Hygienic aspects of electrical installations in food factories

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Stringent standards - applied by regulators, retailers and the consumer public - are making stricter adherence to hygiene measures a necessity.

The purpose of the food processing industry is to produce safe wholesome food from specified raw materials. Consumers are very particular about what they eat and how it is produced. This has always been so but it is becoming more important in a world where less cooking is being done in the home and more processed foods are on offer. Consumers want tasty nutritious food - but they also want to know that what they are eating has been hygienically produced and is safe.

All the safety and quality regulations and standards that apply to other manufacturing industries apply equally to the food processing industry. In the same way that the OHS regulations and ISO 9000 [1] quality standards are applied to other industries, so also are they applied the food industry. In addition to this, food safety management programmes are required in food handling facilities to ensure production of safe food.

Most food safety management programmes today, (for instance the ISO 20000 standards [2]) incorporate the Hazard Analysis Critical Control Point (HACCP) system. This involves a systematic seven stage documented procedure for identifying the hazards and the points in the manufacture that must be controlled in order to minimise risk. These are the critical control points. In addition, the limits of control and methods of monitoring and recording the results are documented. In the production of drinking milk, the critical control point is the temperature of pasteurisation which is set at a minimum, generally 72°C, and controlled though a temperature sensor and a divert valve which returns any unpasteurised milk to the balance tank. A chart or electronic recorder maintains a record of the operation. The temperature of 72°C is sufficient to control the pathogens that might be present in the milk. A similar pasteurisation step for beer does not constitute a critical control point because no known pathogens are present in beer.

Every food safety management system also recognises that certain prerequisite programmes must be put in place prior to identifying hazards and implementing HACCP. These include, amongst others, pest control, recall procedures, training – as well as the hygienic design of buildings and equipment.

Indeed, the hygienic aspects of agro-processing machinery are regulated in the European Union as a part of the machinery directives. Although the hygienic design of food processing machinery is not regulated in South Africa, the design of both buildings and equipment for food processing is included in South African voluntary standards (SANS 10049 [3] and SANS/ISO 14159 [4]). Minimum standards for food handling premises and utensils are regulated in terms of the Foodstuffs, Cosmetics and Disinfectants Act (Regulation 962 under Act 54 of 1972.)

Those areas of the plant which come into contact with the product are the most important. Other areas such as the splash areas, which as the name implies are areas which the food might contact due to splash or spillage, and the non contact areas, are also important because they can become breeding grounds for micro organisms.

Although hygienic design is important in all sectors, the food industry also identifies high risk areas. These are areas where food is particularly at risk, for instance the preparation areas for frozen pre-cooked ready meals - such food is going to be consumed without any further opportunity to control pathogenic organisms that might contaminate it. The areas where the meals are assembled require special care. These areas will need measures such as defined entry procedures for personnel and materials, specific air handling procedures and temperature control.

The distribution of electricity and the use of electrical equipment are particularly important in high risk areas but are also important in other areas of the food factory. Because of the frequent cleaning required many food production plants tend to be wet. Electrical equipment in this case must be water-tight. Ingress of water would not only be dangerous and cause damage to the electrical components, it could also carry micro-organisms with it. In the warm conditions found within electrical enclosures, breeding of such organisms is likely and will result in recontamination of the areas outside the enclosure.

In certain processes such as the production of milk powders, starch or flour milling, both dust and the risk of explosion are prevalent.
Control instrumentation which comes into contact with the food product must be hygienically designed.

Some general guidelines for hygienic electrical installations are given below.

**Materials of construction**

Stainless steel is the material of choice for food process installations. It is durable, smooth and cleanable. The grades used for contact parts in most food applications are the austenitic grades 304 and 316. Other grades such as 3Cr12 may be used in non contact areas.

Other construction metals are generally less suitable in food factories. Aluminium, for instance, is subject to attack by most of the commonly used sanitisers. Galvanising and painting may provide a measure of protection but coatings are subject to flaking and peeling.

**Control panels and distribution boxes**

As indicated, stainless steel is the preferred construction material, particularly in wet areas. Panels should be water-tight. The top surface of the panel should be sloped at 30° rather than flat to prevent, as far as possible, dust or moisture remaining on the surface. Unfortunately standard or off the shelf enclosures which are usually the cheaper option are supplied with flat tops.

