White Paper

Reliable Floor Drainage Connections

August 2020

BUILDING TRUST

DOES A RELIABLE FLOOR DRAINAGE CONNECTION EXIST?

Ideal example of floor drainage connection

Fast moving developments in hygienic resinous flooring and drainage systems are needed to meet the challenging environments present in today's food and beverage manufacturing industry. Individual systems are required to carefully balance a facility's varying and unique requirements of safety, hygiene and intended use. As with other elements of a processing factory's infrastructure, flooring and drainage systems can affect each other's performance. For example, if the connection between the two is failing then the performance of both flooring and drainage can be compromised.

Until now, no proper study or research has taken place to investigate the behavior of common floor drainage connections and develop a precise design guideline. As a result, Sika, the world's largest manufacturer of resinous flooring, and ACO, a leader in the development and manufacture of hygienic drainage systems, joined forces and adopted a professional and scientific approach to this issue. A three-year study and research program was commissioned to establish clear evidence-based guidance with regard to floor drainage connections for food and beverage processing facilities.

THE INDUSTRIAL FLOOR

Floor construction must meet several requirements with regard to safety and hygiene. The main requirements are water-tightness, easy cleanability and high levels of resistance to common cleaning chemicals, dynamic impacts and thermal stress. The floor's surface must also be slip resistant to minimize the likelihood of a slip accident occurring in the workplace. During its lifetime, the floor will be exposed to a variety of elements that are potentially damaging including hot oils, acidic solutions and organic substances like fat and blood. In addition, the floor will have to withstand cleaning and washing with hot steam and aggressive detergents. The ability of a floor to resist these factors is a critical consideration.

Items which are placed on, installed in or retrofitted into a floor such as machinery, trays and drainage can also increase the potential for flooring defects to occur. The drainage specification must be considered to align with the type of floor selected and its physical properties. There are numerous varieties of flooring types available and flooring comes in a wide range of different thicknesses. Every facility floor has a unique operating environment and while the root cause of some defects may be similar, they may also manifest themselves in dissimilar fashions. For instance, blistering of the floor coating can be attributed to moisture migrating through the substrate or to the use of an incorrect primer during installation.

Cracks

Slab uplift

Delamination

Dissolution and dispersion

Other water damage

The most common causes of floor defects are incorrect drainage specification or failure to consider specific environmental conditions.

THE KEY POINTS

Flaws in the floor drainage connection

The harsh manufacturing environment in the food and beverage industry poses significant stresses on the building envelope. This is especially true when it comes to resinous flooring and stainless steel drainage systems, which form an integral part of a factory floor. Failure in the floor or drain systems will lead to downtime in the production process and, potentially, increasing costs. Today, specially developed resinous flooring and stainless steel drainage solutions for the food and beverage processing industry can withstand mechanical, chemical and thermal stresses. However, even when flooring and drainage systems are working well, failure often occurs in the connection between the two. It appears that no research or testing has taken place on this subject let alone the publication of clear guidance.

RELEVANCE TO THE FOOD AND BEVERAGE INDUSTRY

Total cost of ownership is one of the main concerns for the food and beverage manufacturing industry, impacting many areas of the overall production process. This concept also includes the building envelope and is particularly true for factory floors, which are exposed to severe operating conditions. Production facilities also must adhere to a growing number of legislative regulations and requirements which are enforced by federal, state and local authorities. Hence, failure in a factory floor causes disruption to factory operations as well as compromising hygiene. This failure leads to downtime and the costs associated with it.

In order to avoid downtime, resinous flooring systems and hygienically designed drainage systems should be carefully selected for the different production areas with reference to the appropriate guidelines, research and testing results. As no guidelines currently exist in this regard, factory site operators currently have no option but to use trial and error when selecting flooring and drainage systems.

