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# *Batch Process with CIP*

***Prerana Kshirsagar[1], Manaswini Patil[2], Avinash Jayebhaye[3], Nisha Dagade[4]***

*Student[2], Assistant Professor[4]*

*Department Of Electrical Engineering*

*NBNSSOE, Pune*

***Corresponding Authors:*** *Patilmanaswini29@gmail.com[2], nisha.dagade@sinhgad.edu[4]*

***Abstract***

*This paper deals with automation in industrial plants where batch processes are used, such as food, pharmaceutical and cement industries. Individual pieces of equipment in these plants are controlled by independent programmable logical controllers (PLC). PLC-s communicates with each other and synchronizes their work. With a well-designed automated system, the need for operators' supervision is greatly minimized and hence permits the labor cost to be reduced and optimizing the repeatability and efficiency of the process done by the system. Thus, the operator may readily and efficiently take real time action on the flow of the process permitting the latter to have an upper hand on the system as the latter may decide his own desirable set points at critical intervals. Clean-in-plant (CIP) processes are time intensive and waste large amounts of energy, water, and chemicals. New innovations in CIP technology allow plant operators to cut costs in an earth-friendly manner while still conforming to regulatory safety standards. This paper explains how new CIP technologies can improve production efficiency.*

***Keywords:*** *Batch Process, Clean in Plant, PLC, Ladder Diagram, SCADA.*

## I. INTRODUCTION

Now-a-days to maximize profit it is needed to minimize the cost of production. This can be achieved by reducing labor or by displacing labor into another sector. Furthermore, energy consumption will have to be used in an optimum way without any unnecessary wastage. After considering


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these suggestions, the best way to sustain these ideas is automation. In fact, through innovation and upgrading the machineries, the costs of production, as well as the harvest will be more promising to back the above ideas. In recent years, competition for products manufactured by batch methods has expanded from regional to worldwide marketplaces. This change in market conditions has increased the need for automation and advanced controls in order to maintain the competitiveness. In industries manually mass production is difficult due to delay of work, improper mixture of ingredients, compromise in hygiene, etc. Therefore, this calls for automation in batch process.

The aim of this project is to replace manual work in order to achieve real time monitoring and supervisory control of the process. A batch process is one that has recognizable start and finish, with one or more states or phases occurring during the operation. Steps and status changes that occur during the operation help determine the current state, and the operation usually progress from one state to the next toward completion. From a control standpoint, a batch system is a method of synchronizing the operation of the control systems with the external process equipment.

This project helps to increase the productivity and reduces the labour work. It also facilitates real time monitoring and supervisory control.

## II. OVERVIEW OF SYSTEM DEVELOPMENT

Automatic industrial batching system is automatic system that exert real-time monitor and supervisory on the industrial process which powder or liquid are weighed and mixed. It has been widely used to fields of metallurgy, construction material, chemical engineering, medicine, foodstuff. Batch process consist of sequences of operations and tasks, each of which are come out on a discrete quantity of material within a piece of operating equipment (mixer, reactor etc).

The products in batch processes follow an exactly defined production recipe, which defines the sequence and duration of each individual operation on a particular piece of equipment in the plant. Batch processes are usually very complicated, and they are controlled by process computers, which are


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distributed throughout the plant and connected into the local area network.

Very often the same plant produces various products using different recipes. Process computers that control the operation are required to coordinate allocation of specific resources and to control the execution of each individual operation. One of the problems that can specially arise is the failure of one of the equipment pieces used in the production process, that can occur when more than one products are being produced by the plant simultaneously, each using different recipes.

As there are usually more resources of the same kind inside a plant, the production could be continued but there is a danger of the deadlock occurrence i.e. the complete failure of the process.

A batch process is one that has recognizable start and finish, with one or more states or phases occurring during the operation. Steps and status changes that occur during the operation help determine the current state, and the operation usually progress from one state to the next toward completion.

From a control standpoint, a batch system requires a method for synchronizing the operation of the control systems with the external process equipment. It must also provide a means for collecting and managing data on a batch-by-batch basis. Clean in Place (CIP) Automation is typically a complex part of the automation process.

In many instances it is more complex to automate the cleaning process than to make the product since the final CIP automation sequence is often defined after the process equipment is built and cleaning tests are performed. There are many requirements for cleaning equipment as well as many cleaning types. Some process equipment is cleaned with only water while other equipment is cleaned using detergents such as acids or caustic solutions.

