

# **CHME 401 CHEMICAL ENGINEERING LABORATORY II**

## **EXPERIMENT 401-8**

### **LEVEL CONTROL**

#### **OBJECTIVE**

Objective of this experiment is to compare Proportional (P) Proportional Integral (PI) and Proportional Integral Derivative (PID) controls and also effect of gain on proportional control.

#### **PRELIMINARY WORK**

- 1- Study basic concepts of process control. Especially closed loop control.
- 2- Visit laboratory in advance to experiment and familiarize yourself with the experimental set-up with the consent of the teaching assistant.

#### **DESCRIPTION OF THE EXPERIMENTAL SET-UP**

Level control bench is used to illustrate the process control principles. It is equipped with PID controllers to maintain the desired level in a tank. It operates by means of pneumatic valves which control the cold water inlet to the system. By using these units it is possible to investigate the difference between PI and PID control and the effect of control parameters.

Level control unit is mainly composed of a storage tank and a pneumatic valve. The storage tank is connected to water supply and the feed rate is controlled by a valve according to the signal provided by the controller. Experimental setup is given in Figure 1.



Figure 1. Level Control Bench

## **EXPERIMENTATION**

Water level will be recorded with respect to time and changes in control parameters will be observed. Besides control parameters differences between P PI and PID control will also be observed.

### **Procedure**

- 1) Make water and air connections
- 2) Switch device on
- 3) Switch computer on and open the required software
- 4) Open by-pass line

- 5) Start feeding the system with tap water
- 6) Open compressed air line and set the outlet pressure to 1.8 bar
- 7) Enter Set point as 30 % Gain: 10 and I: 1 by using the software
- 8) Half close the valve at the end of the by-pass line
- 9) Close the valve at the outlet of the tank until 30% of the tank is filled then half open the valve.

Effect of Gain ( $K_c$ ) on the system for proportional control:

- 10) Set Gain: 2 I:0 D:0 from the software and set point as 50%
- 11) Record data until it reaches to a stable value (about 15-20 min)
- 12) Repeat step 7 in order to go back to the starting point
- 13) Set Gain: 5 I:0 D:0 from the software and set point as 50%
- 14) Record data until it reaches to a stable value (about 15-20 min)
- 15) Repeat step 7 in order to go back to the starting point
- 16) Set Gain: 5 I:0 D:0 from the software and set point as 50%
- 17) Record data until it reaches to a stable value (about 15-20 min)
- 18) Repeat step 7 in order to go back to the starting point

Effect of PI and PID control

- 19) Set Gain: 5, I:1 D:0 from the software and set point as 50%
- 20) Record data until it reaches to a stable value (about 15-20 min)
- 21) Repeat step 7 in order to go back to the starting point
- 22) Set Gain: 5, I: 1 D: 2 from the software and set point as 50%
- 23) Record data until it reaches to a stable value (about 15-20 min)
- 24) Turn water and air inlet off and shutdown the system

## ANALYSIS

- 1) Using the constants you have used in the experiment find offset and time needed to reach final level and compare with your results
- 2) Draw your data against time and comment about the effects of changing  $K_c$  and using PI and P instead of P control