SCOPE AND OBJECTIVE OF RESEARCH

Being confronted on a daily basis by issues caused by floor drainage connections in food and beverage production facilities, ACO and Sika decided to join forces and commission a research and testing program. The objective was to provide a simple guideline for the specification and installation of an effective connection between Sika resinous flooring and ACO stainless steel drainage systems. There is a complex range of potential installation scenarios. ACO and Sika conducted research for the three main exposure scenarios that are most relevant to the food and beverage processing industry:

- Mechanical impact in areas experiencing heavy traffic from forklifts and pallet trucks
- Thermal shock from either the production process, i.e. wide temperature swings or subsequent high temperature/pressure cleaning
- Shrinkage of cementitious substrates as a result of natural aging of concrete, screeds and resin mortars

For each of these scenarios, testing equipment was developed to recreate the exposures to a high degree of accuracy.

Other requirements, such as aesthetics, hygiene, cleanability and easy installation have been taken into account for the design of the floor drainage connection. These requirements have an influence on the design of the floor-drainage connection, which was reflected in the various samples that were prepared and tested.

THE TESTING

The testing took place over 36 months and set out to determine the optimal floor-drainage connection for specific environments. The tests included various drainage edge types with several floor types, enabling the identification of the best possible floor drainage combinations.

MECHANICAL EXPOSURE TESTING

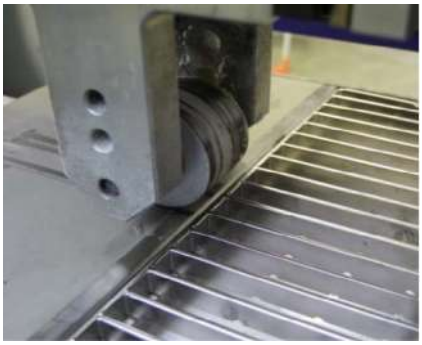
WSTEC rig developed for mechanical exposure testing

For the purposes of mechanical exposure testing, ACO developed a new testing rig. The testing rig is designed to determine the durability and resistance of grates, channels and their connection with floors which are exposed to dynamic loading. The rig enabled us to evaluate performance when different elements were exposed to loads generated by truck wheels commonly used by the food and beverage industry. The type of wheel, wheel loading and speed were varied during testing process.

TESTING PARAMETERS OF TESTING RIG

Test wheel diameter	82 mm
Test wheel width	60 mm
Test wheel profile	Flat, almost line contact with the floor
Travel speed of the wheel	750 mm/s
Vertical force	2000 N
Number of cycles in one direction	100,000 cycles

Wheel runs under load in one direction



Edge-floor connection testing via WSTEC testing rig

THERMAL EXPOSURE TESTING

For this type of test, a testing rig was developed that uses hot and cold water cycles. The hot and cold water circulates in samples of the installation channels which are housed in concrete blocks. Water circulates through the sample in predefined intervals. Hot water (195°F) is followed by cold water (59°F) with a one minute break in between each cycle.

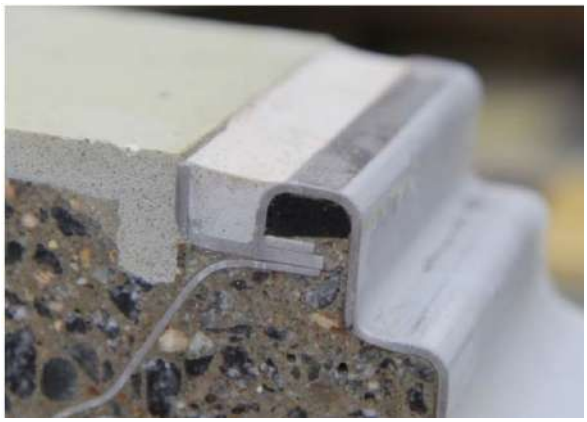
SHRINKAGE OF CEMENTITIOUS SUBSTRATES

Tensile strength testing

This test simulated a deformation from tensile strength. The tensile strength test machine has a graphic output which shows how the effect of the tensile force varies as the jaws of the machine are pulling away from each other. The first damage appeared six times in the middle of the sample at the narrowest point and once where the spigot is located.