Where enclosures are fixed to a wall they should either be mounted flush with the area between the back or the panel and the wall sealed with a silicon or similar material or they should be mounted away from the wall at a sufficient distance to allow cleaning in the space behind the panel. The general rule for equipment installation is that either sufficient space must be left around the piece of equipment for cleaning or the area around the equipment must be completely sealed off.

Where push buttons or instruments are mounted on control panels these should be of a hygienic design. Anti-microbial push buttons are available commercially.

**Electric motors**

Electric motors used in the food industry should be to a minimum IP55 classification. It has been common practice in the food industry to shroud electric motors, particularly those used on pumps, with a stainless steel cover. Where this is done the covers should be easily removable to allow cleaning of the motor. This cleaning is important because the warm area around motors provides a breeding ground for pests.

Electric motors constructed in stainless steel and suitable for wet operation are now available and may be used where budget permits. Where electric motors or geared drives are used, care should be taken that condensation from the surface of the motor or oil from the gear drive will not contaminate the product. Drives on top-entry agitators in tanks and drives of belt conveyers require care in this regard.

**Distribution**

Over short runs distribution cables may be run inside the conduit. In the food industry it is common practice to use a stainless steel tube to carry cables. The tube must be sealed at each end to prevent ingress of pests.

Over longer distances stainless steel wire trays should be used. Cables should not be bundled - but rather mounted individually so that the area between them can be cleaned. Trays should be mounted vertically rather than horizontally to prevent accumulation of dirt. If space does not allow a vertical mounting then cable trays should be...
mounted at an angle of 45°. Where a cable tray is mounted on a wall, a space should be left behind the tray for cleaning.

Where practical, cable runs outside of the food processing area are recommended. This is particularly applicable to high risk areas where the processing area is established with a ‘box’ constructed with hygienic panels. If the cable runs are mounted on the ceiling, individual power or instrument cables and pneumatic distribution pipes can be introduced vertically in stainless steel conduits. Care must be taken to seal such conduits to the ceiling panels to prevent ingress of dust into the processing room.

Condensation of water vapour is of concern in factories where cooking processes are prevalent. Cable runs should avoid areas where condensation will occur.

**Lighting**

The importance of good lighting design common to all industries is also applicable to the food industry. The areas where visual inspection of the food product takes place are particularly important. For general operations, 220 lux is recommended and for places where the examination of the food products takes place, 550 lux is recommended. It is important that illumination does not significantly alter the colour of food products being examined.

Experts in the food industry are divided on the use of natural light in food industry operations. On the one hand the use of glass for windows introduces the risk of breakage and product contamination with glass fragments. All food factories should have a glass inspection routine. The absence of glass windows eases the burden of inspection.

On the other hand it is felt that the glass can be suitably protected and that the use of natural light provides energy saving. Many food factories rely on artificial light.

Armatures must be provided with protective plastic covers to prevent product contamination in case of breakage.

Positioning of light fittings should take cognisance of the fact that cleaning and maintenance will be required. The positioning of equipment in food processing lines can make it difficult to access armatures.

**Instrumentation**

Controls in the food contact area and in the splash area must be hygienically designed. This applies to devices such as pressure gauges or temperature gauges in pipelines as well and level measuring instruments installed in the domes of tanks. Tees in pipelines make for dead spaces that are difficult to clean particularly if they are deep. The best instrument connections are those where the instrument pocket or tee is flush with the pipeline. For food contact areas and for splash areas threaded connections of the BSP or NPT patterns or flanges should be avoided. It is not possible to keep these clean. Hygienic pipe unions used in the food industry may be modified to fit the instrumentation. The electrical engineer should establish from the process engineer which union pattern is standard for the plant in question. There are several different standards currently in use in South Africa.

**Conclusion**

Unfortunately, sound hygienic engineering can add significantly to project cost. More stringent standards being applied by regulators, retailers and the consumer public are, however, making stricter adherence to hygiene measures a necessity. This is a brief summary of some of the requirements. More detail is available in the bibliography and references.

**References**

[1] ISO 9000. The ISO 9000 family addresses various aspects of quality management and contains some of ISO’s best known standards. The standards provide guidance and tools for companies and organisations who want to ensure that their products and services consistently meet customer’s requirements, and that quality is consistently improved.


**Bibliography**