Some plants have taken to recovering the water used for a final rinse and use it as the initial rinse of the next CIP sequence in order to reduce the overall cost of production.

## III. BATCH PROCESS

### *A. Hardware Implementation*

- ***Working***


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a) Whenever low level sensor (LSL) of the main tank i.e batch tank is sense then Tank A fill the water into batch tank with the help of pump P1.

b) Fill the batch tank with the Material A by using pump P2.

c) Then fill the same tank with Material B by using pump P3 to a level LSH.

d) All this mixture should be mixed for some time with the help of stirrer and empty the batch tank after some time with the help of outlet valve.

- **BLOCK DIAGRAM**

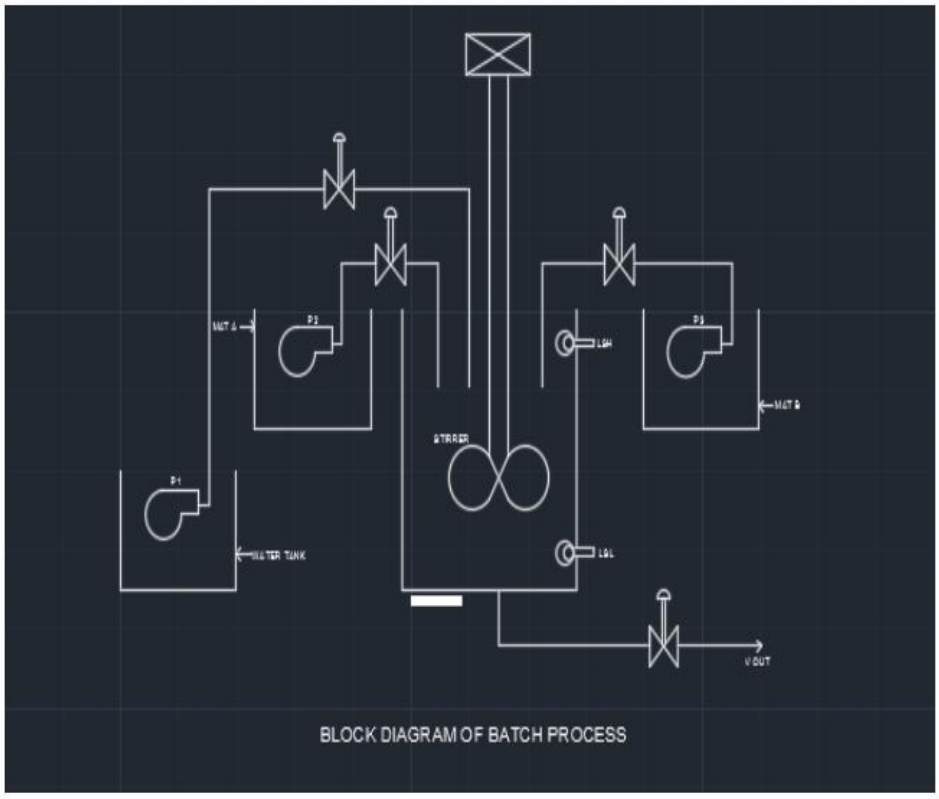



***Fig. 1 Block Diagram of Batch Process***


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- **COMPONENT**

Component which are used for Batch Process are

1) DC Controlled Valve
2) DC Shunt motor
3) Pump
4) Sensor

***B. Software Implementation [11]***

The ladder diagram is traditional way of representing the sequence of the operation. It represents the interconnection of field devices whatever used in the ladder diagram. By this way of representation became easy to communicate and control the field devices. The main purpose these to perform control operations in more reliable and also at lower cost. The designing of the ladder diagram was done by developing the logic of processes of each equipment which makes reliable control over the system in less supervision. **See Figure 2.**

***I. Hardware Implementation***

- ***Working***

CIP is a complex process to automate as there are many requirements for cleaning any equipment. Some equipment needs to clean with only water while the others need to be cleaned with detergents like acids and caustic soda. CIP consists of vessels for preparation of chemicals, pumps and valves for circulation of fluids, instruments to monitor it.

A CIP skid operates in the following manner:

- Deliver detergents, water, acids, etc. from source.
- Control the flow rate of the fluids.
- Control the temperature of fluids.
- Monitoring of the process.

The PLC AND SCADA monitors the flow rate and temperate of the fluids, only if the proportions are met then the timers are enabled. Once the duration is completed, any destination can be cleaned using any source and it can be observed through SCADA.

