

Cleaning and Sterilization of Pasteurization Tank in Dairy Industry using PLC and SCADA

Deepak Chavan¹, Omkar Hurdale², Shriram Role³, Akash Wajage⁴, Prof. G. D. Salunke⁵

^{1,2,3,4}B.E Student, Dept. of Electronics Engineering, All India Shri Shivaji Memorial Society's Institute of Information Technology, Pune SPPU, India

⁵Prof, Dept. of Electronics Engineering, All India Shri Shivaji Memorial Society's Institute of Information Technology, Pune SPPU, India .

Abstract – Industries like Dairy Industry required very high standards of cleaning and maintenances of the utensils and tank. The tanks which are used in this process plants are very difficult to clean. When the tank required cleaning they are removed from their stationary position and the cleaned manually this process is very time consuming as well as expensive as it include re-installation every time. Hence a new system is introduced which is called as CIP (Cleaning In Place). It is a process to clean the process equipment without disassembling or without doing any re-installation. The CIP is a fully automated using SCADA and PLC, hence can be done with any actual human interference which results a fully automated system with a reduced production time and increased productivity.

Keyword— CIP, PLC, SCADA, Automation, Dairy Industry.

I. INTRODUCTION

Food industry requires high level of cleaning and hygiene maintains unit. These needs are fulfilled by CIP using SCADA and PLC. CIP plays an important role of cleaning the plant having pipes, valve, tanks and fluid flow tracks by using cold water, hot water as well as some detergents if required like acid base or any other sterilization base chemicals. The main objective of the CIP process automation is to remove the small food particle which has been trapped inside the pipes, valves and also to stop the growing harmful bacteria and if the growth of bacteria is already happened then to remove them. CIP automation cleaning involves complete removal of the food ingredients or decomposable ingredient from the tank or pipes using appropriate detergents and chemicals under the given conditions. Cleaning in place provides a lot of advantages to the manufacturer as it provides the cleaning function in run time and because of this the manufacturer gets the perfect hygiene in less cost and the productivity is also increased. As this processes to insure less interference of human it is provided with the PLC (Programmable logic controller) and in order to control and monitor the whole plant the SCADA (Supervisory Control and Data Acquisition) screen is used.

II. PROPOSED SYSTEM

In the conventional system plant required to be cleaned after disassembling the whole plant. All the tanks and tube are separated and then cleaned. In this process the operator needs to go inside such tanks and clean manually which results that the operator came in contact with hazardous chemicals and other degradable substances.

The proposed system provides the solution to this conventional system with the help of CIP. CIP (Clean in place) is a process by which we can clean the whole plant without disassembling it. The advantage of the system is that it requires very less interaction with the human as the whole system is design using PLC and SCADA. The whole system is fully automated. The proposed system eliminates the major drawback of conventional system like time consumption and higher cost. Cleaning in the plant like pasteurization plant in dairy industry is the total removal of organic material waste and other disintegrable components.

In the proposed system the three step cleaning cycle is considered which involve the steps as fallow first the fresh water hot or cold is send in to the tank which is to be cleaned. The second step when water is drained the proper required chemicals, detergents, and disinfectants are injected into the tanks or pipes. Step three after the chemical process again some fresh water is passes through the plant to clean and remove all the chemicals.

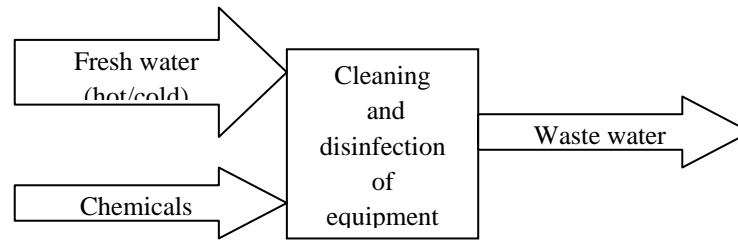


Fig. 1 Cleaning cycle

III. METHODOLOGY

Block Diagram of the system:

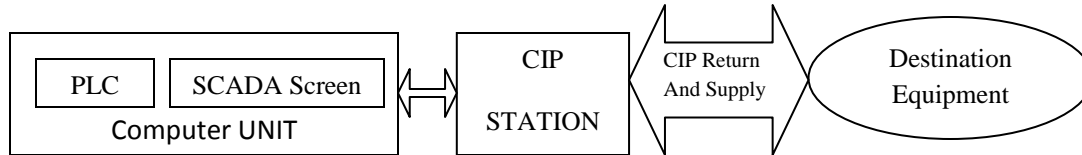


Fig. 2 System Block Diagram

CIP Station is the assembly of all the components. It contains tank, valves, pipes, pumps and other equipment. It is the basic platform or the CIP system. The entire fresh water tank, chemicals and other detergents contains in it.

