Sprinkler challenges in the food industry

The food industry has many high value sites that need sprinkler protection but as Ronald Oldengarm and Johan Hoogeweg remind us, combinations of cold temperatures and hygiene requirements bring their own specific challenges.

One of the sectors currently under a magnifying glass with insurers and customers is the food processing and handling industry. Fires in these types of buildings can have a major impact on the delivery of food to consumers. In recent years there have been several fires in food factories that have led to empty shelves in supermarkets.

At the same time, a market trend in recent years has been a consolidation of production sites. Small sites are being closed and existing sites are being expanded to create 'mega' factories. Therefore, the consequences of a fire in this type of building can be significant for both the business owner and the customers. To ensure business continuity and from the perspective of insurability, the presence of a sprinkler system is increasingly required.

Dividing large production locations into small fire compartments, as often required by building regulations, is often not possible or desirable. Think of the transport systems present and the desire to create large open spaces for processing and storage of goods. A sprinkler system can be part of an equivalent fire safety strategy.

Installing a sprinkler system in a food processing plant sounds simple, however there are more points to consider than you might think. In this article, we will zoom in on some common situations that require a lot of attention when installing a sprinkler system. We will use as an example a slaughterhouse where meat is processed into finished products for sale in supermarkets. For the sake of simplicity, we will also use EN 12845 as the sprinkler rule. There are other design standards such as published by the National Fire Protection Association (NFPA) or FM Global.

Hazard classification

One of the first points to address when designing a sprinkler system is to determine the design criteria – which hazard class is applicable?

Appendix A of EN 12845 [1] indicates the hazard class for many occupancies. Table 1 shows an example of the hazard classification based on this Annex.

Ordinary hazard group 2 (OH2)	Ordinary hazard group 3 (OH3)
Abattoirs, meat factories	Dehydrated vegetable and soup factories
Bakeries	Sugar factories
Biscuit factories	
Chocolate factories	

Table 1: hazard classification (EN 12845: Table A.2 — Ordinary Hazard occupancies)

Using this annex the building falls under the description "Abattoirs, meat factories" and will be classified as an 'Ordinary hazard group 2' risk. A frequent mistake is to automatically declare this classification as suitable for the entire object. Of course, there are areas that fall within this class. However, if we make a proper analysis of the use and associated fire behaviour of the

Figure 1: storage of empty crates e.g. " Dolav"

materials and processes present in the building, we often conclude that in some areas a different hazard class is required. For example, take an area where large pieces of meat are cut into small pieces. The activity itself falls within an OH2 class but the stacks of plastic crates or pallets used to store the products mean a higher hazard class should be applied, at least OH3 depending on the stack height. Local storage of packing materials like foam meat trays and foils can similarly lead to a higher hazard class. There are also areas where empty plastic crates are stored on the floor, see figure 1. These fall into a much higher hazard class.

It is possible that EN 12845[1] does not give guidance on how to protect a certain situation. For example the storage of plastic pallets over 3 metres high in areas with a ceiling height over 7.6 metres is not covered. It is then sometimes possible to achieve suitable protection by using other design standards such as NFPA 13 or the FM data sheets. The use of these design standards must be accepted by all parties involved.

Incorrectly determining the hazard class can have major consequences later. The sprinkler system will have insufficient capacity to control the fire so the usage must be adjusted to what the sprinklers can protect. This can have far-reaching consequences for the usability of the building.

Food safety

If there is one aspect that is important in this type of building it is food safety. For the users this often even takes precedence over fire safety. A sprinkler system must therefore be suitable for use in an environment where there are high demands regarding food safety. Some aspects to take into consideration are:

Glass bulb sprinklers: The use of glass bulb sprinkler heads is something about which people are very wary. Although the chance of a sprinkler bulb spontaneously breaking is very small a head can always be broken during work activities. Just the idea that glass could

