How important is cleaning for successful plant hygiene in food processing plants?

Cleaning assumes a key role in the obligatory hygiene measures performed in food processing plants and it cannot be substituted by disinfecting alone. The German standard DIN 10516 (Food Hygiene – Cleaning and Disinfection) describes cleaning as an operation in which undesirable substances are removed from surfaces of rooms, devices and equipment. These undesirable substances include food residues, microorganisms, and other contaminations such as allergens or chemical residues. The legislator has focused on avoiding adverse sensory, spoilage-causing or even pathogenic germ flora and thus on protecting consumers. Furthermore, process-relevant factors in connection with cleaning are also significant for production plants. For example, regular and correctly performed cleaning protects machinery and equipment for instance against corrosion or the deterioration in efficiency that always occurs when heart-exchanging systems develop a coating. Cleaning adapted to cope with the residue and process situation helps plants to tackle economic and environmental issues purposively.

Cleaning – Removal of undesirable substances prior to disinfecting

In food processing plants where organic residue levels are high, special attention is paid to thorough cleaning before performing disinfecting. Cleaning and disinfecting are carried out in separate steps in the majority of cases, as food producers know that even slight residual germ counts remaining on the surfaces after cleaning measures or entering facilities via rinsing water or the atmosphere can lead to swift re-contamination. This risk is always high when residues are not successfully removed prior to the disinfecting operation.

Microorganisms love moist-warm surfaces contaminated with organic residues, such as occur in many areas of food processing. Bacteria such as *Escherichia coli* can reproduce every 20 minutes under ideal conditions. This supposedly moderate reproduction appears as an exponential growth explosion when examined more closely. Impressive scenarios can be developed on the basis of theoretical calculations. For example, assuming that a bacterium weighs $0.000000000000045$ g (= 0.45 pg), a biomass of $10^{25}$ metric tons (a one with 25 zeros!) would result already after just 48 hours. The fact that this does not in fact happen in food plants is due to the shortage of back-up nutrition supplies.

In this connection, the cleaning step has the key task of removing organic and mineral residues and thus withdrawing the nutrient base from microorganisms. Not least for this reason, systematic cleaning is an indispensable requirement for maintaining hygiene in food plants. The large number of hygiene measures that are determined and specified within the context of internal risk analyses form an integral constituent part of modern quality assurance systems.
Example of classification of common cleaning and disinfecting active ingredients for the food processing industry

Since organic residues represent a risk for potential formation of critical biomass as described above, it is advisable to carry out the cleaning measures thoroughly and systematically, using appropriate cleaning agents and processes. Prior to disinfecting, the cleaned surfaces should be examined carefully for cleanliness and re-cleaned as needed. Generally a visual inspection is sufficient here. Depending on requirements, various test methods are available for checking cleaning results and can be used as needed to verify cleaning.

Thorough cleaning is necessary wherever dirt residues exist in order to avoid possible reductions in the efficiency of disinfecting agents. Just how great the influence of residues is de-
pends on the nature of the residues, their volume, and above all the nature of the active in-
gredient in the disinfectant. It is possible that microbicidal active ingredients might then no
longer be completely available to kill off existing germ flora. Moreover, microorganisms locat-
ed underneath coatings are also "safe" from the influence of disinfecting agents.

Cleaning agents – Nature and function of the active ingredients

High-grade modern cleaning agents for safe removal of residues are made up of a number of
different ingredients. Thousands of different active agents are available for this. The above
Table shows a selection with a rough classification of various active ingredients.

The characteristic of a cleaning agent is defined by its pH-value. An alkaline base is to be
selected for removing organic residues, while an acid cleaning agent is used to detach min-
eral residues. However, if users limit their vision to this property alone when selecting a
cleaning agent, they disregard the fact that a large number of further ingredients are indis-
pensable for successful cleaning. For reasons of supposed savings in cleaning agent costs,
it might be decided to use cleaning agents that contain only few or no other cleaning support
substances apart from the alkali or acid medium. In these cases and where only alkaline
(e.g. caustic soda) or acid (e.g. nitric acid) media are used, it happens not seldom in practice
that considerable residue and quality problems result in finished products. A representative report of a hygiene audit carried out on a food processing machine states in this connection: "...Condition after dismantling: tank interior with distinct coating and tide marks...; ...surfaces feel roughened...; ...apparently well-cleaned surfaces display brownish-black discoloring that show up particularly well on swab material..." As described above, such a residue situation after cleaning leads sooner or later to microbiological and/or process-technological problems.

In order to prevent this, different active ingredients are added to the cleaning agents depending on their specific purpose. For example, surfactants moisten, diffuse, improve the reachability of residues and dissolve oils and greases. Sequestering agents avoid the formation of mineral coatings (crystal formation) during alkaline cleaning and in connection with other active ingredients they reinforce the cleaning performance. Builders keep detached residues in suspension and prevent them from being deposited elsewhere. They also boost cleaning in combination with appropriate active ingredients. Complexing agents detach mineral and organic constituents and reinforce protein removal. Oxidizing agents improve solubility by oxidizing the residues chemically and thus making them more easily soluble. The combination of expedient active agents based on the know-how of the cleaning agent manufacturer represents the value of a cleaning agent formulation and leads to permanently successful results.

Cleaning agents – Legal framework

Although cleaning agents for the food processing industry are not subject to any statutory licensing procedures, the legislator requires them to be toxicologically safe. For example, when examining and selecting active ingredients for cleaning agents at Ecolab, maximum care is paid to functional, environmental and toxicological properties. For many years now Ecolab has been actively involved as a member of the European Industrial Federation AISE (International Association for Soaps, Detergents and Maintenance Products) and the German Association of Hygiene and Surface Protection Industries IHO (Industrieverband Hygiene und Oberflächenschutz) as part of the German Chemical Industry Association VCI (Verband der Chemischen Industrie) and has always regarded it as perfectly natural to play an active role in facilitating laws and legal initiatives so that it can act in the interest of food processing plants. Ecolab naturally also addresses the consequences of the REACH legislation, partly also to ensure high-level performance features and future availability of high-grade cleaning formulations.

Summary

Successful cleaning is the prerequisite for achieving the necessary germ reductions during subsequent disinfecting of the cleaned surfaces. Furthermore, appropriate cleaning is indis-
Pensable for value and process conservation. Modern, tailored cleaning agents make it possible in many cases to adapt conventional cleaning methods in such a way that time, energy and water can be saved. These are cost benefits that more than justify the comparatively slight extra costs of advanced cleaning agents.

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