Hygienic design in food processing with focus on control of Listeria

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Hygienic Design in Food Processing with Focus on Control of *Listeria*
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Hygienic Design in Food Processing with Focus on Control of *Listeria*

Nordiska ministerrådets seminarium: Kontroll av *Listeria monocytogenes*

Scandic Triangeln, Malmö, Sweden; November 3, 2015

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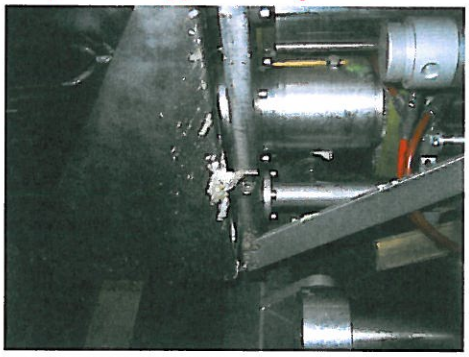
Example: Poor hygienic design



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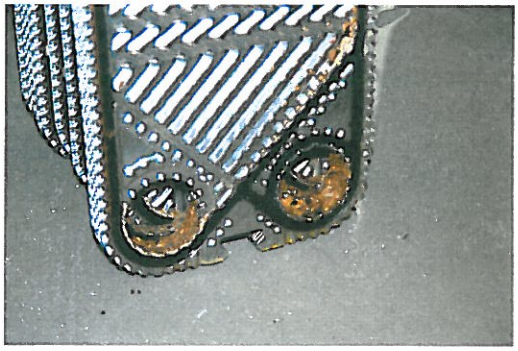
Example: Poor hygienic design



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Overall consequences of poor hygiene

Reduced lifetime of process equipment

- Increased cleaning & disinfection
- Prolonged downtime of process line
- Costly repairs

Product contamination

- Single cases influence the whole food industry
- Bad reputation for retailer brands
- Closing of factories
- Law suits against leading staff

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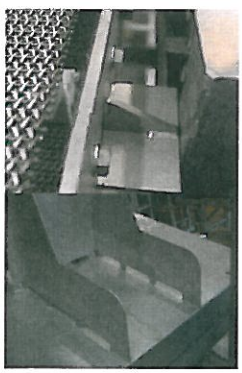
We need to know...

- How to **construct**
- What to **avoid**
- What to **buy**
- How to **clean & disinfect**
- How to **evaluate**



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Priorities to ensure high quality and safe products:

1. **Remove soil** (fat, protein, carbohydrates, salts & minerals)
2. **Remove/kill microbes** (cleaning/disinfection)
3. **Avoid recontamination** (rinsing/drying)

By combining proper design, correct cleaning procedures and use of effective cleaning agents & disinfectants we should be able to obtain as low microbial loads as possible in the process This is also the best clue to the control of *Listeria monocytogenes*

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Hayes, 1985

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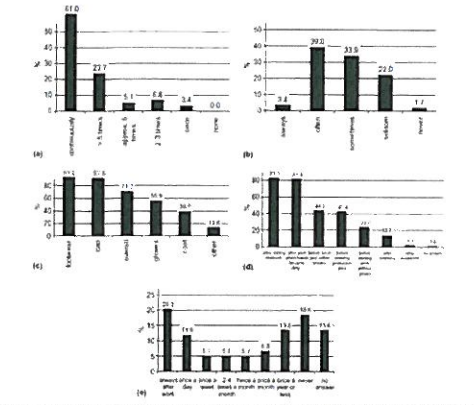

Aarnisalo, K., Tallavaara, K., Wirtanen, G., Maijala, R., Raaska, L. 2006. The hygienic working practices of maintenance personnel and equipment hygiene in the Finnish food industry. Food Control 17, pp. 1001 - 1011.

PARTIES INVOLVED IN PRODUCING HYGIENIC EQUIPMENT, WHICH CAN IMPROVE FOOD SAFETY

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Details in Hygienic Design:

- **Materials** must be durable in the process temperature interval, be non-toxic and inert to products (odour and taste), cleaning agents and disinfectants, be corrosion resistant, be wear and tear proof and be **easily cleanable.**
- The **surface structure of the material** must be **smooth –** the surface profile properties e.g. shape, height and roughness can be measured **– and free from crevices.**
- **Joints** shall be **shallow and polished** to the same roughness as the surrounding surfaces.
- **Suitable materials in the gaskets** shall be used since **metal/metal** joints are **not tight.**
- Equipment and process lines must be **accessible and cleanable.**

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Details in Hygienic Design:

- Pipes and equipment should be **self-draining.**
- **Dead spaces** should be **avoided.**
- **Fastners** with e.g. nuts, bolts, screws and rivets shall be **avoided in product contact areas.** Alternative fastening methods should be used. Use domed heads.
- **Internal angels and corners** should be **aradiused** to facilitate cleaning.
- **Bearings and shaft seals** shall be mounted **outside the production area** to avoid contamination.
- **Instrumentation** should be **hygienic.**
- **Surfaces** shall be construced **to avoid dust accumulation.**

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Main EHEDG Guidelines in Hygienic Design of Processes and Their Equipment

