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Process Characteristics

The three important characteristics of a process, that represent the system behaviors are (i) process gain (ii) process time constant and (iii) dead time.

Process Gain

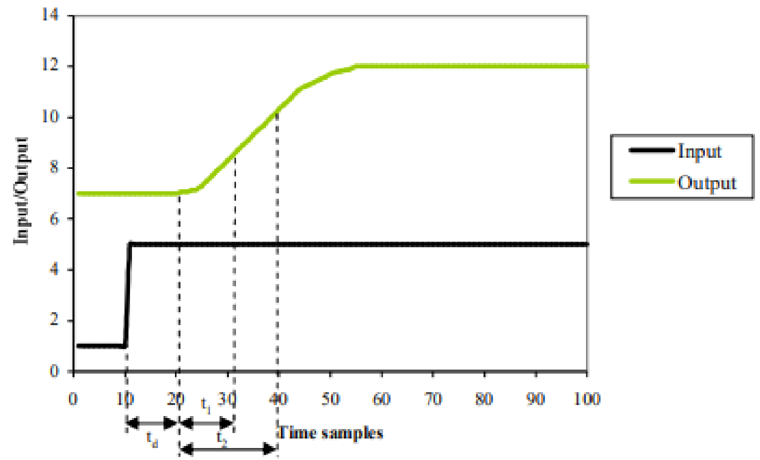
The gain is a steady state characteristic of the process and is defined as the ratio of the change in output to the change in input or the excitation function. The process gain is a measure of the sensitivity of the output variable to a change in the input variable. The process gain can be positive or negative and specifies the direction in which the input and output variables change. The gain does not specify the dynamics of the process, that is, it does not give information as to how fast the process variations occur.

Process Time Constant (τ)

This is a measure of how fast the process responds to a change in input. This term relates the dynamics of the process. The speed of response of a process and the time constant are inversely related.

Process Dead Time (td)

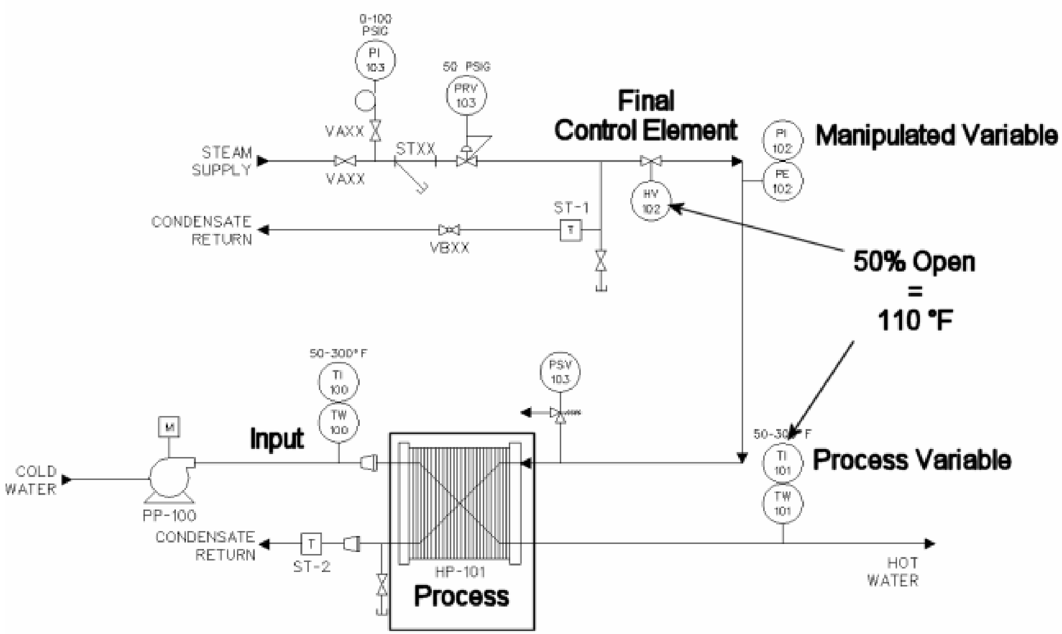
This is defined as the finite amount of time between the change in input variable and when the output variable starts to respond. The parameters τ and td are shown in Figure. The numerical values of K, τ and td depends on the physical parameters of the process, such as size, calibration, etc.



Servo response of a plant used in the measurement of td and τ

Open Loop Control Process

In open loop control the controller output is not a function of the process variable.



Above figure depicts the heat exchanger. This is a stable process, and given no disturbances we would find that the process variable would stabilize at a value for a given valve position, say 110°F when the valve was 50% open. Furthermore, the temperature would remain at 110°F as long as there were no disturbances to the process. However, if we had a fluctuation in steam supply pressure, or if the temperature of the water entering the heat exchanger were to change we would find that the process would move to a new point of stability with a new exit temperature.

INTRODUCTION

Example of open loop control process

- **electric clothes dryer**. Depending upon the amount of clothes or how wet they are, a user or operator would set a timer (controller) to say 30 minutes and at the end of the 30 minutes the drier will automatically stop and turn-off even if the clothes where still wet or damp.
  In this case, the control action is the manual operator assessing the wetness of the clothes and setting the process (the drier) accordingly.
  So the **clothes dryer would be an open-loop system** as it does not monitor or measure the condition of the output signal, which is the dryness of the clothes. Then the accuracy of the drying process, or success of drying the clothes will depend on the experience of the user (operator).

- Electric bulb
- Electric hand drier
- Time based Bread toaster
- Volume of the audio system
- Water faucet
- TV remote control
- Clothes drier
- Shades or blinds on a window.
- Stepper motor or servo motor
- Inkjet printers
- Door lock system etc.