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NEW INSTRUMENTS TO ENHANCE SAFETY, SUSTAINABILITY AND EFFICIENCY IN THE DAIRY INDUSTRY

The latest research on technologies and approaches for sustainable processing and enhanced consumer satisfaction. Novel technologies applied to dairy manufacturing, non thermal processes, hurdle technologies, enhancement of dairy products' health benefits and dairy foods packaging

Look beyond the hygienic design of dairy equipment to reduce overall costs of cleaning

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Terms and definitions

Hygienic design and engineering: Design and engineering of equipment and premises assuring the food is safe and suitable for human consumption (*EHEDG Glossary, Version 2013/12.G03*).

Cleanable or Cleanability: The suitability of materials of construction, design and fabrication required to assure that the equipment can be freed of soil (*3-A® Sanitary Standards for General Requirements. ANSI/3-A 00-00-2014*).

Product contact surfaces: All surfaces which are exposed to the product and from which splashed product, liquids, or soil may drain, drop, diffuse or be drawn into the product or onto surfaces that come into contact with product contact surfaces or packaging materials (*3-A® Sanitary Standards for General Requirements. ANSI/3-A 00-00-2014*).

Clean-In-Place (CIP) Cleaning: The removal of soil from product contact surfaces in their process position by circulating, spraying, or flowing chemical solutions and water rinses onto and over the surfaces to be cleaned (*3-A® Sanitary Standards for General Requirements. ANSI/3-A 00-00-2014*).

Disinfection: Process applied to a clean surface which is capable of reducing the numbers of vegetative micro-organisms, but not necessarily their spores, to a level considered safe for product production (*ISO 14159:2002 Safety of machinery. Hygiene requirements for the design of machinery*).

Sanitizing or Sanitization: A process to adequately treat a clean product contact surface that is effective in destroying vegetative cells of microorganisms of public health significance, and substantially reducing numbers of other undesirable microorganisms, but without adversely affecting the product or its safety for the consumer. Any process used must be acceptable to the Regulatory Agency (*3-A® Sanitary Standards for General Requirements. ANSI/3-A 00-00-2014*).

Pasteurizable: (Equipment) Designed to be capable of being pasteurized (*ISO 14159:2002 Safety of machinery. Hygiene requirements for the design of machinery*).

Sterilizability: (Equipment) Designed to be capable of being sterilized (*ISO 14159:2002 Safety of machinery. Hygiene requirements for the design of machinery*).

Not only effectiveness but also efficiency

An equipment can be cosidered hygienic if it can be adequately cleaned and, if necessary, disinfected, or sterilized or pasteurized. This regardless of time and overall costs.

Today it has become essential, beyond complying with the hygiene requirements, the environmental and economic sustainability of the food processing

New technologies and integrated solutions

In past years, the technological innovation for the food industry has focused on automation to permit an increasingly **high production capacity**.

More recently, most of the attention in the development of food equipment focalize mainly of the **energy efficiency aspects**, leaving the reduction of the other environmental aspects, waste production, water efficiency, reduction of chemicals, in background.

It is time that also these aspects has to be considered in the design of new machineries, and for this the proposal is to redesign industrial equipment to **improve the overall sustainability of the process** and the competitiveness of the food industry.

Eco-hygienic design of equipment

Cleaning activities consume large amounts of water and chemicals, including alkalis, acids and disinfection agents. This generates large amount of contaminated wastewater and organic waste. Cleaning is also one of the most energy-consuming operations in the food industry.

On the other hand, cleaning and disinfection of equipment and facilities in food industry are critical for food security and quality. Thus, frequency and intensity of these operations depend on the hygiene requirements, the efficiency of the cleaning processes and on the design of the equipment.

Eco-hygienic design of equipment and installations may be considered a preventive strategy to reduce the environmental impact of cleaning and disinfection operations.

