WAKE TECH
Biotechnology, Engineering, & Skilled Technologies

PID Loop with Simulator

BAT-212: BAT Logic and Programming

PID Loop with Simulator

OBJECTIVES

Upon completion of this activity the student will be able to:

- Use PID simulation to demonstrate desired PID response.
- Predict the effect of changing PID loop parameters.

PARTS AND EQUIPMENT

- PID Simulator (download from http://www.engineers-excel.com/Apps/PID_Simulator/Description.htm)

REFERENCES

- Tutorial: PID control without the math https://www.splatco.com/skb/2809.htm
- PID Loop Simulator http://www.engineers-excel.com/Apps/PID_Simulator/Description.htm

BACKGROUND

From the PID Simulator web page:

 "The tool simulates the parallel form of the PID equation, this is form that is widely used in academic environments. The equation implemented is:

$$MV(t) = K\,e(t) + \frac{1}{T_i}\int_0^t e(x)dx + T_d\frac{de(t)}{dt}$$

CONTROLLER	
Controller Gain	0.35
Integral Time (sec)	4
Derivative Time (sec)	

where

t = Time
MV = Manipulated value
K = Controller Gain
e = Controller error = Set Point - Process Value
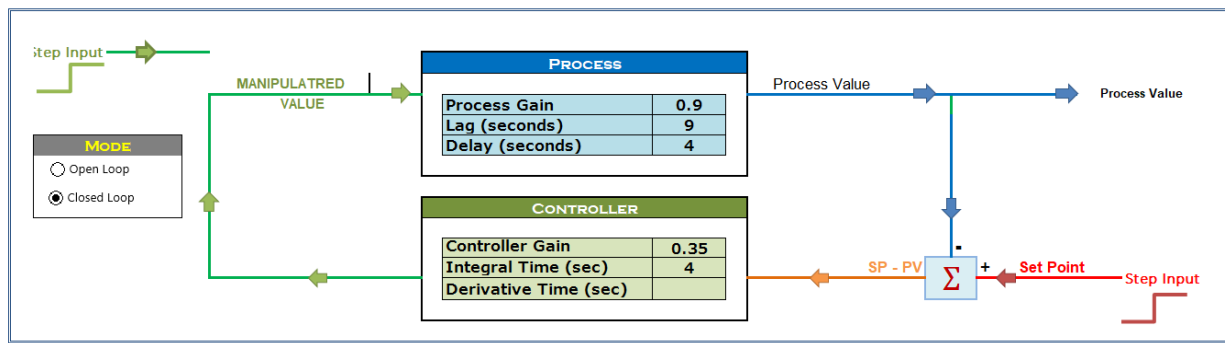T_i = Integral Time
T_d = Derivative Time "

Notice that the controller gain does not have units. From the website again:

"Dimensionless Gain = (Change in PV/PV range)/ (Change in MV/MV Range)"

This is the way the controller gain is often presented, but it does not relate to the physical sense. This gain is normalized to the expected range of each variable. For the equation to make sense, the error $e(t)$ and the manipulated variable $MV(t)$ also need to be normalized. In the simulator, this is not a problem, because we are not dealing with physical quantities. We will discuss the physical implications more in the next lab when we apply the PID loop to a VAV box.

PROCEDURES

- Download the PID Simulator software and open the application. It will be an Excel worksheet. The top of the Excel sheet should look like this:

  We will leave the Process parameters as is. We will be working with the Controller parameters to tune the given process.

- Set Integral time to blank (no entry) and the derivative time to blank. This removes them from the calculation.

- Experiment with gain values and note effects. What happens as gain gets smaller? As it gets larger? Use pictures and words to describe effects in your lab report.

- Set the gain to get as close as you can to steady-state oscillation. The image below illustrates this. Make note of the gain value that you use, Ap.
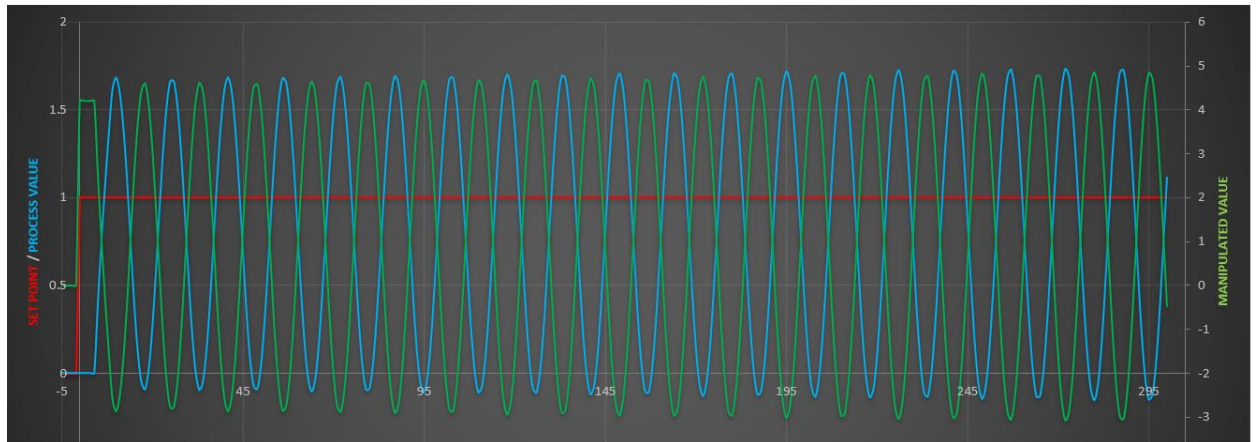
- You will add the integral, and then derivative factors, based on a rule of thumb (reference: https://www.splatco.com/skb/2799.htm).   Measure period of oscillation, Posc. To add integral term alone:
    a. $K = Ap*.45$
    b. $Ti = Posc\ /1.2$
    c. Save image of the output with these settings for your report. Include your calculations in the report.

- To add integral and derivative:
    a. $K = Ap*.6$
    b. $Ti = Posc\ /2$
    c. $Td = Posc/8$
    d. Save image of the output with these settings for your report. Include your calculations in the report.