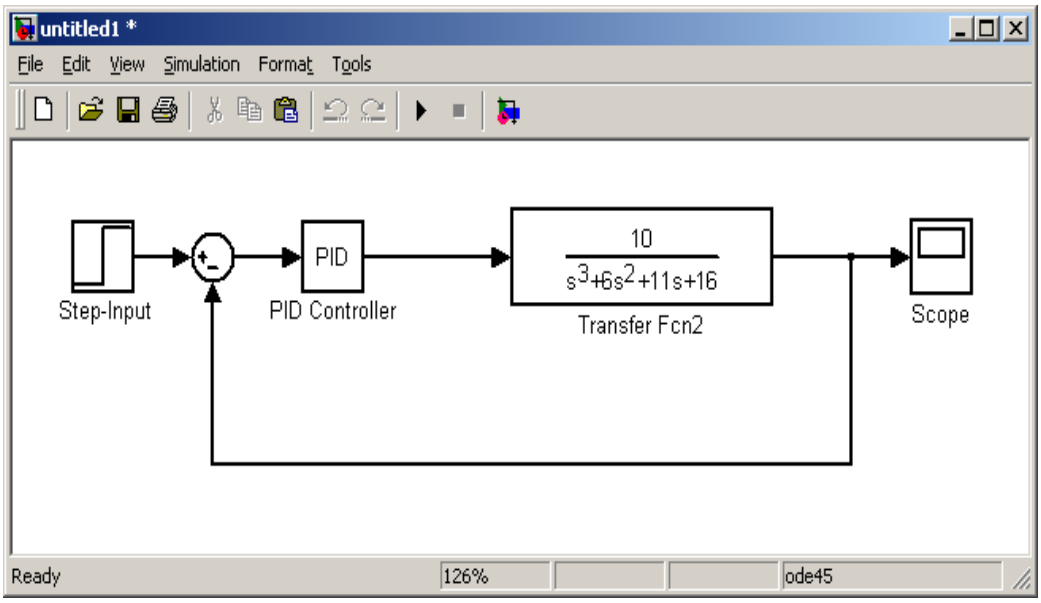

Fig1.5: MATLAB tool of PID controller

6.2 Characteristics of P, I, And D Controllers

CL RESPONSE	RISE TIME	OVERSHOOT	SETTLING TIME	S-S ERROR
Kp	Decrease	Increase	Small Change	Decrease
Ki	Decrease	Increase	Increase	Eliminate
Kd	Small Change	Decrease	Decrease	Small Change

Table1.1: Characteristics of P, I, and D controllers

VII. Conclusion

Our paper eliminates the disadvantages which were prevalent with the earlier contactors based ON\OFF system. The current system which is employed is nothing but a larger scale execution of our model. The advantages of this system included:

- Allows flexibility in use and fine temperature control.
- Ensure a longer life period of the equipment.

- Reduces energy losses.
- Lesser breakdowns and energy losses ensure higher productivity.

7.1 Applications Of Pid Based Scr Control System

PID based SCR control system used for several heating application . Its currently in use for the following :

- Lead melting for manufacturing of storage batteries
- Plate drying ovens
- Furnaces

7.2 Future Scope

PID based SCR control system used for several heating application . In future, it can be used for the following:

- Reduces continuous power supply
- Reduces fault current in circuit breakers
- Avoiding breakdowns

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