***Recipe of CIP:***

1. Preliminary flush with clean water
2. Caustic soda
3. Hot water
4. Final rinse


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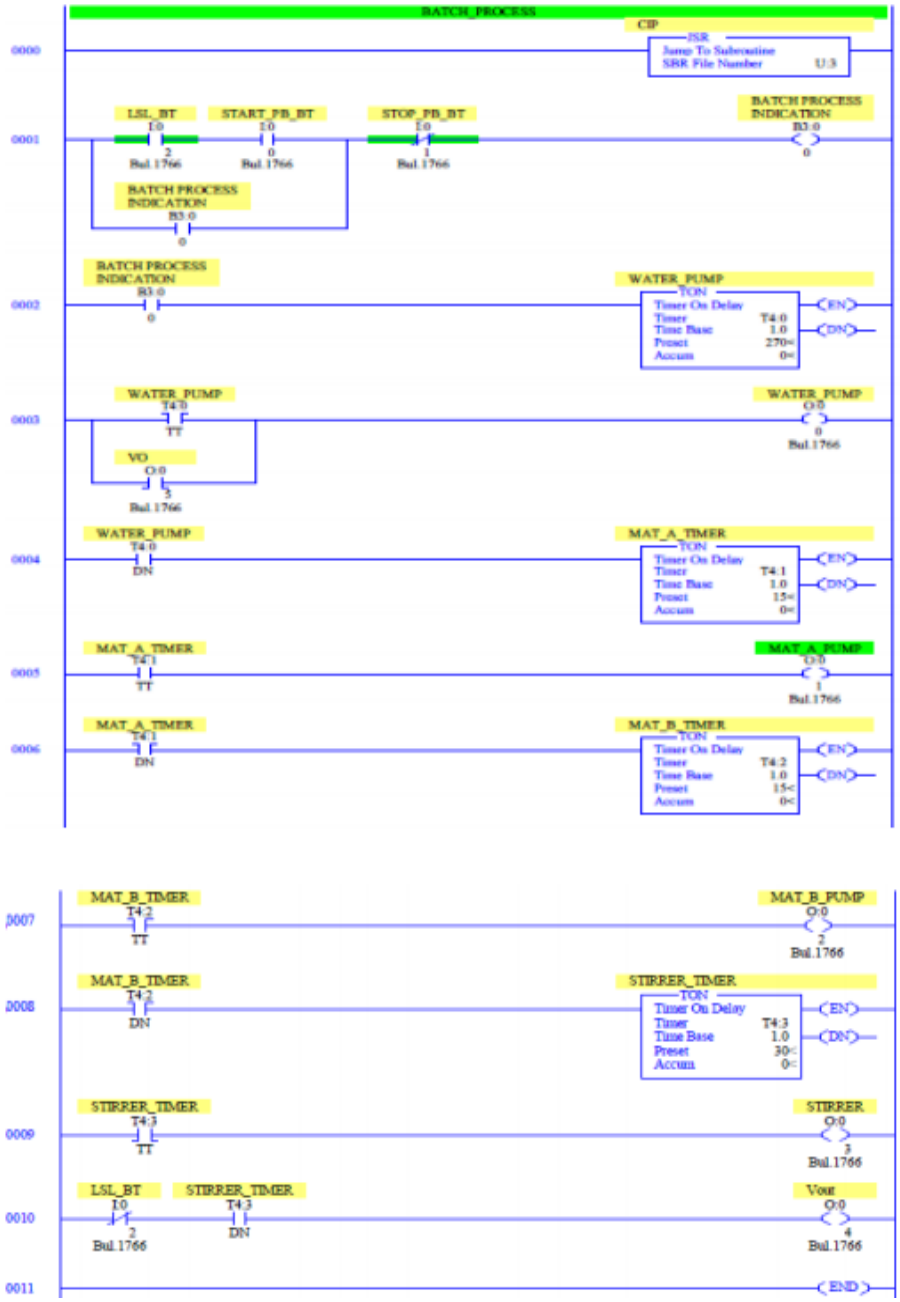



