Water savings and food safety challenges in drain design

The food and beverage processing industries exert a stringent set of demands on manufacturers of drainage systems. Not only should the system deliver the highest level of hygiene and remove the risk of contamination by preventing harbourage of bacteria, eliminating standing water and removing solid waste, it should also operate efficiently and effectively using as little water as possible.

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Significant reductions in water use during food production have been an industry target for the last few years and have been effective at delivering major cost savings on processing and cleaning water. New-build production facilities and the installation of new equipment offer excellent opportunities to reconfigure drainage solutions to meet these new demands, but what of existing facilities? It makes no economic sense to reduce the water volumes used in processing if more water and time are then required for washing off. Simply flushing drains, gulleys and channels with sufficient water is no longer a valid option, and new thinking within the field of drainage design is required.

The water trap is the heart of drain

The reduced water targets desired by the food industry have presented drainage designers and installers with a new challenge when it comes to the design of the water trap. Large volumes of water will effectively flush any trap clean, but qualities such as self-cleaning become particularly important in low-volume systems. Traps tested to EN 1253 standards indicate systems with a self-cleaning ability and comparable low-flow capacities.

In hygienic areas, it is important that the trap allows contaminated water to drain out of the bowl during cleaning. This is assisted by the presence of removable traps, which typically consist of two parts that are separable for cleaning. Traditional removable water traps have a seal under the waterline, which has a tendency to leak over time as a result of daily use. Recent designs in water traps retain the water in a pocket sealed above the water line, which avoids the risk of the trap running dry due to seal failure and thus provides a more robust solution.

The removable water trap also is integral to allowing free access to the piping system to clear blockages. Importantly, this enables hygienic food processing areas to avoid the need for traditional cleaning wells.

Figure 1. The sealed pocket over the water level in a removable water trap prevents seal failure.

Eradicate crevices, prevent bacteria buildup

It is well known that crevices should be avoided in hygiene critical areas because they are damp, humid and harbour unhygienic waste, allowing bacteria to colonise rapidly even after the cleaning process (Figure 2). Mesh grating has been widely used in food industry facilities for years but the grate joints are not welded and their many crevices cause them to be unhygienic. For example, a grating for a large drain could have around 100 non-welded joints, with each of them harbouring bacteria. This level of contamination demands much more effort in cleaning, but will still result in a lower level of hygiene compliance.

Tests conducted by the independent DTU laboratories in Kolding, Denmark – a European Hygienic Engineering & Design Group (EHEDG)-approved test institute – compared mesh grating with other grating designs to evaluate the bacteria load after cleaning. Under defined conditions, each grate was soiled and then cleaned equally. The mesh grating was shown to have more than eight times more bacteria on the surface than the best grating design in the test.

Figure 2. As shown, a cast stainless steel grating design eliminates the areas where bacteria can hide and aids cleaning due to its rounded design. The open sides further allow easy access to the drain for solid waste, keeping the floor safe and clean.

Dealing with solid waste

In facilities where solid waste rapidly accumulates, such as meat, fish, fruit and vegetable processing areas, the challenge is to transport the solid waste into the drainage system and then through the channel to the filter basket at the outlet, while still using lower water volumes. In many cases, the filter basket is the limiting factor to drainage flow in areas of high solid waste, typically because the initial drainage design phase did not anticipate the large volumes of solid waste that would be generated. As a result, filter baskets are often too small and require more frequent emptying during production. If emptying is not frequently undertaken, it could lead to contaminated water accumulating on the floor during production time.

It is recommended that any new build or retrofit should evaluate the potential volume of waste and calculate the size of filter baskets while allowing for sufficient overflow to accommodate a full shift. In existing facilities with under-dimensioned filter baskets, however, it is still possible to install retrofit systems without any extra civil engineering work.

