CONTINUOUS STIRRER TANK REACTOR (CSTR) BASED ON PLC & SCADA

Pritam Chandawale[1],Yogesh Dhadge[2], Shubham Kodam[3],Prof.H.P.Chaudhari[4]

[1] *Student, Instrumentation, AISSMS IOIT, Maharashtra, India*
[2] *Student, Instrumentation, AISSMS IOIT, Maharashtra, India*
[3] *Student, Instrumentation, AISSMS IOIT, Maharashtra, India*
[4] *Professor, Instrumentation, AISSMS IOIT, Maharashtra, India*

ABSTRACT

The art of control plays an important & major role in all branches of engineering & science. But when we work or focus at the core of Instrumentation Technology, the various control techniques have also taken rapid strides during recent years with introduction of many types of instrumentation devices, innovations, refinements & altogether new techniques. In this project, Programmable Logic Controller will play the role of automation tool to control the Back-mix reactor. The impetus for making this project arose from the fact the PLC offer many positive advantages over other controller. We included serial communication so that the controller can be interfaced to the computer. The major or main objective of assuring this project is that PLC will control particular parameter like level, temperature, flow effectively, optimally ,efficiently & accurately.

1. INTRODUCTION

In day to day life, there is problem of shortage of water. And it is because of wastage of water. The wastage of water is due to many causes such as leakages, mankind laziness, operator error etc. There is also problem of irregulation of water supply i.e. the time of water supply is not fix. So the public problem may increase.

This can be avoided by implementing the automation in this controlling of water supply. Such type of problem can be reduced by using PLC controlling in water supply system. We can control the various valves which is use in pipeline by using PLC. So the irregulation problem can be reduced. It is also possible the detecting the less pressure due to connecting pump so that this may be helpful to restrict the uses of pumps in main supply line.

The wasting of water is more due to leakage of pipeline. By using PLC we can detect the location of leakage in pipeline. This is effectively saves the more water.

So the main objective behind designing this system is to reduce water wastage by considerable amount & proper utilization of it for domestic purpose. It is fully automatic system but in our India it is not implemented. But it is possible to implement such system to reduce the wastage of water.

2. DESCRIPTION:

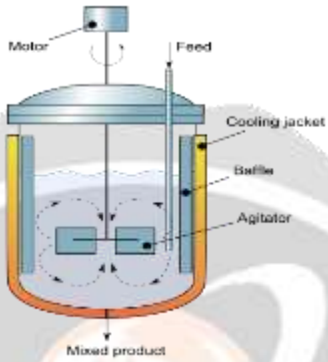

Fig -1: Cross-sectional diagram of Continuous stirred-tank reactor.

In a CSTR, one or more fluid reagents are introduced into a tank reactor equipped with an impeller while the reactor effluent is removed. The impeller stirs the reagents to ensure proper mixing. Simply dividing the volume of the tank by the average volumetric flow rate through the tank gives the residence time, or the average amount of time a discrete quantity of reagent spends inside the tank. Using chemical kinetics, the reaction's expected percent completion can be calculated. Some important aspects of the CSTR:

- At steady-state, the flow rate in must equal the mass flow rate out, otherwise the tank will overflow or go empty (transient state). While the reactor is in a transient state the model equation must be derived from the differential mass and energy balances.
- The reaction proceeds at the reaction rate associated with the final (output) concentration.
- Often, it is economically beneficial to operate several CSTRs in series. This allows, for example, the first CSTR to operate at a higher reagent concentration and therefore a higher reaction rate. In these cases, the sizes of the reactors may be varied in order to minimize the total capital investment required to implement the process.
- It can be seen that an infinite number of infinitely small CSTRs operating in series would be equivalent to a PFR.

The behavior of a CSTR is often approximated or modeled by that of a Continuous Ideally Stirred-Tank Reactor (CISTR). All calculations performed with CISTRs assume perfect mixing. If the residence time is 5-10 times the mixing time, this approximation is valid for engineering purposes. The CISTR model is often used to simplify engineering calculations and can be used to describe research reactors. In practice it can only be approached, in particular in industrial size reactors.

2.2. OPERATION OF CSTR:

We first of all converted a bottle into a reactor like vessel, then mounted solenoid valves on it, these valves are powered by a PLC, then by giving start command, we made the cycle started in which firstly 1st valve opens, then used simple wires to detect level, for that we used simple conductivity method through water. After sensing level, the 1st valve closes and 2nd gets opened. This sequencing is done by PLC. Again level is sensed in the same manner as before and after attaining set level 2nd valve is deactivated. Then we heated the material till some set point, then sensed it through RTD and this temperature is also operated through PLC. Thus, after desired temperature gained out put is continuously drained out by drain valve. Since, feed is continuous & outlet is also continuous thus CSTR action takes place.

2.3 PLC (Programmable Logic Controller) & SCADA(Supervisory Control And Data Acquisition)-

Features of Micrologix-1000:

- Available in 10-point, 16-point or 32-point digital I/O version.
- Analog version available with 20 digital I/O points, 4 analog inputs and 1 analog output.
- Includes built-in EEPROM memory no need for battery backup or separate memory module.
- Supports simply connectivity through RS-232 communication channel to PC
- Includes build-in high speed counter.

2.4 COMMUNICATION:

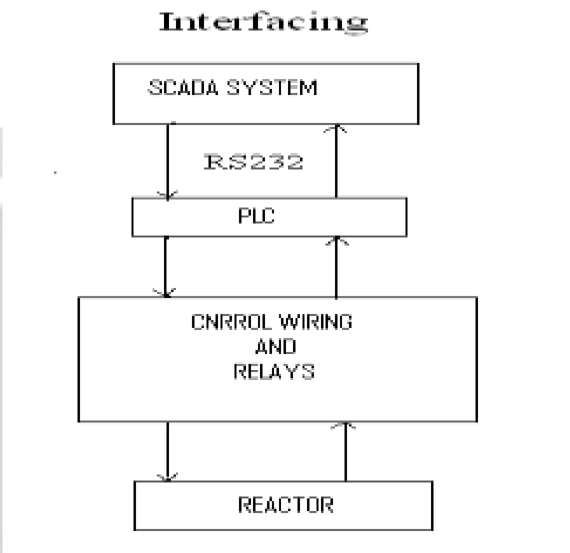

Fig.2 Field To SCADA System Communication.

3. Algorithm:

1. Start.
2. Is First and Second inlet valve open IF not then open .
3. Is First and Second drain valve closed IF not then close.
4. Control Flow via rotameter.
5. Is level upto 15cmIF not then open inlet valve.
6. Start Heater IF not then test temperature.
7. Start Stirrer.
8. Open Output valve.
9. Stop.

4. Advantages:

1.Continuous operation.
2.Good temperature control.
3.Reactor has large heat capacity.
4.Good for producing small amounts of products.
5.Simplicity of construction.
6.Low operating (labor) cost.
7. Easy to clean.

5.Conclusion :

With the aid of PLC, there is flexibility in programming & CSTR control can be easily done.
Need of conversion between analog to digital is minimized ,hence reduction in quantization error & cost.

In case of industrial application of series type cstr , we will use optimal advanced control or modern adaptive control technique.
The main constraint during project development was the dimension determination, component selection &interfacing due to signal conditioning problems which has been successfully dealt by using proper mathematical approach.

6. References:

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