This testing method proved that concrete can fail under the channel and around the drainage installation. The tests also proved that we can prevent concrete breakage under the channel by using various types of anchors and that ACO is able to design drainage to accommodate expansion grooves anywhere on the floor.

FLOOR-DRAINAGE CONNECTION TYPES (EDGE PROFILES)



Sample edge to floor connec-

- Standard edge connected directly to the floor
- Standard edge with flexible joint

For evaluation purposes, other connection types were also tested including different types of edge profiles and installations that lack a groove usually present at the floor drainage connection.

FLOOR TYPES

Testing sample

- Polyurethane - Sikafloor-315 N + Colored Quartz + Sikafloor 217

  Elastic and self-leveling system with textured surface providing excellent mechanical and chemical protection. Ideal for wet areas typically found in the food and beverage industry. Textured surface provides slip resistance while maintaining easy maintenance.

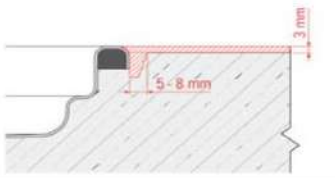
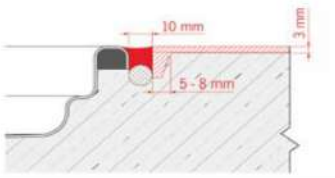
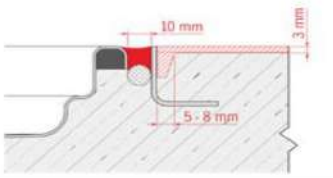
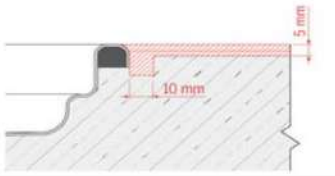
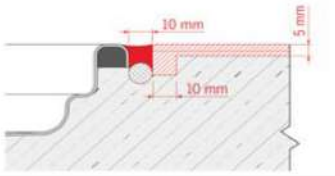
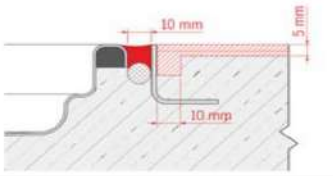
- Cementitious Urethane Slurry - Sikafloor-22 NA PurCem

  Self-leveling, solid color, three component, cementitious slurry designed to provide excellent resistance to abrasion, impact and chemical attack. It may be broadcast with colored quartz for a decorative finish.

The flooring samples were also subjected to water exposure for various time periods and the diameter of the wheel in the mechanical testing jig was altered to simulate changing conditions. .

RESULTS

The preliminary test results show promising outcomes with certain types of edge profiles. The research proved to be a valuable experiment that will establish a new way to design floor drainage connections. Choosing the right type of systems with respect to operating conditions and site traffic has always been a challenge and is turning out to be one of the key topics under review when undertaking a drainage assessment. As with any specialty design consideration, professional consultation and recommendations should be sought from manufacturers.

Floor type	Resistance to exposure scenarios[1)]		
	Standard edge connected directly to the floor - Resistant to dynamic stress (thermal load < +77°F) - For areas with heavy traffic **Typical applications**: - Warehouses - Corridors 	**Standard edge connected to the floor with flexible joint** - Resistant to temperature extremes by alternating hot and cold water **Typical applications**: - Cleaning in place (CIP) - Commercial kitchens 	**L shaped edge** - Resistant to both thermal and dynamic shocks **Typical applications**: - Beverage production - Packaging plants - Bottle washing facility 
Sikafloor- 315 N **+ Colored quartz** **+ Sikafloor-217**			
Sikafloor- 22 NA **PurCem**			

1) The results are according to a floor to drain connection testing carried out by ACO and SIKA

2) Testing was performed at the Institute Tazus, Brno, Czech Republic

LEGAL NOTE

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