Chemical Process Control
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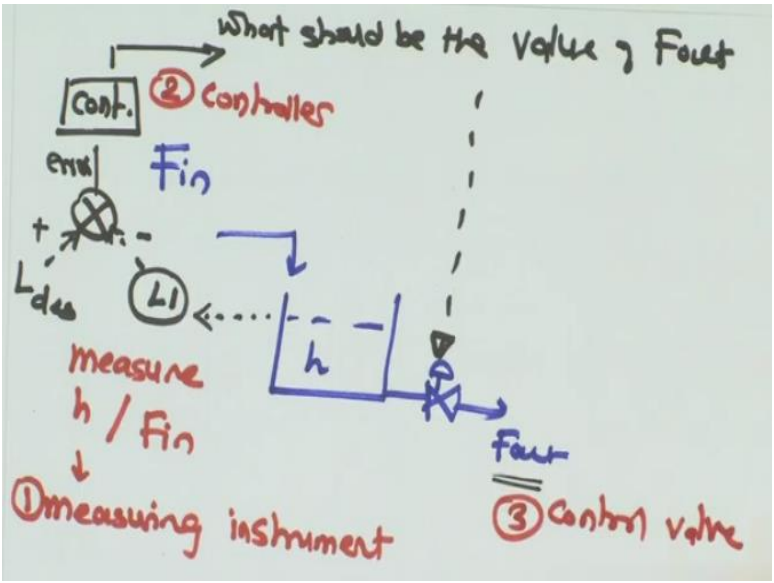
Lecture - 04
Components of Process Control System

Let us now look at what are the different elements of a control system and we will work with the same example.



This is our system where we want to control the level or height inside this tank. The first and foremost what we need in order to take any control action is to measure either the height or the inlet flow rate that is either the controlled variable or the disturbance. So all you need is a measuring instrument. The first thing which is required is a measuring instrument which would measure either the controlled variable or the disturbance variable.

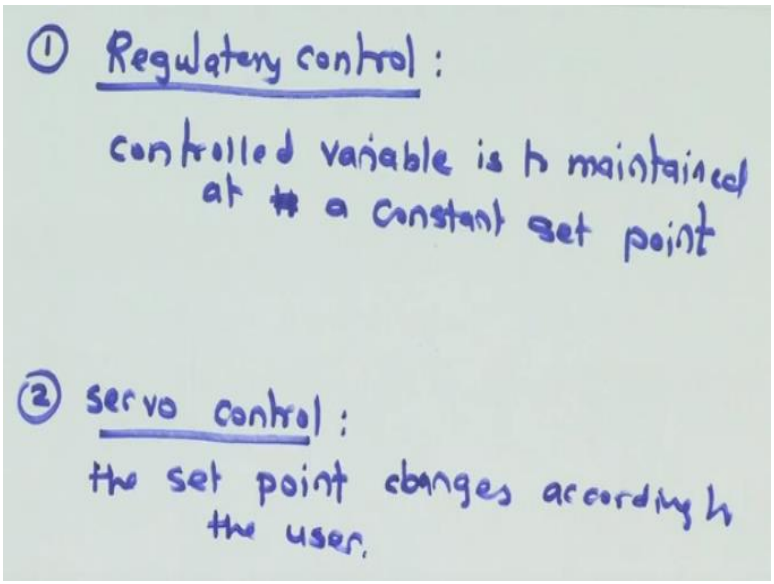
For this case, let me just show you what happens if we measure the controlled variable. This is a level indicator which will measure the height. Once we measure the height inside this tank, in order to take the control action what we need to know is what is the desired value of the height and you would compare whether my current value is higher or lower than the desired value. So you generally find out an error between the desired value and the current value.

Based on the value of this difference, if the difference is 0, no action has to be taken. If the desired minus the current value is higher or is positive, then you would reduce the outlet flow rate so that the level will keep on increasing and the error will go on reducing or if the other way round then it is vice versa. So your control action or the controller would work on this error signal and it will give out a particular action on what should be the value of outlet flow rate.

But again this controller is an electronic piece of equipment. Just by saying this is the value of the outlet flow rate, the process is not going to adopt that value. So what it needs to do is that particular value has to be sent back to the process and this controller will then talk with the control valve and change its opening. Either it will open the valve or close the valve so that the desired value of Fout is maintained.

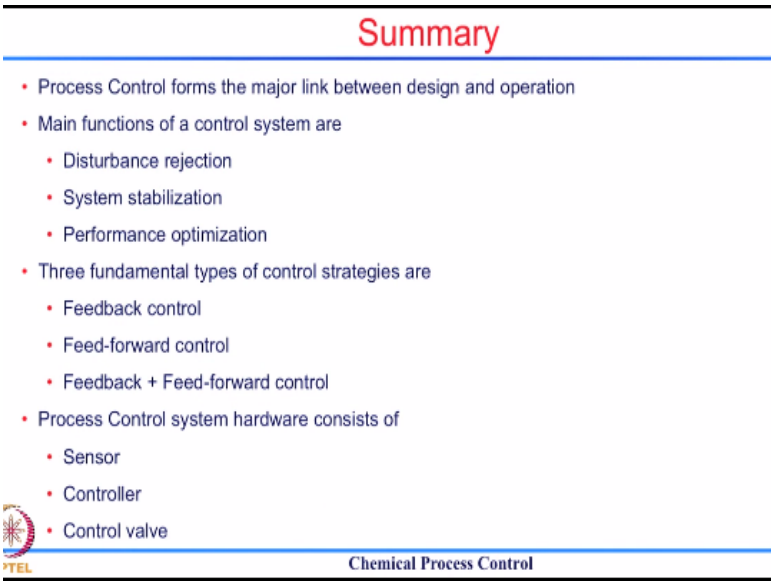
So the second piece of hardware was the controller and the third thing is the control valve which is going to implement the action given by the controller. These three are the elements of the control system. Now when you talk about the measuring instrument and the control valve, these generally become part of instrumentation and controller will become part of the process control. This controller may be a manual controller or it may be an automated controller.

So we will close this lecture with the last distinction or the last type of information which is what are the different types of control problems which are solved in process control?



The first type of problem is known as a regulatory control problem wherein the controlled variable is to be maintained at a constant desired value or set point and it deals with disturbance rejection. The examples being the surge tank which we had considered where the height was to be supposed to be maintained at 50% or the pressure cooker where the pressure has to be maintained at a certain value.

The other type of control problem is known as servo control problems wherein the set point changes according to the user. So this is the case where your market conditions dictate that you should operate it at a different value or the reaction chemistry has changed because the catalyst has degraded and you want to operate the reactor at a slightly different temperature. In that case, whenever there is a change in the desired value of the controlled variable, those type of control problems will be known as servo control problems.



To summarize, what we have seen is that process control forms a major link between the design of the process which you have done based on the steady-state and actual operation. Without this link of process control, your designed process will not be able to give you the result in a real field. We saw that there are three major functions of a control system. The first one is rejecting the effect of disturbance. The second one being stabilizing an unstable process. And lastly to optimize performance.

There are different control strategies like feed-forward control strategy, feedback control strategy and a combination of feedback and feed-forward and we saw what are the individual advantages, disadvantages as well as what are the situations when one strategy works better than the other.

The elements of control system are, measuring instrument or sensor which is going to tell you where the process is at, the controller which is going to take the necessary action based on the current value of the process, and a control valve which is going to implement these changes suggested by controller into the real process. In the next lecture, we will look at what is the role of dynamics in terms of achieving process control. Thank you.