Computer unit consist of two component PLC and SCADA. PLC (Programmable logic Controller) is used to automatically control the valve, tank and other controls. The system must show on working screen for that the SCADA screen is provided.



Fig. 3 CIP station

CIP Operation:

CIP operation is based on the ladder programmed which is return or build for the system. In this system the ladder diagram which is build is for the three tanks and for valves. CIP system involves number of tanks which have different type of solutions. In the proposed system we have added three tanks which have cold fresh water hot water and salts and detergent added water simultaneously. The fresh water and other liquids are injected in the destination system with force and hence it cleans or flush out the material from the tanks or from the valves and from pipes of the system. The CIP system also involves some sensors like temperature sensor level sensor and it is equipped with heating tank to provide hot water.

Filling Process:

As the name stats it is the process to fill the tanks all the tanks are filled with normal fresh water with less TDS (Total dissolved salts). As the system is completely automated the tanks are drained and filled with water using the level sensor. Using level sensor we know exactly the amount of water present in the tanks. While filling the tanks the drain valve is closed and supply valve is opened simultaneously at the same time.

Preparation process:

In the preparation process the water is heated and prepared for the cleaning. The water is heated up to 80⁰ C. The water in the second tank is passed through Heat Exchanger for heating purpose. During this both valves of the tank is opened for the circulation purpose. The water is heated until the temperature sensor matches with the set point; once the set point is achieved the circulation of water through the heat exchanger is stopped. And both valves are closed the same procedure is done in third tank but in the third tank the caustic soda is added.

Cleaning in Place:

When the CIP operation takes place it is required that all the three tanks are ready for the operation. The tanks required to be filled with fresh and cold water with less TDS. After that one of them required to fill with hot water. The tank which has hot water is filled with the detergents and other cleaning agents. Hot water can speed up the dirt and detergent reaction process temperature acts as a catalyst in the reaction. After all this preparation done the first tank is drained through the Destination system it clean and remove the unwanted material but the material which are still inside the tank or which is stick on the inner surface is cleaned using the hot and detergent added water. This water goes through the system and cleans and removes the unwanted material thoroughly. After that again some fresh water is passed through it to get the clean Destination Sytem.

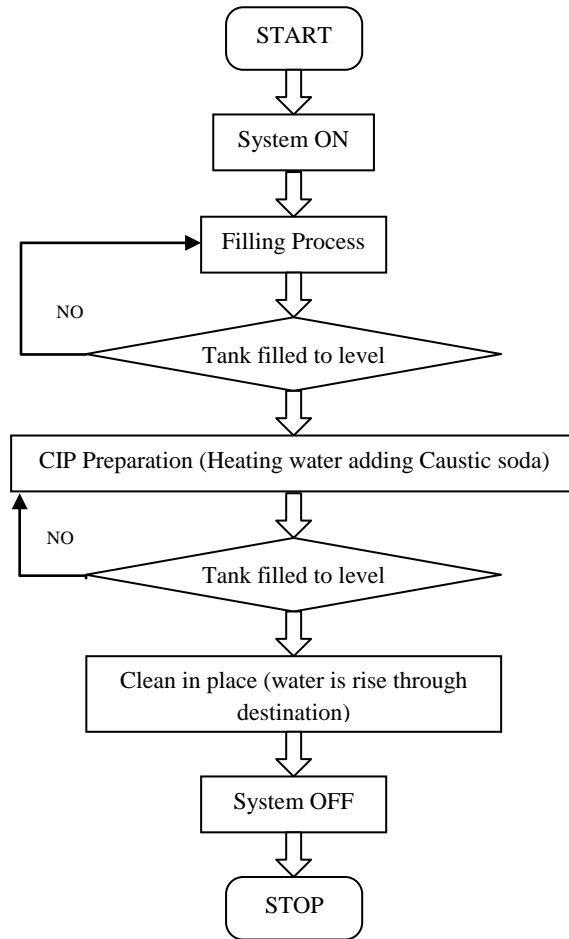


Fig. 4 Flowchart of CIP Process

IV. RESULTS

The proposed system is able to clean the destination system. It is very convenient to use such CIP system as it shows that it requires a very less amount of time but the results are great. The cleaning is very nice and provides a great hygienic. A ladder diagram program which is builds in PLC and run in PLC to execute a CIP system. The SCADA window which used in the proposed system is as fallows.