***Figure 2***


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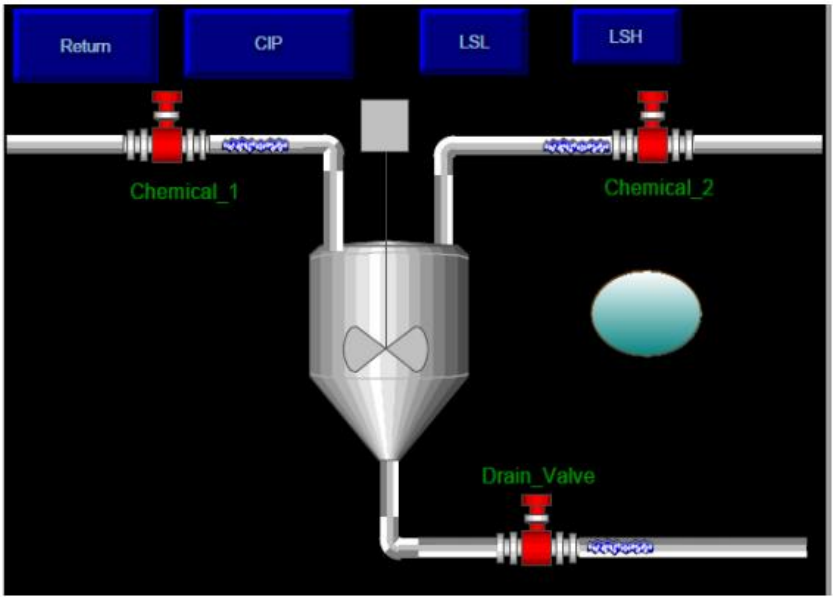



***Fig.3 SCADA screen for batch process***

## BLOCK DIAGRAM

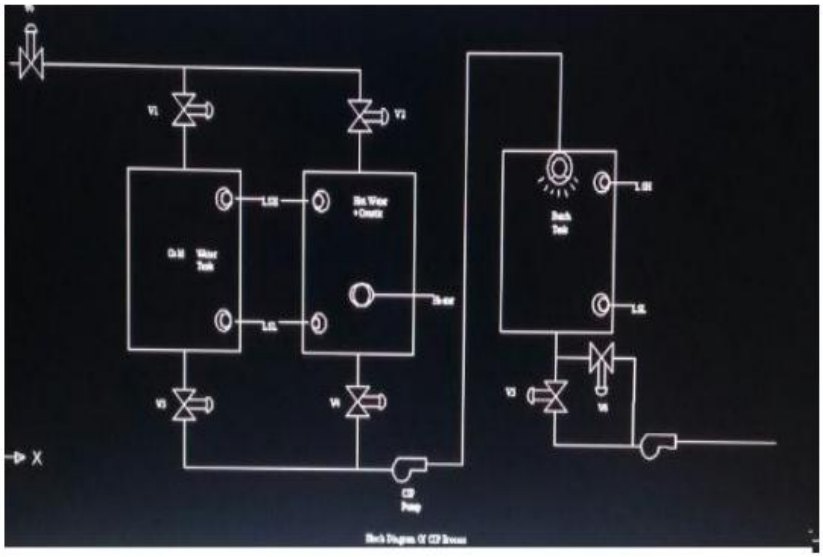


***Fig. 4 Basic Block Diagram of CIP***

***Component***

Component which are used for CIP Process are

1) DC Controlled Valve
2) Level Sensor
3) Spray ball


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## II. SOFTWARE IMPLEMENTATION

**[11]** The rules for ladder diagram designing are as follows

1) The horizontal lines are represented as rungs and vertical are power rails. The flow of power from right to left.

2) They read from left to right and top to bottom.

3) The RHS of the ladder diagram is represented as input and LHS as output.

4) Each program ends with word END or RET for return.

5) Particular input or output devices can be appears more than one time as per requirement.

