Hygienic design of enclosure boxes in relation to high pressure cleaning?

High-pressure cleaning has long been employed in the food and beverage industry. Food residues are removed from the soiled machinery and plant enclosures by mobile high-pressure cleaners working at up to 120 bar, using water and detergents. This report outlines the disadvantages that may still arise when using high-pressure cleaning equipment, and describes what alternative cleaning solutions look like in conjunction with hygienic design enclosures.

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The degrees of protection of enclosures from water are regulated in the European standard EN 60 529 (Protection Classes Provided by Enclosures). Point 6 (Protection from Water Jets) states that water directed at the enclosure in powerful jets from all directions must have no harmful effects. Compact enclosures with IP69K protection (water with high-pressure/steam-jet cleaning), in accordance with DIN 40 050, Part 9 (Road vehicles, IP Protection Categories, Protection against Foreign Bodies, Water and Contact; Electrical Equipment) are now also available. When water is directed against these enclosures from every direction under very high pressure, it must not have any adverse effects.

Figure 1. Hygienic design is a necessity for easy-to-clean production systems in hygiene-critical processes in the food industry.

The risks of high-pressure cleaning

Even though the use of high-pressure cleaning is recommended for cleaning road vehicles or machinery, as in the automobile industry, it is not necessarily of benefit to the food industry. Although it is perfectly possible to clean the equipment with that procedure, the risk is that either spray is forming that can lead to a micro-contamination and that dirt is spread to the adjacent, otherwise uncontaminated surroundings. The fact that liquid also can penetrate into the enclosure when using high-pressure liquid cleaners has to be tolerated to a certain extent. It thus remains the decision of the plant manufacturer to define the protected area in the enclosure. If neither buttons nor signal lamps have been installed in the enclosure door, and the manufacturer has restricted the size of the protected interior, water may be allowed to drop within the enclosure, behind the door. However, it must be ensured that that this has no adverse effect on the electrical equipment.

In terms of hygiene, however, the penetration of liquid into the enclosure is a very serious business (Figure 1). Where the slightest amount of moisture enters the enclosure, microorganisms such as bacteria, yeasts or moulds also may find their way inside. The heat dissipated from the controls, and so on, also substantially increases the risk of contamination within the enclosure. When opening the door for maintenance work or to alter a control function, the environment and the production area may easily become contaminated. Enclosure gaskets damaged by aggressive cleaning also can increase the risk of contamination of conventional enclosures. The penetration of fluids into the enclosures used in the food industry production environment must be avoided in all circumstances. The risks of contamination cannot be easily reduced through the use of high-pressure cleaners, as they are unable to prevent the harmful effects on electrical equipment defined by the EN 60 529 and DIN 40 050 standards.

If any parts do have to be cleaned by high-pressure methods in the food production plant, enclosures are available that ensure adherence to protection class IP69K. This can be done by attaching removable parts by multiple screws or by using a labyrinth seal in front of the gasket. With multiple screw joints, there is a risk that not all the screws will be tightened sufficiently during later service work and so the intended level of protection will no longer be ensured.

Dead spaces must be avoided

The labyrinth, a tortuous construction, protects the gasket from the sharp jet of water. However, the labyrinth gives rise to dead spaces, which have to be avoided at all costs.

DIN EN 1672-2 (General Design Principles and Guidelines for Hygienic Food Production Machinery, Part 2, Hygiene Requirements) demands the elimination of these dead spaces, except where it is technically impossible. The DIN EN ISO 14159 standard (Machine Safety – Hygiene Requirements Pertaining to the Design of Machinery) makes an even clearer demand: dead spaces must be avoided. In its Document 13 (Hygienic Design of Apparatus for Open Processes), the European Hygienic Engineering & Design Group (EHEDG) provides a great deal of unambiguous information on avoiding hollows, gaps and dead spaces.

Special gaskets make it possible

Today, effective cleaning can be accomplished with lower pressures, at 25 bar, for example. Thus, the penetration of water into the enclosure can be avoided by choosing the adequate IP66 protection class and by employing special gaskets, as well as by using a minimum number of lock or hinge points.

What is necessary is that suitable gaskets not only withstand pressure, but that they also remain stable over a long period in the face of cleaning agents and disinfectants. Practical experience shows that, over the long term, no gasket can stand up to alkalis and acids, which are highly aggressive in some cases. As a minimum, it should thus be easy to replace gaskets in the event of damage.

Figure 2. A special silicone seal assures a gap-free sealing of the enclosure that produces higher resistance to acids, alkaline solutions, detergents and disinfectants.

The original protection category guarantee must not be reduced by inserting the new gasket improperly. Welded gaskets are useful here. Unlike rolls of seals that are available by the metre, they avoid having the sealing strip being pulled during assembly, so causing subsequent gaps at the ends.

Cleaning hygienic design enclosures

Rittal's hygienically designed series of enclosures have sealing frames. Silicone is used in the seal, instead of polyurethane, as it is more is resistant to all kinds of detergents and disinfectants (Figure 2). Hygienic gaskets are coloured blue, so that they are immediately noticed in food production applications, important in the case of foreign bodies, which stand out and are thus are easily detected. The easily replaceable, outer silicone gasket ensures a gap-free seal. The sloping roof of the enclosure, which has a 30-degree gradient, also allows the water and detergents to drain off completely (Figure 3). With their residue-free cleaning, confirmed as effective by the Fraunhofer Institute following extensive comparative tests, the Rittal enclosures, designed for very high levels of cleanliness, make an active contribution to safety. They are effective in minimising the risk of cross-contamination in highly sensitive food production applications.

Figure 3. A chamfered edge fold prevents liquids from accumulating. The hinges are located inside the enclosure.

Conclusion

Easy-to-perform cleaning and disinfection procedures at low pressures and hygiene-friendly production systems offer major advantages over high-pressure cleaning. This allows the processors of meat or poultry, fish and delicatessen products, frozen and convenience meals, bakery products and confectionery, as well as the bottling and beverage industry – in coordination with the health regulators –to achieve top results and meet demanding quality and environmental requirements.