ASSESSMENT METHOD FOR HYGIENIC DESIGN IN FOOD INDUSTRY. WATER DRAINAGE AND WATER SAVING STUDY CASE

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Abstract: *The new trends in consumer asking — staring from minimally processed and reduced additive/preservative foods, to pre-prepared ready-to-eat/ready-to-cook food—are placing enormous pressures on all food producers, not only to innovate but to remain on top of food safety challenges. Food producers must be sure that their products are protected throughout production by restricting access and controlling conditions for survival of microorganisms, foreign bodies, pests, and chemical contaminants such as lubricants or biocides. This paper presents the assessment method used by EHEDG (European Hygienic Engineering and Design Group) and some results obtained, as study case for Water drainage and water saving study case. By using hygienic designed equipment and hygienic facility design into the operation at the same level of importance as Good Manufacturing Practices (GMPs) and Hazard Analysis and Critical Control Point (HACCP) programs, food manufacturers not only significantly reduce potential food safety hazards but can obtain energy, water, and cost-savings.*

Keywords: *assessment method in food safety, hygienic design*

1. Introduction

For nearly 30 years, EHEDG has led the way in guiding the food industry in hygienic design solutions by offering practical guidelines, test procedures, training and education. To develop a comprehensive food production hygiene toolkit, EHEDG garners knowledge from the practical experience of food and beverage processors, the technical expertise of equipment and component manufacturers, and the scientific findings of respected academic and research institutes. This information translates into EHEDG's best practices resource portfolio that includes industry guidelines, hygienic equipment certification, and training workshops.

EHEDG provides food manufacturers with science-based but practically oriented guidelines and other resources for applying hygienic design and engineering principles in their plants.

2. Method for evaluation

During last decades EHEDG developed o series of test methods, in order to evaluate hygienic and aseptic appropriateness for equipment. These are not intended to indicate performance in specific applications. The results of these tests provide documentation and guidance on the selection of hygienic and/or aseptic equipment. The onus still rests with the food manufacturer to develop suitable cleaning regimes particular to a process.

Current test methods include:

- In-place cleanability of small and moderately sized closed equipment
- Steam sterilisability
- Bacteria tightness

  The list of institutes and organisations which are authorised by EHEDG to test and certify equipment by the use of the EHEDG logo can be found here: https://www.ehedg.org/testing-certification/test-certification-institutes/

Both open and closed equipment used in food processing environments can be certified. EHEDG maintains a list of all equipment that has been certified. Although there are no limitations on the complexity of the piece of equipment, typically only small, individual components are certified rather than large, complex machines or processing systems.

For certification of open equipment, ALL equipment surfaces are evaluated as product contact surfaces and must meet all hygienic design criteria in relevant EHEDG guidelines.

Currently, only closed equipment with pipe connections between 25 mm O.D. and 75 mm O.D. can be tested due to limitations of CIP testing.

In general, all sizes of the same piece of equipment must be evaluated with a design review and CIP tested prior to certification. However, in a few instances where equipment designs are considered completely scalable by an EHEDG Authorized Test Institute, testing of only one size can be used for certification of the entire range. In most instances, equipment is NOT completely scalable. Currently, the only alternative to testing each size is to perform computational fluid dynamics modeling (CFD) of the different designs to select the size for testing that may be the most difficult to clean based on wall shear stresses and fluid exchange in critical areas. If this characteristic size passes CIP testing, the sizes with higher wall shear stresses and fluid exchange in critical areas may also be considered for certification and listed on the same certificate**.**

All closed pieces of equipment which are installed in a pipeline, e.g. pumps, valves, and inline sensors, must be tested according to the method of EHEDG Doc. 2. This test is a screening test for hygienic design and identifies areas that may contain a crevice which can trap soil and microorganisms or are not easily cleaned due to the flow dynamics.

Closed equipment which fully comply with the hygienic design requirements can be certified without testing. Examples are pipe lines or pressure sensors without elastomeric seals.

The method of assessing the in-place cleanability of food processing equipment is described in EHEDG Document 2 published by EHEDG. The test method is used as a basic screening test for hygienic design. It is used to determine if areas (or features) within a piece of equipment are “easily cleanable” by comparing the test results to that of a standard reference pipe soiled and cleaned during the same test. Due to inherent variability in the cleaning of equipment, the test must be repeated successfully at least 3 times for equipment to be eligible for certification. This test is required for equipment to be certified as Type EL Class I and EL Aseptic Class I.

EL Class I is only for closed equipment, intended to be cleaned-in-place (CIP) with liquids, and can be CIP tested using the method of Doc. 2. EL Class I AUX is for certification of auxiliary open equipment which is intended to be cleaned-in-place with liquids but not tested. EL Class II is for equipment which is intended to be cleaned with liquids but must be disassembled or dismantled prior to cleaning.

Since open equipment cannot currently be tested to ensure cleanability, open equipment intended to be cleaned with liquids can only be certified as EL Class I AUX or EL Class II. Open equipment intended to be dry cleaned only can be certified as ED Class I or Class II.

Different elastomers may have different material properties. Experience has shown that different materials in the same mechanical design may affect the equipment cleanability. Since 2009 the certificate lists the elastomers that were CIP tested. The equipment is only certified when used with the elastomers listed on the certificate. Each elastomer listed on the certificate must be CIP tested using the method of Doc. 2

For closed equipment components intended to be cleaned in-place (CIP) with liquids (EL CLASS I certified), only the internal, wetted surfaces/parts are evaluated and certified to meet the hygienic design criteria according to EHEDG guidelines. This means that for pumps, valves and in-line sensors; the motor, drive, actuator or frame (if present) are NOT evaluated and certified for cleanability according to EHEDG guidelines. Only the internal, product contact surfaces are evaluated and certified according to EHEDG guidelines and, if necessary, tested for easy cleanability according to Doc. 2.