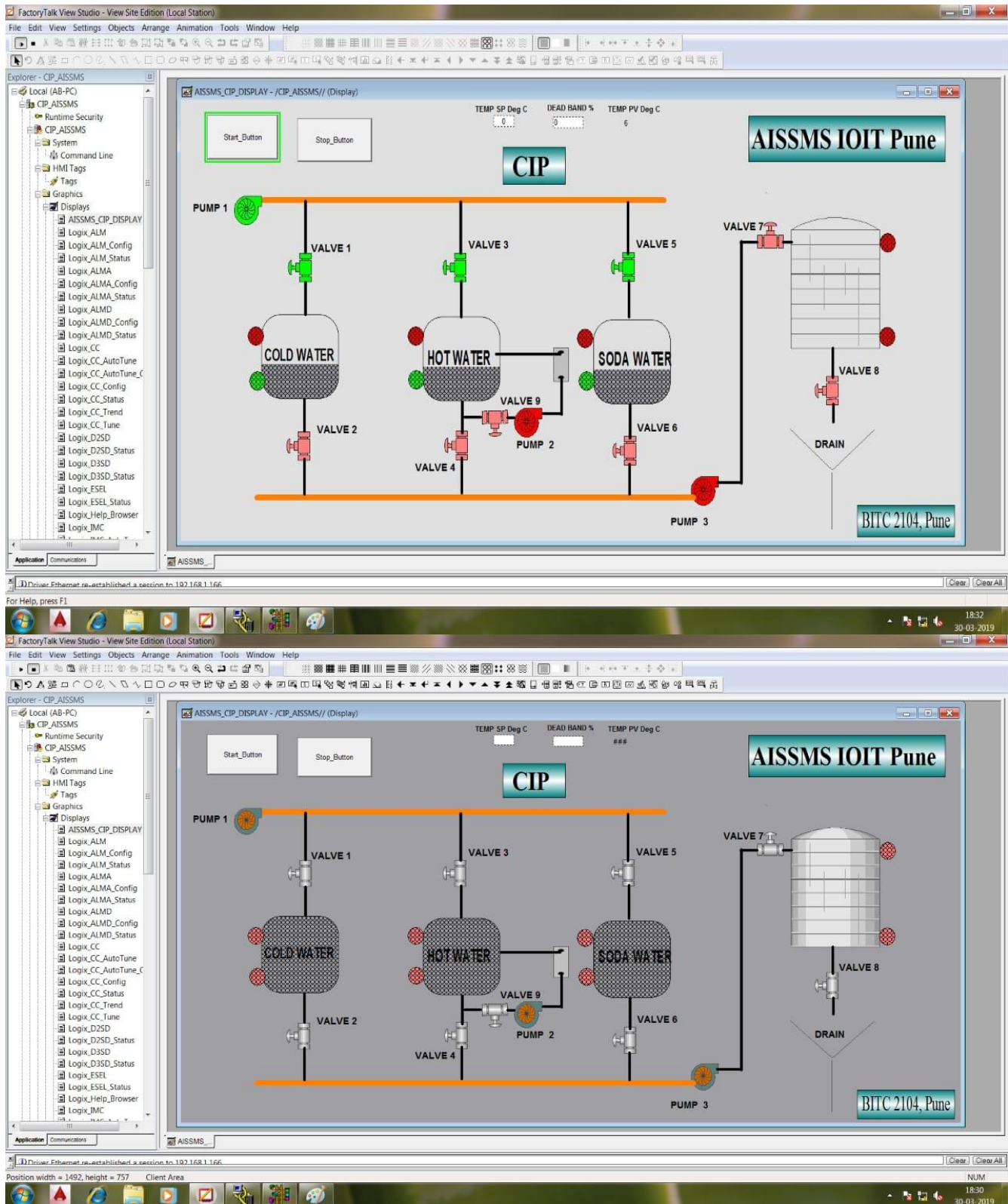


Fig 5 SCADA Screen of CIP Process

V. CONCLUSION

In the proposed system the main goal is to provide such a system which will clean the Destination System without disassembling it. The system achieves the goal to do so as it clean without disassembling the destination system. The results are very promising and it provides a very hygiene system. The system required a very less time to be executed. The only demerit of the system is that the installation costing is high.

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