Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

CIP System

Clean-In-Place (CIP) is used in many operations to maintain sanitary conditions in processes

Measuring concentration in CIP process

Typical cleaning fluid storage tanks

CIP piping with instrumentation

Application description
There are many different configurations and designs for CIP process, but a general principle applies – cleaning is done without removing process components through flushing the system with cleaning agents. The following terms are used to define the degree of cleanliness:

- Physical cleanliness: removal of all visible dirt from the surface
- Chemical cleanliness: removal not only of all visible dirt, but also microscopic residues which can be detected by taste or smell but are not visible to the naked eye
- Bacteriological cleanliness: attained by disinfecting
- Sterile cleanliness: destruction of all microorganisms

It is important to note that equipment can be bacteriological clean without necessarily being physically or chemically clean. A typical CIP run consists of a recovery of product residues by scraping, drainage and expulsion with water or compressed air. Pre rinsing with water to remove loose dirt, cleaning with detergent, and rinsing with clean water. Disinfecting by heating (steam) or with chemical agents if this step is included, the cycle ends with a final rinse, if the water quality is good.

Each stage requires a certain length of time to achieve an acceptable result. four components (Time, Temperature, Concentration and Velocity) determine the effectiveness of the CIP and is optimized for each application.

An example of CIP systems are single use, 1, 2, 3 or 4 tank systems. The number of tanks describe how CIP media is recovered or what detergents are used. The example shown in the process map on page 2 is a 3 tank system. CIP systems are designed for central or decentralized systems. Central systems are used for smaller plants where it is practical to use one centrally located CIP and a de-centralized system is often used for larger facilities. As a general rule, separate CIP systems are used for raw and pasteurized product. HTST pasteurizers and UHT systems have dedicated CIP systems. There is also a differentiation between line circuits and tank circuits. Tanks are cleaned using burst of flow through a spray ball or a rotary nozzle. Cold processes commonly only use a caustic detergent (typically sodium hydroxide) while hot services may use caustic and acid (typically Nitric or Phosphoric acid) to remove burnt or caramelized deposits. A CIP program for a “hot components” circuit can consist of the following stagers:

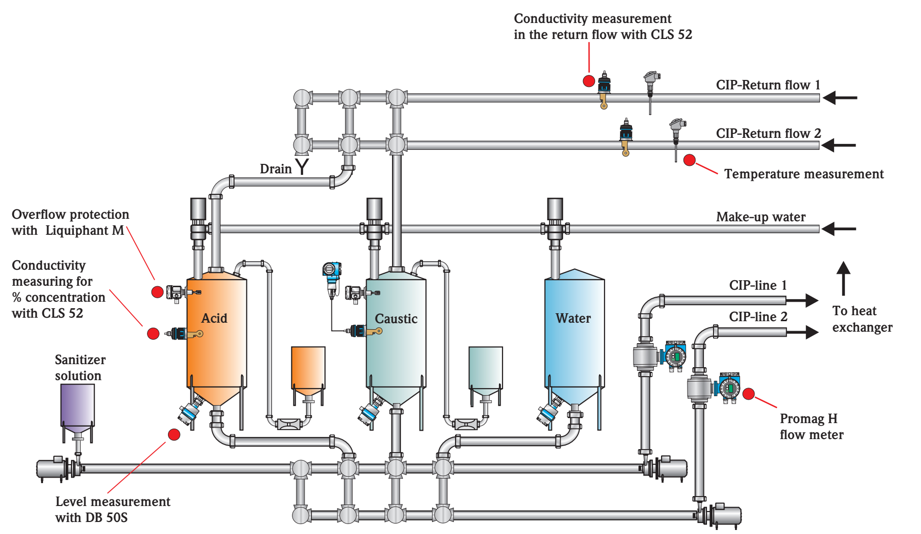
1. Rinsing with warm water for about 10 minutes
2. Circulation of an alkaline detergent solution (0.5 to 1.5%) for about 30 minutes at 170°F
3. Rinsing out alkaline detergent with warm water for about 5 minutes
4. Circulation of (nitric) acid solution (0.5 to 1.0%) for about 20 minutes at 160°F
5. Post-rinsing with cold water
6. Gradual cooling with cold water for about 8 minutes.

The circuit is usually disinfected in the morning, before production starts. This is typically done by circulating hot water at 195 to 205°F for 10 to 15 minutes after the returning water temperature is at least 185°F.

To control the process, flow meters are used to ensure that the correct flushing action takes place. Note that flow velocity of 5 to 10 ft/sec is common during CIP. This is sometimes overlooked when sizing flow meters, since the flow rate of the process media is usually much lower. Temperature of CIP is closely monitored, if temperature is too low, the effectiveness of the cleaning is compromised. As a rule of thumb, cleaning with alkaline detergent should be done at the same temperature as the product has been, and at least 160°F

CS0606/24/ae

Concentration of the CIP detergent is monitor by conductivity measurement. Commonly, two points are monitored, the concentrations in the CIP tank and on the CIP return line. The transmitter on the CIP return line controls the CIP diverter valve. Depending on the system, the diverter valve returns the CIP fluid to the CIP tank for reuse or dumps it to drain. The response time and performance of the conductivity transmitter is important. A slow response often results in unnecessary waste of CIP chemical to drain, resulting in higher cost for replacement chemicals, heating of more media and additional cost for water treatment.



Typical CIP process

Measurement capabilities from Endress+Hauser

Conductivity sensor CLS 52 with CLM431 or CLM 253 transmitter for concentration measurement of CIP solutions.

Level measurement for the storage tanks is ideal for the Deltapilot hydrostatic pressure sanitary level transmitter.
Levelflex M radar unit is a downward-looking Time-of-Flight (ToF) continuous level system ideal for storage tanks.

Flow measurement with the Promag H electromagnetic flow meter designed for hygienic and sanitary applications. For CIP systems with ultrapure water, conductivity is too low for electromagnetic flow meters. Endress+Hauser offers Vortex flow meters or Promass mass flow meters for these applications.

Overflow protection and pump protection with the Liquiphant M vibration level limit switch, suitable for hygienic applications plus SIL 3 functional safety.

Temperature measurement using the TH 17 Pt 100 sensor, designed for use in hygienic and CIP applications.

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CS0606/24/ae/05.05