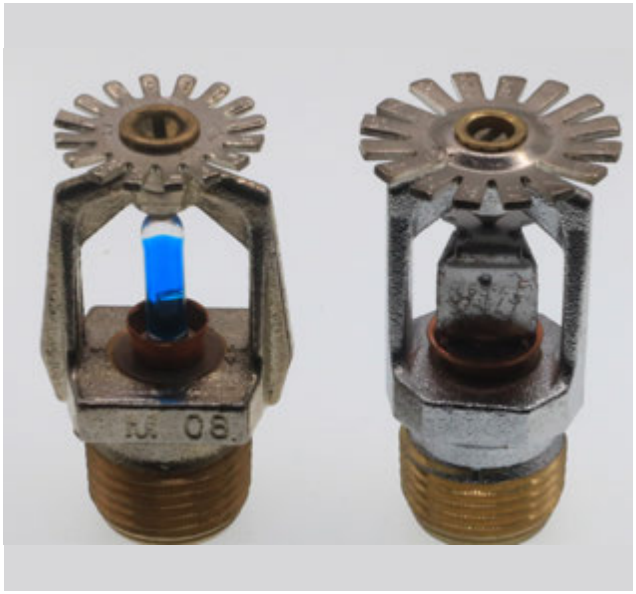

Figure 2: Left glass bulb sprinkler head, right all-metal sprinkler head.

be released, which is then very difficult to retrieve and detect (very small pieces) is a nightmare scenario for many users in the food sector. The use of all-metal fusible link sprinklers is then a good solution, because metal is easier to detect, see figure 2 for an example. Metal, fusible link sprinklers are almost always used in food processing facilities.

Cleaning: From a food safety perspective, rooms and facilities must be cleaned regularly. Aggressive cleaning agents are often used for this purpose. The need for piping systems, including hanging and bracing, that are resistant to corrosive cleaning agents often in practice results in the application of stainless-steel pipes. It is important that the cleaning agents used are compatible with the materials used. For example, cleaning agents based on chlorides can lead to corrosion problems with stainless steel.

Figure 3: corrosion due to cleaning agents

System type	Cooling	Stainless steel piping	'no glass'	Cleaning with chemicals	Cleaning with Steam >100 oC activation temperature
Wet pipe	No	Possible	Possible	Possible (1)	Possible
Dry pipe	Yes	Possible	Possible	Not possible (2)	Possible
	Yes	Possible	Not possible	Possible	Possible
Anti-freeze	Yes	Possible	Possible	Pssoble (1)	Possible

Table 2: Matrix of options (1) Use stainless steel pendent sprinklers
(2) No upright stainless-steel sprinklers are currently available on the market.

To ensure the long-term proper functioning of a sprinkler head it must be resistant to the cleaning agents used. Figure 3 shows an example of an indicative test of a sprinkler head where a cleaning agent caused heavy corrosion after a period of four weeks.

Steam is often used in cleaning. This should be taken into account when determining the activation temperature of the sprinkler, which should be above 100°C.

Cooling: To maintain food freshness the rooms are actively cooled. The temperatures can drop locally below 4 °C. Additional measures are then required to prevent damage from freezing in the pipe network. Possible solutions to prevent freezing of pipes include the use of:

- dry-pipe systems, with upright sprinklers
- pre-action systems, with upright sprinklers
- anti-freeze systems, with food-safe anti-freeze for small areas
- insulation and heat-tracing of pipes

The latter option is often undesirable from a hygienic point of view and is also inappropriate for a sustainable building because the pipes are permanently heated to prevent freezing.

High airflows can also impact the effectiveness of the sprinkler system.

Sprinkler system design

The above issues are easy to solve as individual challenges. It only starts to get interesting when more than one of them occur together.

In Table 2 some different options are put together in a matrix.

The above table shows it is possible to achieve a sustainable and reliable system for many combinations of challenges. The difficulty arises when a dry-pipe system is required, there is a demand for high corrosion resistance of the applied heads and there is a 'no glass' requirement. Stainless-steel sprinkler heads that have a very high resistance to corrosion are currently only available in a pendent variant. Also K-factors above 115 are not available in stainless steel.

Each situation must be carefully examined to determine the best option. The conclusion can be that replacement of parts, such as sprinkler heads, must take place more often than usual.

Last but not least

Providing adequate sprinkler protection in buildings where food is processed requires a lot of attention; there must be a good understanding of:

- the use of the building
- the room conditions such as temperature and air velocity
- the method of cleaning

This requires proper consultation with all the parties involved and choosing the right technical solutions. Sometimes it has to be admitted that not everything can be solved perfectly.

1 EN 12845 Fixed firefighting systems - Automatic sprinkler systems - Design, installation and maintenance: 2015