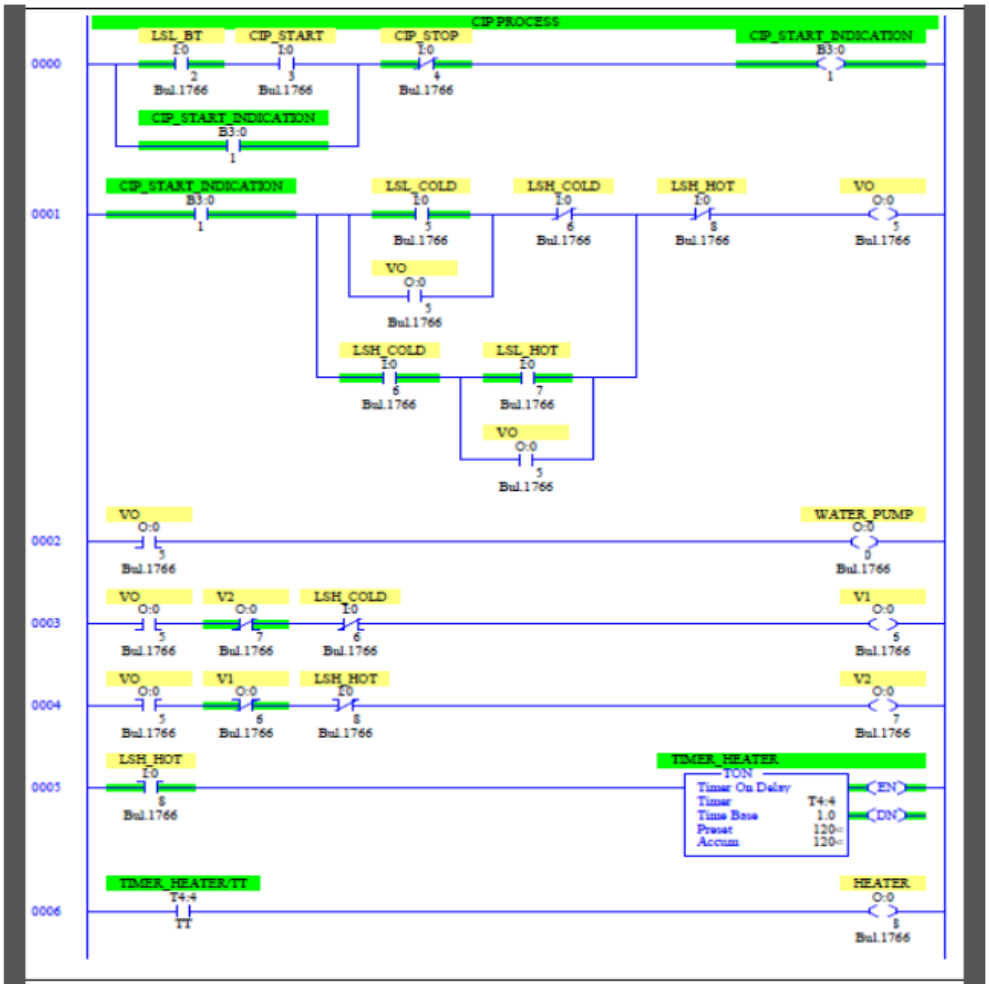



***Figure 5***


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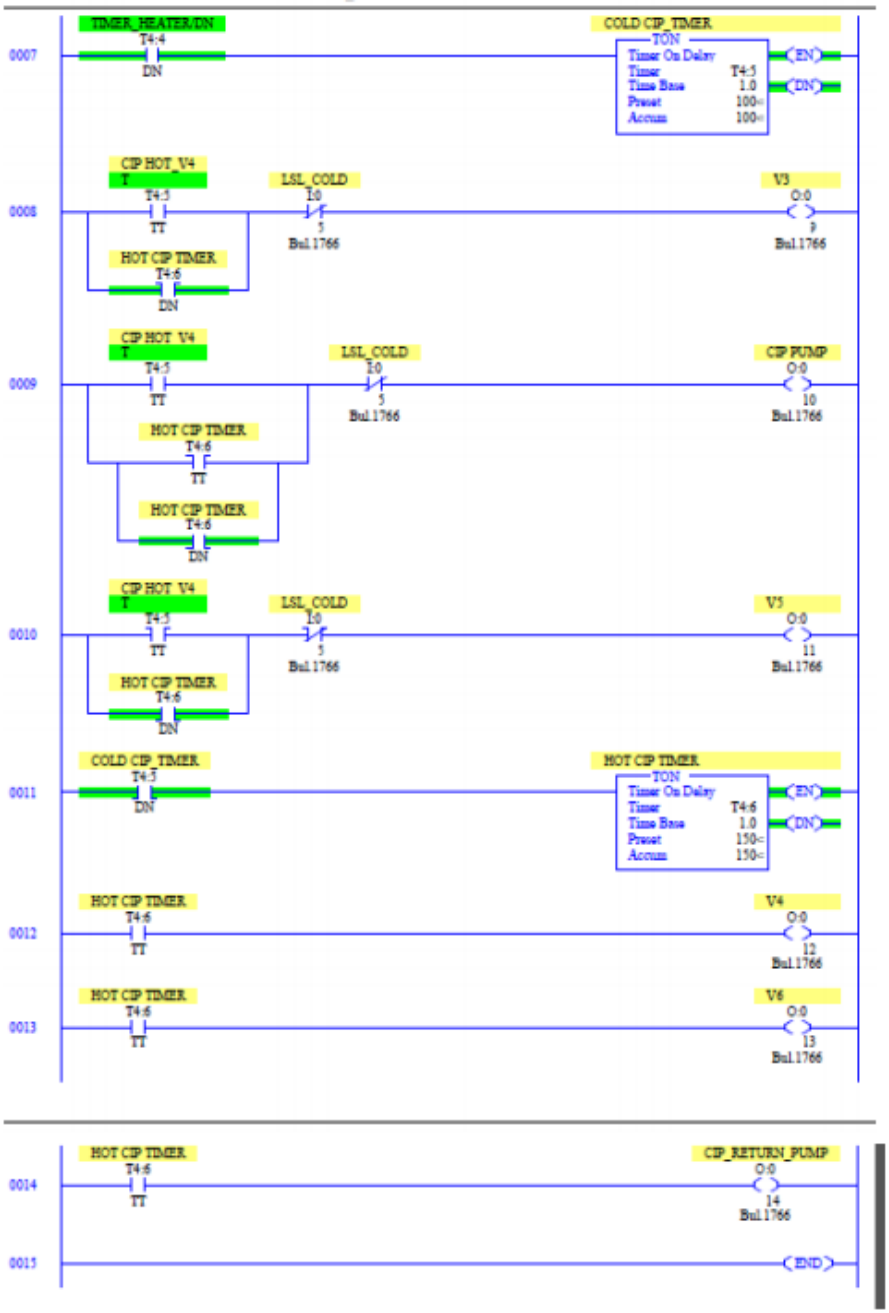



