
CIP cleaning processes in the dairy industry

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Abstract

This paper presents the basic principles of CIP washing process in the dairy industry. CIP procedures mean automatic or semi-automatic internal sanitation of production facilities without dismantling them. This method of sanitation requires special design of the surfaces to be treated.

1. Introduction

In the last 10-15 years techniques and washing of equipment used for food processing have been perfected. In the past, cleaning of the equipment in dairies has been done by workers who had to dismantle the equipment and enter the reservoir to reach the area they needed to clean up. Products were often infected by inadequately cleaned equipment. The system of circular “cleaning in place” (CIP) which is adapted to the various parts of the production plant has been developed in order to achieve good results in cleaning and sanitation. In the pipelines, valves have been installed in order to perform programmed opening and closing in order to regulate the circulation of fluids. Pumps which dictate circulation of the fluid enable automatic circulating, washing and rinsing, a technique called washing in place or CIP. CIP can be defined as circular washing, with fluid running through tubes and machines, and through the stages of enclosed machines because it is too expensive to disassemble and open them frequently.

2. CIP washing systems

There are various types of CIP systems: a) simple closed systems (washing by circulation) - typical for devices of limited volume, such as plate heat exchangers, filters or chargers or little CIP systems for so-called “lost washing” - for each wash a new
cleaning solution is prepared, and b) the automatic CIP system conducts return of the washing solution.

Benefits of CIP procedures for sanitation of equipment, machinery and pipelines, which are washed in dairy plants are: a) greater safety - fewer manual operations, removal of the human factor errors, safety at work; b) higher quality of sanitation - control of the washing is implemented via the control panel and the results are reproducible; c) controlled costs - lower labor costs, the controlled use of resources for sanitation, water and energy.

The transition of fluid over surfaces of equipment at high speeds creates the effect of mechanical friction that releases dirt deposits. This only applies to flows in pipes, heaters, pumps, valves, separators, etc. The dairy industry uses a variety of machines, so the design and the volume of the internal parts or surfaces have to be monitored, and it is difficult to run only circulating washing. Here, mechanical cleaning is not sufficient but must be augmented with specially designed nozzles for washing.

2.1. Suitable materials and design of CIP washing systems

For effective CIP, equipment must be connected in the cleaning circuit and must be easy to clean. All surfaces which are washed must be accessible to detergents. The equipment and pipelines should not have blind ends to which detergents cannot access or through which they cannot run. Machines and pipes must be placed so that they can easily drain. All places from which residual water after washing cannot run off will become a place for bacterial growth and cause a serious risk of product contamination. Materials in the process, like stainless steel, plastics or elastomers, must be of such quality that they leave no trace, smell or taste to the product. They must also be resistant to contact with detergents and disinfectants at the cleaning temperature.

Stainless steel is a universal material for surfaces in contact with the product in modern dairies.

2.2. CIP programs

CIP programs in dairies differ according to whether circuits include cleaning of the heating surfaces or not. Accordingly, they can be divided into the following programs:

A - CIP programs for rotary washing into which are included pasteurizers and other equipment containing heating surfaces (UHT, etc.).

B - CIP programs for rotary washing which involve tanks for the reception of pasteurized milk with a pipe system.

The main difference between these two programs and types is in that the acid circulation is always included in the first type so as to remove deposits of proteins and salts from heating surfaces. CIP rotary washing into which pasteurizers and other equipment containing heating surface are grouped is called “hot components”.

Pasteurizers are usually sanitized in the morning, before the start of production. This is typically carried out by hot water circulation at 90-95°C for about 10-15 minutes just after the temperature has reached at least 85°C. In some dairies, after washing with water, CIP system is programmed to start rinsing with acidic detergents, in order to first remove salt deposits and break up the layer of dirt and thereby enable the breakdown of the proteins by alkaline detergents. If the disinfection is performed by chlorine chemicals, there is a risk of fast corrosion if deposition of acidic detergents occurs. Accordingly, where the cleaning process begins with alkaline and ends with acidic detergent, after the final rinse water, the equipment to be cleaned should be rinsed with weak alkaline solution to neutralize acid before disinfecting by chlorine chemicals.

Conventional CIP systems have four reservoirs: with cold water, an acid, a base and the so-called steamy water, and there are systems with another added hot water tank.

The operator has the option of choosing the washing program. A complete wash or particular washing step can be selected. In the system, there are sensors for measuring levels, temperature and concentration of the fluids in each tank. All signals from the probes and pumps are forwarded to the central computer. All the relevant data for the system can be seen at the terminal, and it is possible to select washing program cycle, generate diagrams, etc.

Fig. 1. Central CIP and washing lines in dairies.
3. The design of centralized CIP systems

CIP is a process that is used for washing and cleaning of technological elements (tanks, pasteurizers, pipelines) without dismantling them. Conventional CIP systems have four reservoirs: with cold water, an acid, a base and the so-called steamy water, and there are systems with another added hot water tank.

Operator has the option of choosing the washing program. It can be selected complete wash or particular washing step. In the system, there are sensors for measuring levels, temperature and concentration of certain fluids in each tank (Christian and Fryer, 2006). All signals from the probes and pumps are forwarded to the central computer. All the relevant data for the system can be seen at the terminal, and it is possible to select washing program cycle, generate diagrams, etc. In practice, there are no restrictions in meeting individual requests for the size and complexity of the CIP system. CIP station in a dairy consists of the necessary equipment for the storage, tracking and distribution of cleaning liquid to the various CIP circuits. A centralized CIP system has found its place in many dairies, but in large dairies with a large processing capacity, the distance between the central CIP systems and peripheral CIP circuits becomes too long. CIP pipe systems contain large amounts of fluids, even if they are “pumped out”. The residual water in the pipes after flushing dilutes detergent solution, which means that large amounts of the concentrated detergent must be added in order to maintain the required concentration. The greater the distance, the higher the cost.

4. Conclusion

Modern technology implemented in food processing methods and microbiological food safety standards have led to reduced, but not completely eliminated, likelihood of diseases that are associated with food and the occurrence of food product defects in industrialized countries. On the other hand, modern methods of food production and processing are based on the use of various forms of secure technologies for washing and sanitation of the equipment that aim to simultaneously provide and maintain product safety and acceptable, and at the same time, unchanged quality from the moment of production to the moment of consumption.

Preventing human diseases that are transmitted by food, reducing the failure of finished products and improving their quality, are the basic trends in the modern food industry. The development of modern food industry includes a diverse array of technological processing procedures and range of food products, so as well as an increasing volume of production, adequate and timely application of sanitary principles is a necessary factor in the process of creating a healthy food product.

Acknowledgement

The results presented in this paper are part of Project III, No 46009: “Improvement and development of hygienic and technological procedures in production of foodstuffs of animal origin with the aim of producing high-quality and safe products competitive on the global market” funded by the Ministry of Education Science and Technological Development of Serbia.

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