EHEDG only allows metal to metal joints for equipment subject to certification under Type EL Class II and Type ED Class I and II. As they may harbor soil or liquids and could corrode, EHEDG does not recommend any direct metal to metal joints other than welding.

3. Procedure for HD evaluation

Every piece of equipment (open and closed) considered for certification must be evaluated by one of the EHEDG Authorized Test Institutes. All evaluations will include a “Design Review” and most closed equipment will require cleanability testing according to EHEDG Doc. 2. For a design review, a new sample of the equipment is compared to official drawings provided by the manufacturer and to the appropriate EHEDG guidelines. For example, a pump will be reviewed for compliance with EHEDG guidelines 8, 9, 10, 16, 17, 23, 25, 32 and 35. During the review, certain design features will also be measured and verified, e.g. surface roughness and internal radii. After the design review, the equipment may be recommended for re-design due to deviations from the EHEDG guidelines. Some deviations from the hygienic design criteria in the guidelines may be allowable if deemed "technically unavoidable" for the particular device to function properly. After a successful design review, open equipment may be submitted directly for certification but most closed equipment will require testing for cleanability according to EHEDG Doc. 2. Only after successfully completing at least 3 CIP tests, will the closed equipment be eligible for certification.

Evaluation and cleanability testing for equipment cleaned with liquids (Type EL) proceed using the following steps, published in this Evaluation Procedure (PDF).

For Type ED, the procedure is based only on a design review using the following steps in this Evaluation Procedure (PDF)

Equipment which is considered to comply with the EHEDG guidelines following a design review and CIP testing (if appropriate) by an EHEDG Authorized Test Institute can be submitted for EHEDG certification. A certification file will be completed by one of the EHEDG Authorized Test and Certification Institutes and reviewed by at least one other Authorized Institute before being accepted by EHEDG. Since open equipment and dry cleaned equipment cannot currently be tested, these certification files must be reviewed by all of the EHEDG Authorized Institutes prior to certification. After successful review of a certification file and acceptance of the terms of the EHEDG contract for use of the logo, a "Certificate of Compliance" will be issued and the equipment will be included in the list of certified equipment on the EHEDG website. EHEDG has published a certification procedure for better understanding of the whole process.

4. Results

As a results of the EHEDG method assessment applying, many companies improved their technical solution in different are they are working in.

Below are some improvement made by ACO **drainage system** producer:

- The drainage system is designed in accordance with the best practice hygienic design principles specified by the European Hygienic Engineering & Design Group (EHEDG). This means, for example, that corners such be rounded with a minimum radii of 3mm, welds must be continuous and not be made on corners or overlapped, and the surface of the drainage needs to be smooth with a roughness factor of 0.3 to 0.5 micro-metres.

- The drainage is made from stainless steel of Grade 304, 316 or higher. When it comes to food safety, the only real option when specifying a drainage solution is one constructed from stainless steel. Stainless steel is easier to clean and to keep clean than systems made from other materials such as plastic or iron. Consider operating conditions such as acidity and temperature as well as the cleaning methodology you want to adopt when deciding which grade of stainless steel to use.

- The stainless steel drainage system should be fully pickle passivated to minimise corrosion and pitting. This is a key recommendation of EHEDG and fabricators that don’t fully pickle passivate their products run the risk of failing to meet longer term durability requirements as well as compromising hygiene.

Regarding **water saving**, can be mentioned the Ecodhybat project. According to 2006 European Commission data, water consumption in the European food production sector represents 12 percent of total industrial water consumption, with sanitation cited as the main reason for water use in most food sectors.[1] On the other hand, water used for sanitation becomes wastewater, which contains food residues (organic load) and cleaning agents such as acid, alkali, detergents and disinfectants. The main pollutants found in wastewater are organic matter (e.g. chemical or biological oxygen demand [COD, BOD]), oils and fats, suspended solids, nitrate, chloride, phosphates, ammonium and nutrients as nitrogen and phosphorous. In general, the food and drink sector is considered one of the largest producers of wastewater.

Table 1 summarises the results obtained in terms of water savings during cleaning when comparing the hygienic version with the conventional one.

Tabel 1. *Percentage of water savings*

Facility	**Equipment**	**Water savings (%)**
Dairy	Sterile tank 30000 L (lid)	40
Dairy	Tank cleaning device (SSB vs. RSJ), tank 7000 L	42
Dairy	Eq. packaging disposal (interior)	75
Dairy	Eq. packaging disposal (exterior)	9
Dairy	Conveyor belt	37
Fish plant	Batter tank system	96
Fish plant	Viscosity measurement system	83
Fish plant	Batter mix pumping system	27
AINIA	Sensor	38
AINIA	Centrifugal pump	39
AINIA	T-piece 60 AINIA Load cell	29

Conclusions

Hygienic processing is a sine qua non requirement for the food industry. Because of this, food producers devote a lot of time and resources to reach the required cleaning and disinfection level, among other preventive measures. Any surface in contact with food should be sanitized to reach an appropriate safe and hygienic standard. This study shows that hygienic design reduces environmental impacts related to sanitation of equipment and installations – from water, energy and chemical products, to wastewater and CO2 emissions – and consequently, can positively contribute to a cost reduction in the industrial activity. Overall, a 48 percent water savings was obtained when cleaning the hygienically designed equipment.

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