***Figure 6***


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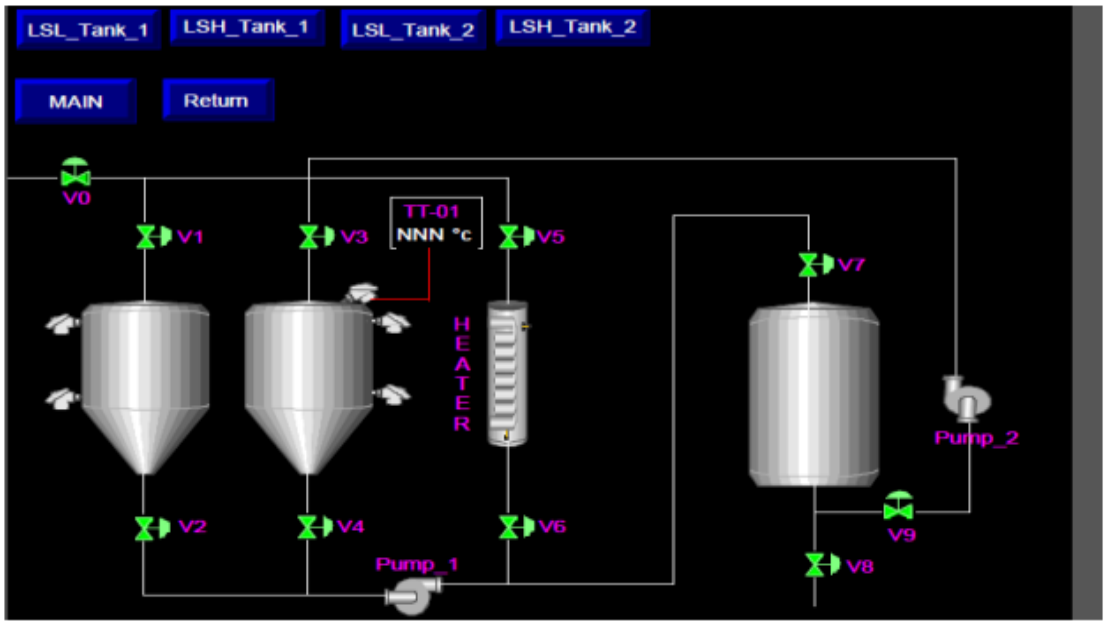



*Fig 7 SCADA screen for CIP process*

## CONCLUSION

The advantage of the system is requires less manpower, effective mass production along with maintaining hygienic constraints which is more useful for perishable foods and products such as diary industry, food and beverage industry etc. It reduces the labour and hard work of cleaning the process equipment. The CIP recipe need to change everytime. Operation of CIP is easy and can be done by small crew. It helps to minimize the waste.

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