Automation of CIP (Clean In Place) in Manufacturing Industries

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Abstract **- PLC control CIP (Cleaning in Place) System is suitable for the cleaning of pipes and containers during the producing process for dairy products, beer, and fruit-juice. These PLC control CIP (Cleaning in Place) System consists of the fully integrated Control System with HMI including all related instrumentation. The system is pre-engineered and built for the addition of detergents.**

The Project includes storage tank, pump, instrumentation and controls, valves, electrical devices and any other necessary design components. The project contains small demo of CIP. This process will be controlled by PLC and displayed by SCADA. This project also contains motors, and Control Element. The whole process in brief will be shown on SCADA

Keywords - CIP (Clean In Place), Automation, PLC,SCADA

I. INTRODUCTION

Creating control code for the typical major steps of CIP including preliminary flush with water, caustic cleaning, hot water flush and final rinse. Establishing the conditions that define when a step has completed, such as waiting for a conductivity value following the hot water flush before moving on to the next step. Creating control code to perform the CIP procedures as defined during automation design.Physical factors, biological factors, chemistry of detergents, concentration, temperature, exposure time etc. Coordination between the CIP skid and the destination to be cleaned. Equipment arbitration.

II. MATERIAL AND METHODS

A. Flow of the Process:

In this process for cleaning of equipments, here as shown in the figure the flow of the process is shown. The washing elements such as detergent, caustic soda, etc. which are used to clean the equipments are accumulated in the CIP station, this is transferred to the destination equipment where actual cleaning procedure is made. After cleaning is done the materials which remains after this procedure is transferred back to the CIP station.

B. Expected Outcomes

1. Reduced Sanitizer Consumption
2. Reduced Operating Costs
3. Increased Efficiency - Reduced Cycle Times
4. Increase Available Process Time

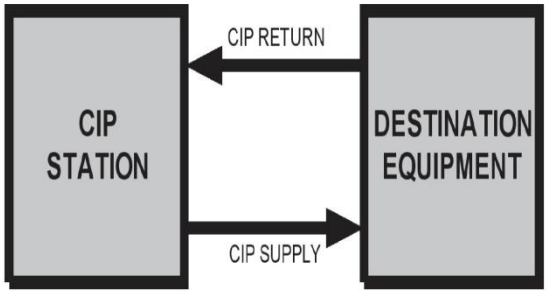

Figure 1 CIP Return

C. Actual Working Mode

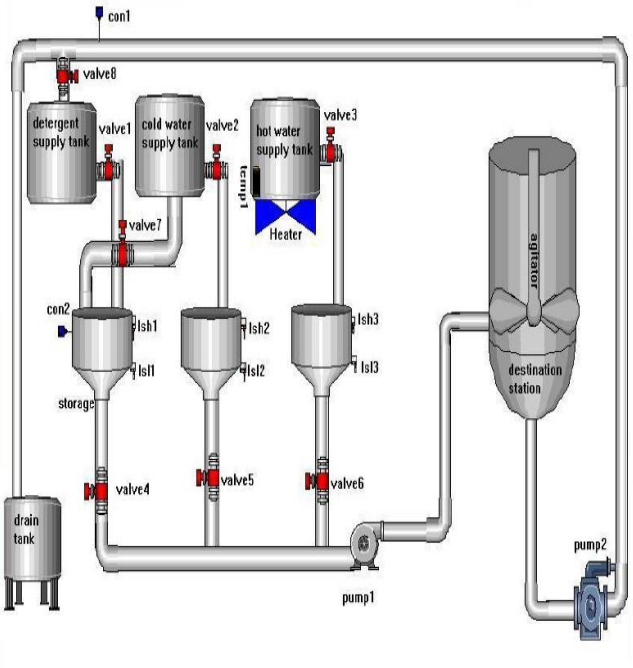

Figure 2 SCADA Representation of Working Model

III. WORKING OF PROCESS

1) Filling of tank
2) Pre washing with cold water
3) Applying detergent
4) After wash with hot water

A. Filling of Tank

As shown in the figure, water and the detergent will be filled in the water and detergent tank respectively depending upon the signals from the level sensor i.e. valve1, valve2, valve3 will be started as soon as the level reaches below the lsl1, lsl2, lsl3 respectively and the valves will close as soon as the level reaches lsh1, lsh2, lsh3 respectively, so as to make sure the storage tank is fully filled at all times.

B. Pre Washing with Cold Water

As soon as start push button is pressed valve5(cold water outlet), pump1 and agitator will start to work for some amount of time for the supply of cold water and proper washing of tank through cold water after proper treating with cold water the return pump will start working and cold water will be drained in the drain tank .

C. Applying Detergent

After the tank is cleaned with cold water, the outlet valve4 (detergent) will open and the CIP delivery pump will start for some time, then the agitator will start the whole detergent will mix for sometime and then it is returned back to CIP skid where the conductivity sensor will check if it is reusable or not if it is reusable then it will be returned to the detergent tank or it will be drained depending upon the conductivity.

D. After Wash with Hot Water

After detergent is properly applied in the destination station tank it is washed through hot water for that the valve6 (hot water) will be started parallel the CIP delivery pump will also get started , after sometime agitator will start and the whole tank is cleaned properly , then the CIP return pump will start and hot water is drained.

This process is repeated until the stop button is pressed, in this way the whole of the tank or vessel is cleaned effectively.

RESULT AND DISCUSSION

1. A correctly designed CIP system: This ensures that the plant is clean. It also prevents issues such as risk of chemicals contaminating the product side, excessive waste/cost from poor valve selection/sizing and location, or risk of incorrect operation due to lack of alarm systems.

2. A correctly designed process system: The process must be specifically constructed for automated cleaning, e.g. radius of pipe bends, self-draining equipment and pipe work (including adequate support to prevent local sagging) and no ‘dead ends.’ An excellent CIP side will not compensate for a poor process side.

3. Minimize CIP time: to help speed time- to-market and reduce impact on plant production.

4. Optimize thermal efficiency: to avoid unnecessary heat loss and reduce energy requirements.

5. CIP should be used in any industry and plant where hygiene is critical; the process is usually an integral part of established automation systems. However expanded health and safety / food security compliance is set to make CIP more stringent - which good given a shiny surface on the outside of plant is no guarantee of cleanliness on the inside.

6. Time: Up to an hour depending on the quantity and concentration of cleaning solution applied.

7. Temperature: Cleaning effectiveness is highly dependent on temperature selection. Extreme temperatures may ‘cook’/‘bake’ soil on, making it very difficult to remove. Low temperatures may reduce cleaning efficiency so that soil is not completely removed. The CIP system should monitor and maintain the solution temperature at all parts of the system throughout the cleaning cycle, and prevent production if the system has not been adequately cleaned.

8. Conductivity measurement critical: Concentration (cleaning chemicals and sanitises): Concentrations (i.e. the strength) of the cleaning/sanitising chemicals must be maintained within set ranges. The system should prevent production if concentrations were not maintained within the acceptable range. Too lower concentrations or too higher concentrations of cleaning/sanitising chemicals will not clean and sanitise the plant effectively.

REFERENCES

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