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Shared Control for a Level Process using Distributed Control System

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Abstract

The control of a process in practical is mandatory one. In control of such the process is performed by different control techniques like conventional PID, intelligent controller, gain scheduling approach and some advanced control techniques. But in practical, the control configuration is made by shared manner. Because of the plant hold more sub process in practical. Normally, in the most of the studies the control actions are carried out by any of the control technique in centralized manner. If the process is single configure, it is good to use of centralization controller. But the most of the industry process have more sub process. Hence to control the plant's all sub process it is necessary to use a shared configuration of control method. Based on the strategy, a configuration is introduced to control which called distributed control system. In the study, to make a process control action like a plant shared control fashion a simple DCS is used. Here, the process is level control process. By using the DCS based level station, it is easy to control the different parameters like flow rate, level simultaneously.

Keywords: Tank Level Process, PID, AC 800M, DCS, flow rate, level control, sub process, centralization controller.

1. Introduction

Initially direct digital control (DDC) is used and it has some disadvantage like the connectivity of the system over with the higher inputs hence DCS came into the process. Distributed control system uses decentralized element system. They do not require user intervention for routine operations but many permit operators interaction via supervisory control. The DCS uses process control software and input/output data base. The

communication medium in a DCS is wired link which connects the remote control panel. Selecting DCS require analysis of network protocol that uses bus topology and supports data transfer of 10Mbps to handle simulation demands, Ethernet uses carrier sense multiple access/collision detection network protocol for DCS also include area network bus. DCS differ in terms of complexity and applications. Smaller implementations may consists of single programmable logic controller connects to a computer in a remote office. After the usage of the DCS it helps in increase of the plant efficiency, flexibility of operations and etc. The all subunits of the system are connected to the DCS through which all system mix up and work.

2. Process Description

2.1. Distributed Control System

A distributed control system is a technology that has evolved to meet the specific needs of process applications such as pulp and paper, utility, refining, and chemical processing. DCSs are generally used in applications in which the proportion of analog to digital is higher than a 60:40 ratio, and/or the control functions performed are more sophisticated. A DCS typically consists of unit controllers that can handle multiple loops, multiplexer units to handle a large amount of I/O, operator and engineering interface workstations, a historian, communication gateways, and an advanced control function is dedicated proprietary controllers. All these are fully integrated and usually connected by means of a communication network. A DCS typically takes a hierarchical approach to control, with the majority of the intelligence housed in microprocessor-based controllers that can each handle 10–1000 inputs and outputs.

The DCS is a tool, which is used to control a group of process in efficient manner. It is advanced model of centralized control system. Like direct digital and CCS the process's control action may be affected due to some malfunction problem of hardware or host controller. But such the drawbacks are avoided in DCS by using the process control in divided fashion. Normally in DDC and CCS the control actions for the plant are allocated with group manner. But in DCS the entire sub controller acquired the flow of control action for the different sub process.

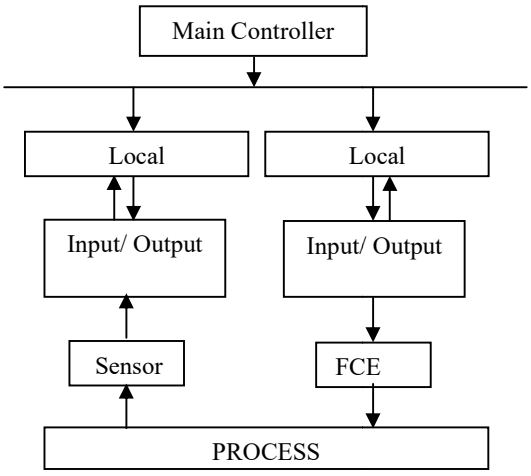

Figure 1.Block Diagram of DCS and Process Setup

Figure 2. Interfacing of DCS with Process Setup

With the help of the DCS we can control the various process like Flow, Temperature, Pressure and level and we have discussed these in the below statement.

A. Drum Level Control

In this process we are going to maintain the drum level, we had already seen the general controlling parameters for level, Let us take the case study of controlling the level drum in boiler, Here the level should be controlled hence three transmitter (LT1, LT2, LT3) are used ,The LT1 represents the drum level of the boiler and other two are used to make up the controller action with the LT1. If 2 transmitters deviates by 10% then the control action should initiate that manual mode is to taken up and the process is to be carried out. If the value is greater than 10% then the whole process in the level for control is to be tripped over here Level signal act as a process variable to the Controller block LIC the controller process will vary as per the input or the level changes and hence the level gets controlled in this process.