(*Ortuño R. Hygienic Eco-Design. Food&Drink Technology - 19 March 2014*)

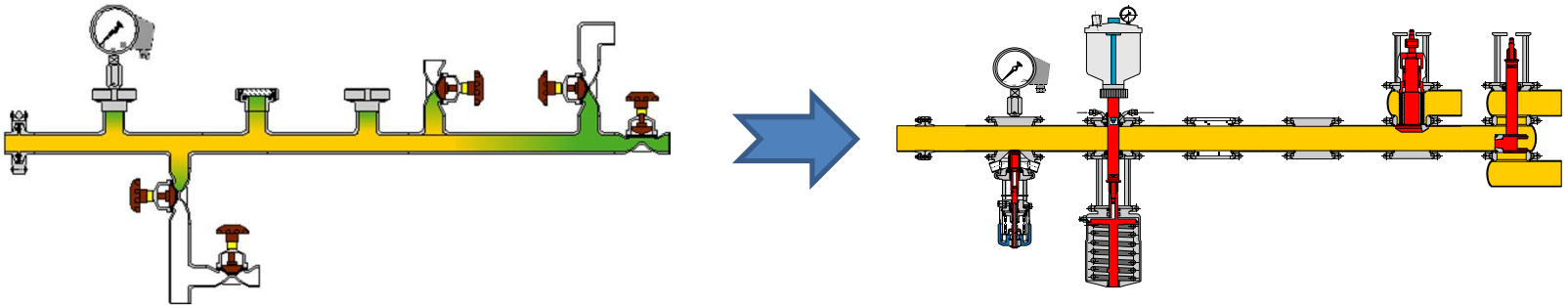
Closed equipment

The cleaning process is essential for the food safety and is often a CCP of the production process. It can consume up to 70% of the total water consumption and water treatment

Clean-in-place (CIP) systems were developed by the dairy industry as a means of reducing the amount of labor needed for cleaning and sanitizing operations.

One of the main advantages of CIP systems is that they can recirculate and allow the reuse of chemicals and rinse water, thereby **reducing consumption by as much as 50%**.

Improving the hygienic design of equipment equipped with CIP and **completely avoiding crevices, gaps and dead spaces** (with particular reference to pipe, valves and sensor connections),



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the time of cleaning may also be reduced by more than 70%, with corresponding savings:

- increased productive time
- reduced chemicals and additives
- reduced power, steam and fuel consumption
- reduced water and water treatment costs

So that pay-off time in a dairy plant can be a few days

(*Lorenzen K., EHEDG. Potential Savings in CIP of Food Production Plants through Hygienic Design*)

Open equipment

In this equipment the cleaning is very laborious also because, generally using water and solutions in pressure, splashing contaminates surfaces originally clean.

Open equipment could be redesigned by applying the **principle of zoning**.

- Limit with shielding surfaces that necessarily come in contact with the product during the production,
- For cleaning operations close the soiled area with a movable shell equipped for CIP

The introduction of the CIP, drastically reducing the variability of the manual operations, more adequately would ensure the effectiveness of the cleaning and disinfection process.

A particular case is constituted by the **cooling equipment**, in which typically the air cooling group is not designed to be cleaned, even if promotes the growth of psychrotrophic microorganisms such as *Listeria monocytogenes*.

In this case, with particular reference to ready-to-eat chilled foods, the application of zoning with CIP would respond primarily to a food safety requirement

Further improvement of the CIP efficiency

Dry pre-cleaning (vacuum or compressed air jets and/or dry ice) with **direct recovery** of the food product

Treatment of washing water with membrane, to allow **recycling**

Detergents that can be easily **controlled** and **recycled** (NaOH and HNO_3)

Disinfectants compatible with **reuse** of water (Ozone)

In general is necessary a holistic approach

Reduce the wash water, detergents and chemical disinfectants:
- minimizing fouling
- not spreading product residue during the same cleaning
- dry pre-cleaning, with direct recovery of the product

Reuse product residue, chemical agents and rinsing water:
- with the hygienic recovery of product residue from the wash water
- with the selective recovery of cleaning and disinfectant solutions
- with the reuse of final rinse water for initial washing

Recycle water from the sewage treatment plant:
- directly, for uses which do not require drinking water
- after it is made drinkable, for rinsing product contact surfaces

Thank you for your attention

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