



PLC Based Automatic Sequential Batch Process System

K.Saraswathi

Assistant Professor, Department of EIE, Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya, Enathur, Kanchipuram, India.

ABSTRACT

Automating the process in many industries reduces the percentages of errors and improved the productivity of the system. This paper deals with an automation system for a mixing process which can be used in food industry, chemical industry, process industry, oil refineries or in pharmaceutical industry. Automation in the mixing process improves the overall accuracy of the system and reduces the risk for humans near the hazardous chemicals. The proposed system uses a Programmable Logic Controller (PLC) to control the entire system. PLC is programmed using Ladder Diagram which is very user friendly and easy to understand. In this system the solutions from two different tanks are mixed in the third tank with the help of stirrer automatically batch by batch.

INTRODUCTION

Automatic mixing system has mainly two advantages over the conventional manual method. The advantages of automatic mixing system are i). High accuracy and ii). Improve safety of humans. At first making an automatic system will highly improve the accuracy of the system the ratio of mixing different solutions can be controlled precisely by controlling the open and closing of the control valves automatically. Secondly as certain solutions on mixing with other solutions will release some hazardous gases which may be highly affects the workers when the mixing system is done in manual mode. In order to avoid such dangerous situations the automatic mixing system can be used to improve the safety of the workers.

PROPOSED SYSTEM

The PLC controllers the mixing process of two different solution (with equal ratio) in the third tank with level sensor. An equal amount of solution from tank1 and tank2 fills the tank3 then the PLC switch on the stirrer for programmed time. After the mixing process the outlet valve of tank3 is opened to unload the mixed solution for next stage. Once the tank3 is empty the low level sensor in tank3 will be turned on which in turn will repeat the entire process. The entire system is divided into two parts as

1. System Design and Hardware
2. Working and Ladder Logic

SYSTEM DESIGN AND HARDWARE

The system consists of three tanks with solenoid valve each. Tank1 and Tank2 are used to hold solutions A and B respectively. The tank3 is a mixing tank, it additionally consists of a stirrer and level sensors- Low & High Level sensors. In addition the system has Start and Stop push buttons. The controller used in the system is PLC Allen Bradley MicroLogix 1100. It is a fixed type PLC, it has ten inputs and eight outputs.

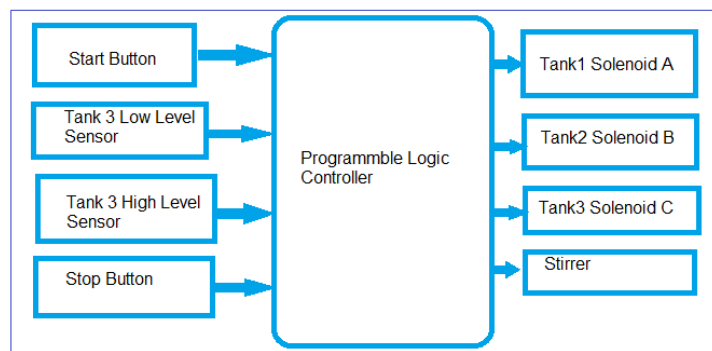


Figure 1: Block Diagram

WORKING AND LADDER LOGIC

For programming the PLC the MicroLogix 500 Rockwell Automation software is used. The sequence of operation of the system is as follows:

- Step 1. The mixing process starts by pressing the "START" push button.
- Step 2. And if level of solution in tank 3 is low then the Low Level sensor indicates this to PLC. On receiving the signal from Low Level Sensor the PLC will open the solenoid value A & B of tank 1 and tank 2 respectively to fill tank 3.
- Step 3. Once the level in the tank 3 reaches high level then the High Level Sensor gives signal to PLC.
- Step 4. On receiving the input signals from High Level Sensor the PLC close the solenoid value A & B.
- Step 5. After closing solenoid value A&B if level in tank 3 is high, then PLC turn on the stirrer motor for 10 seconds.
- Step 6. Once stirrer motor is turned off after ten seconds the PLC open solenoid value C until the level in the tank reaches low.
- Step 7. Once the level reaches low solenoid C have to close and the sequence 2 to 6 repeats until the stop push button pressed.

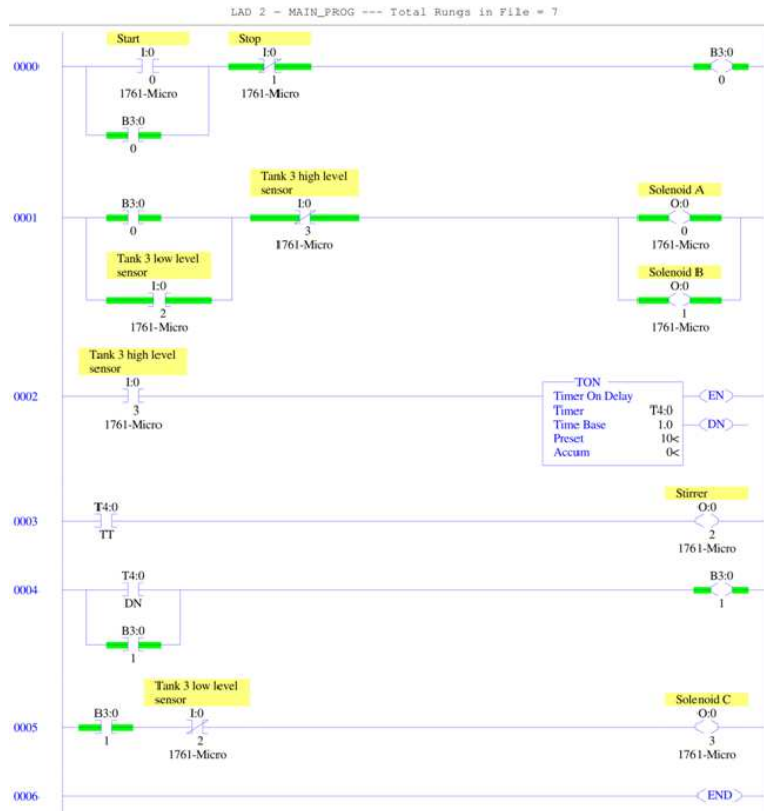


Figure 2: Ladder Logic

FUTURE SCOPE

The proposed system can be enhanced to a sophisticated system by adding additional hardware.

1. By incorporating a Flow control valve in the outlet of tank1 and tank2 the mixing ratio of two solutions can be varied.
2. We can extend the system for multiple solutions mixing system, simply by extending the number of solution tanks.
3. Addition of level sensor in the tank1 and tank2 will help to avoid the head effect in the system.
4. The system can be improved to filling, capping and labeling system.
5. The proposed system can be utilized for Automatic Coffee or Juice making machine with appropriate hardware changes.

CONCLUSION

This paper presents a PLC based automatic mixing system for two different chemicals. The same system can be controlled by using ARM7, but it is complicated to design and use. If suppose addition hardware is implemented the flexibility in programming is less if we use ARM7. The system can be enhanced by using SCADA system to monitor and control the entire process. The system is more efficient and economical for small scale industries as the cost of the entire system is not much. The system is well suitable for automatic food processing industries for mixing different types of ingredients. The system should be fully automated i.e. system should be capable in mixing the chemicals according to the user's requirement with the help of sensors, timers, programmable logics.

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