Designers also are focusing on the channel profile, because box channels are hygienic but not very good for transporting solid waste, while slot channels do not offer a good hygienic solution. New profile designs have been shown to improve the transport of solid waste with reduced water flows, and considerable effort is being made to find a solution that will meet the required hygiene levels of the food industry.

Contaminated water collects around drains and channels

Drainage is always located at the lowest point in the floor, so it is important that the connection between the floor and the drainage system is safe and watertight, and without crevices where contaminated water or solids can accumulate (Figure 3). The major risk for these connections comes from the stresses caused by wheeled transport and large temperature deviations. It is particularly important to protect the edge against horizontal stress. An edge just one micron higher than the surrounding floor increases the risk of crevices considerably and raises the corresponding contamination risk. To secure these long edges against crevices, it is recommended that a flexible sealant is used between channel and floor, cross bars are inserted in the channels and, angle bars are used to fasten the channel in concrete. In addition, the channel should also be constructed in 2-mm gauge stainless steel, and the outer frame stabilized by backfilling with hardened epoxy resin.

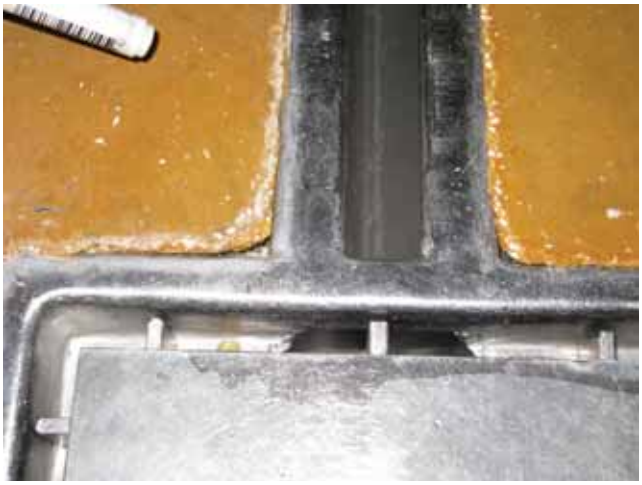

Figure 3. Sharp angles and a lack of flexible sealant where the resin floor meets the channel create crevices that can retain contaminated water.

When installing drains, round drains are generally used for resin floors while tiled floor drains are generally square and secured by an epoxy resin backfilled outer frame. A flexible sealant is recommended for use, especially in hot water areas.

Production plant managers can influence the drain issue by designating movements of internally controlled wheeled transport so that they do not ingress over channels and drains, and by ensuring water is led directly to drains via piping and not left to flood over the floor first.

Clogging, corrosion and collapse in pipes causes issues

Contaminated water on the floor can also be caused by the clogging of pipes. However, modern designs of drainage systems are making cleaning more effective. Removable water traps open the access to the drain while drainage-shaped fittings with soft 45° bends and branches allow the clearance of even the most clogged pipe (Figure 4).

Drainage piping exposed to very hot clean-in-place (CIP) water is liable to corrode or soften over time, leading to water pollution of the subsurface and a reduction in drainage flow, which can leave contaminated water on the facility floor and poses an economic and hygiene risk that can close production down. A stainless-steel drainage piping system reduces the risk of such situations, because it retains its shape under stress and extreme hot and cold temperatures, and with smooth internal surfaces, no corrosion and no collapse, the likelihood of blocked or clogged drains is much reduced.

Figure 4. Designing drainage piping with soft 45° bends makes clogging less likely and cleaning easier.

R&D helping the food industry to improve hygiene

Both multinational and smaller food producers are seeking to update their internal drainage systems with solutions that not only deliver higher hygiene benefits but also the daily savings offered by the ease of cleaning, the options for conserving water, and the easy access for solid waste to enter the drain. But designing to meet the new drainage and water saving challenges within the food industry requires an understanding of the key processes and issues. Professional drainage suppliers need to recognise that meat, fish and dairy processors, dry product manufacturers, and the various segments of the beverage industry each pose very different challenges when it comes to drainage.