B. Steam Temperature Control

In this process main aim is to maintain the steam at the setpoint this is because as the level inside the boiler as per our case study which we consider changes the steam output changes so the output also varies, Hence the steam is to be maintained at the particular setpoint. It can

be controlled by measuring the final temperature of the steam by using TT, Then the output is compared with the setpoint and if there is any change in the process the it instructs the spray control valve TV to control the flow of water inside the at temperature.

D. *Furnace pressure control*

We know that increase in temperature increases the pressure change in the level is inversely proportional to the change in temperature which also affect the change in pressure. The change in pressure is read with the pressure transmitter and that denotes the process variable(PV). It's then compared with PIC. The change varies the speed of the motor which control the pressure (ID FAN)

E. Combustion Control

The aim of the combustion control loop is to maintained the rated steam pressure. It is controlled by sending the air and fuel ratio in the proper amount for getting the same output. And the Primary loop considered as pressure and temperature. They are controlled by using the pressure and temperature transmitter and send over to the controller and the loop gives the signal to the coal generation unit with which the sending of the coal can be controlled and the combustion rate can be adjusted. Secondary unit is Air fuel rate with which the airflow as the Process variable (FI) and total heat demand as remote set point. This remote set point is total combustion air requirement. The air flow controller generates an output signal comparing the remote set point and the process variable. The output is fed to the FD fan to control the net air flow. These were the some process discussed above can be controlled by using DCS Here we are going to give the detailed process on the case study of how to control the level of the process.

3. Process Working Description

In the study, the aimed process to control through DCS is level of tank. The basic idea about the process is the water pump into a process tank. In the process tank, level of the liquid has to be maintained in desired range. The process is configured as Direct Digital Control (DDC) configuration like from controller to process through the interface card. But here, there are two controllers are placed. One is local controller and remain is main controller. The main controller makes the control action through the human influences. The respective control signal will transfer into local controller through the interface units such as input and output

modules. The proposed process is configured in DCS as shown in the figure 2. The control loop unit is configured in shared manner since to make the control action in distributable manner. The shared control is made by combination of the local control unit and shared units. When giving the input to the process via main controller, the respective data will transmit to local control unit through the output module. If there is any change in the process, it will reflect in main controller through the input module.

Figure 3 . Level Process Setup

Initially, the process is maintained at zero level. When the input range is given in main controller the proposed process is started and reaches the process to desired level. Here, the process behavior is affected by feed flow rate. Now, the master controller makes a control action through the local controller to the control valve by manipulate the flow rate of process. Here, the manipulation of flow rate is to maintain the level in desired range. From the main controller, the proposed process status is read out and the information is recorded.

From the study, it is understood, how the control action is made for a process in distributed manner. The advantage of the process is even any controller get failure other will make a control action. Hence, the redundancy of the process is achieved. This is the reason to use DCS in most of the process control industries.

4. Result and Discussion

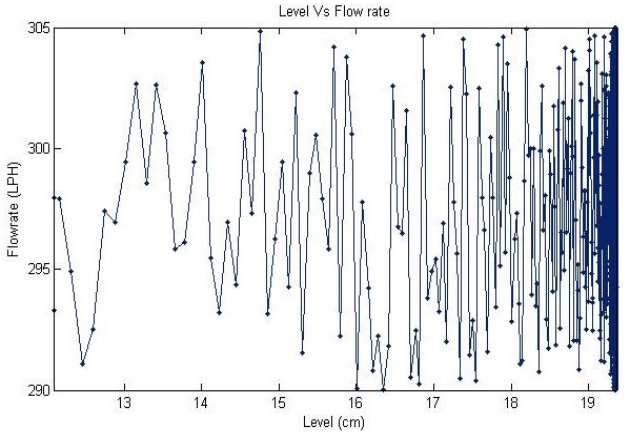

Figure. 3. Level Vs Flow rate

VI.CONCLUSION

From this graph we get to know that flow rate is manipulated in respect to the change of level As shown in the figure

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