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Temperature control of shell & tube type Heat exchanger By using Twin CAT PLC

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Abstract:- In many industrial process and operations Heat Exchanger is one of the important unit for the transfer of thermal energy. There are different types of heat exchangers used in industries, the shell and tube type heat exchanger is most common. The main purpose of heat exchanger is to maintain fluid at specific temperature conditions, which is achieved by controlling the exit temperature of one of the fluids.

Here we have presented an automation system that is composed of Heat exchanger, Twin CAT PLC and sensors. To control the tube outlet temperature of the fluid of heat exchanger system Twin CAT PLC used. The designed controller regulates the shell outlet temperature of the fluid to a desired set point in the shortest possible time.SCADA system is used to give a virtual display of the proposed process. The end system is a fully automated for the transfer of energy in industrial applications.

Keywords: - Heat exchanger, I/P converter, PC, SCADA, Temperature sensor. Twin CAT PLC

I. INTRODUCTION

In practice,all chemical process involves production or absorption of energy in the form of heat.Heat exchanger is commonly used in a chemical process to transfer heat.Heat exchanger are probably the most common type of heat exchanger applicable for wide ranges of operating temperature and pressure They are easy to manufacture in large variety of sizes & configuration.Heat exchangerused in refrigeration,chemical process,power generation plant,heating and air conditioning and medical application.A heat exchanger consists of bundles of pipes or tubes enclosed within a cylindrical shell. In heat exchanger one fluid flows through a tubes and a second fluid flows through shell.

This paper reports the system in which, the main objective is to maintain the process fluid temperature at the desired value by adjusting the control valve located in the cold water line, that control valve control by the Twin CAT PLC and PC based automation system.Feedback control strategy is used to achieve the control objectives.

II. DESIGN OF SYSTEM

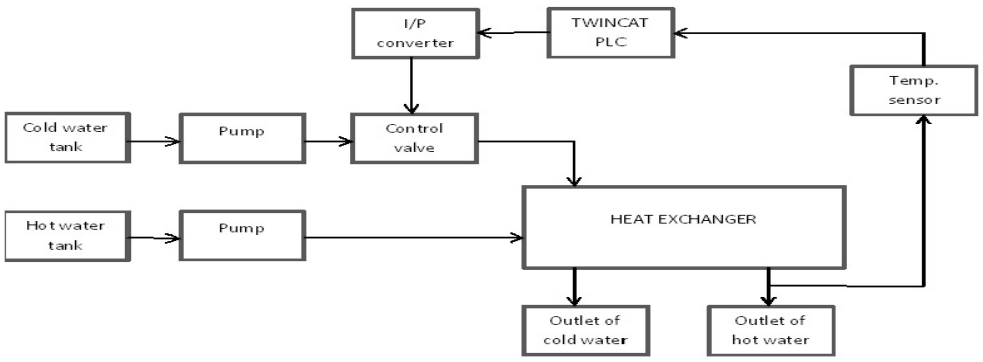

FIG. 1. BLOCK DIAGRAM OF THE SYSTEM

Block diagram of the proposed system is as shown in fig 1. It consist of

1. Heat exchanger.
2. Control valve.

3. Twin CATPLC.
4. Temperature Sensor.
5. I/P Converter.
6. Pump

In this proposed system, the temperature measured by the temperature sensor(RTD) and the output signal goes to Twin CATPLC where it is compared with set point value. Actuating signal from the controller enters into the current to pneumatic (I/P)converter which produce a pneumatic signal(3-15 psig) to regulate control valve opening thereby regulating cold water flow. This flow enters into the Heat exchanger and produces desired output temperature. Twin CATPLC is main controller.. In addition the system is controlled via Control panel and a Graphical user interface using SCADA. The system can be controlled in auto mode as well as in manual mode.

Different assumptions have been considered in this system.The first assumption is that inflow and outflow rate of fluid are same so that fluid level is maintained constant in heat exchanger. The second assumption is the heat storage capacity of the insulating wall is negligible.

1. Heat exchanger:

In the proposed system shell and tube type exchanger used, which is very adaptable, flexible and can operate the full range of designed pressure and temperature.

Principal of temperature control in shell and tube type heat exchanger-

$McCp(Tin – Tout) = MsA$

Mc = Cold water flow
Ms = Hot water flow
Cp = Specific heat of water
Tin = Inlet water tempetarure
Tout = Outlet water temperature
A=Effective heat transfer area

2. Control valve:

The pneumatic control valve is the most commonly used final control element. In this case Air to close type with equal percentage valve is used. For this valve the position of the stem will determine the size of opening for flow and consequently the size of flow (flow rate).

The signal from the TwinCAT PLC passes through I/P converter and it converted into pressurized air. This air pushes against one side of a diaphragm and work against a spring to move the valve stem to desired position.

3. Temperature Sensor:

Temperature sensor used in this system is RTD. The temperature of the outgoing fluid (outlet hot water) is measured by the RTD and output of RTD sent to the transmitter unit,which converts the RTD output to a standardised signal (4-20 mA).The output of the transmitter unit is given to the PLC.

4. I/P Converter:

The I/P (Current to pressure) converter takes the controller output in the range of 4-20 mA and converts it into a standardised pressure signal i.e in the range of 3-15 psig .

5.Pump:

It is used to pass the fluid in the Heat exchanger.

6.Twin cat PLC:

The controller used in this system is TwinCAT PLC with PC.The controller implements the control algorithm, compares the output with setpoint and gives necessary commands to the final control element via I/P converter. It is standardised programming frame for modular programming, It is equipped with all PLC programming languages as per IEC61131.TwinCAT PLC software along with PC acts as controller.

III. RESULT ANALYSIS

The design of Temperature control of shell and tube type heat exchanger using TwinCAT PLC has been developed and testing has been carried out.The temperature of shell outlet is controlled by using a PC based automation that is TwinCAT PLC. The algorithm in TwinCATPLC is programmed to keep the shell

outlet temperature at a desired setpoint. This programming is based on Codesys user interface as well as we have developed visualization for the process.

IV. CONCLUSION

The temperature of heat exchanger is maintained a desired set point with the help ofTwinCAT PLC and PC based automation. This system reduces the maintenance cost.

There is wired communication between heat exchanger and PC based automation system. This can be improved by wireless communication to avoid the hazard condition in the case of wire failure.

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