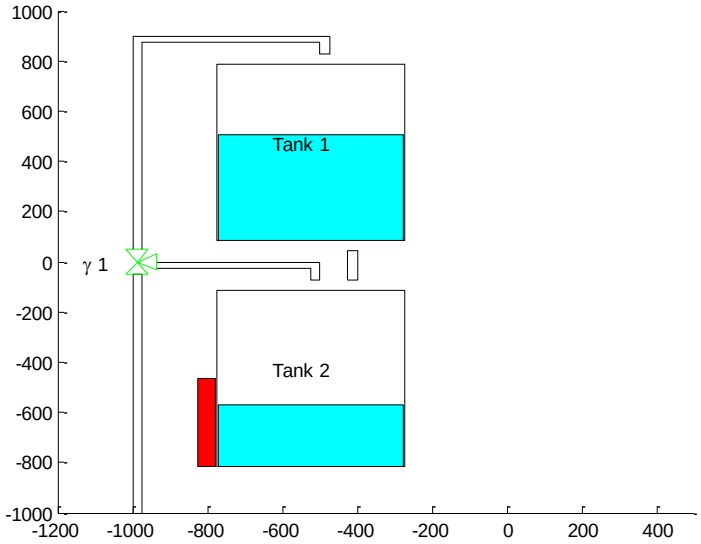
Chemical Engineering 436
Special Problem #3

Objectives: Use graphical methods and optimization methods in order to fit a FOPDT model to dynamic data and use it to tune a PID controller.

1) For the gravity drained tank problem, conduct a step test by manipulating the pump rate and recording the level in the bottom tank. Use graphical methods to obtain a FOPDT model and report the values of the three parameters (K_p, τ_p, θ_p).



2) Use Excel to optimize the same parameters in the FOPDT model. Compare the values you calculated with those obtained graphically. Are they the same? Why or why not? Which values would you use and why?

3) Repeat the test in 1) using a doublet test instead of a step test. Fit FOPDT parameters using Excel to optimize the three parameters (K_p, τ_p, θ_p). Why is it important to obtain values above and below the steady state value for nonlinear processes?

4) Use an appropriate tuning rule (either ITAE or IMC) to obtain a starting value for the controller gain (K_c) and reset time (τ_I) of a PI or PID controller. Implement the PI or PID controller in Simulink and tune the controller constants (adjust up or down) until an acceptable response is achieved for step changes in the set point. Include plots of with initial values, tuned values, and a justification of your criteria for an acceptable response. Remember to define your criteria in terms of rise time, peak time, overshoot ratio, damping ratio and settling time.