Guideline 8:	**Hygienic equipment design criteria, 2004**
Guideline 10:	**Hygienic design of closed equipment for the processing of liquid food, 2007**
Guideline 13:	**Hygienic design of equipment for open processing, 2004**
Guideline 34:	Integration of hygienic and aseptic equipment, 2006 (undergoes extensive renewal)
Guideline 44:	Hygienic design principles of food factories, 2014

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HYGIENIC DESIGN OF CLOSED PROCESS EQUIPMENT AND SYSTEMS

In Guideline 10 drawings on: 1) how to avoid crevices, shadow zones and stagnant product areas, 2) how to connect and position equipment in a process line to ensure unhampered draining and cleaning-in- place *etc.* & 3) how to prevent leakages in processes and thus also product contamination:

- pipe joints (Fig. 1)
- metal-to-metal seal (Fig. 2),
- O-ring seals (Figs 3-4)
- flange connection (Fig. 5)
- heating of sealing (Fig. 6)
- dynamic seal (Fig. 7)
- double shaft-seal (Fig. 8)
- pipe transitions (Fig. 9)
- centrifugal and lobe pumps (Fig. 11)
- pump by-pass arrangements (Fig. 17)
- swept tee (Fig. 10)
- flow diversion (Fig. 16)
- poor probe mounting (Fig. 12)
- temperature probes (Fig. 15)
- screw connections (Fig. 20)
- vessel lid mounting (Fig. 19)
- metal plate welding (Fig. 18)
- vessel insulation (Fig. 21)
- dead legs (Figs 13-14)

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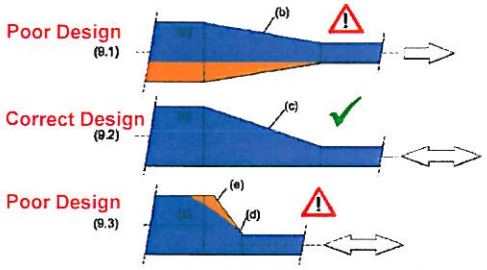
Some Examples:

Poor Design (9.1)

Correct Design (9.2)

Poor Design (9.3)



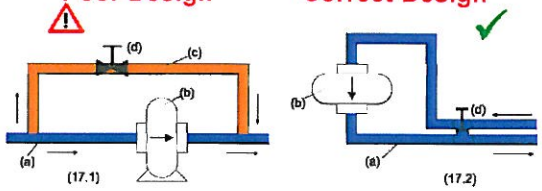
(a) product area, (b) concentric reducer, (c) eccentric reducer, long version, (d) eccentric reducer, short version, (e) potential shadow zone

Figure 9 — Transition of pipe diameters.

Some Examples:

Poor Design

Correct Design



(a) product area, (b) positive displacement pump, (c) bypass, (d) valve

Figure 17 — Arrangements for positive displacement pumps with pressure relief valve or bypass.

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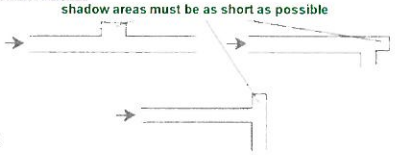
Some Examples of Poor Designs:

(a) product area, (b) air bubble, (c) condensate, (d) heat radiation; arrows represent heat loss

Figure 14 — The adverse influence of dead areas on the decontamination of process lines.

(14.1) and (14.2) decontamination with liquids,
(14.3) decontamination with steam

shadow areas must be as short as possible



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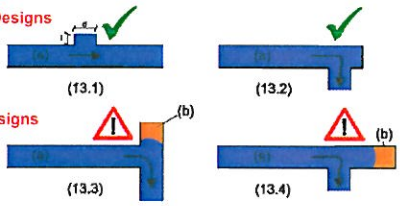
Some Examples:

Correct Designs

Poor Designs



(a) product area, (b) dead leg with residual soil

Figure 13 — Position of dead legs with reference to the flow of product and cleaning liquids.

Short dead legs (13.1, 13.2) will be cleanable, long ones not (13.3, 13.4). Dead leg position in (13.4) is better than in (13.3) due to the direction of the flow

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HYGIENIC DESIGN OF OPEN PROCESS EQUIPMENT AND SYSTEMS

In Guideline 13 factors affecting operation hygiene and cleanability are dealt with using the following pictures:

- corners (Fig. 2),
- screw joints (Figs 4 & 5)
- welded joints (Fig. 1)
- dismountable joints (Fig. 3)
- equipment rims (Fig. 8)
- drainability (Fig. 6)
- equipment covers (Fig. 10)
- shaft arrangements (Fig. 11)
- stirrer blade attachment (Fig. 13)
- equipment accessibility (Fig. 26)
- equipment fixed to floor/walls (Figs 24-25)
- product protection (Fig. 12)
- flange couplings (Fig. 14)
- foot bearings (Fig. 15)
- belt reinforcement (Fig. 16)
- conveyor belts (Figs 17-19)
- framwork structures (Fig. 22)
- horizontal framwork (Fig. 23)
- framework cladding (Fig. 21)
- walkway design (Fig. 27)

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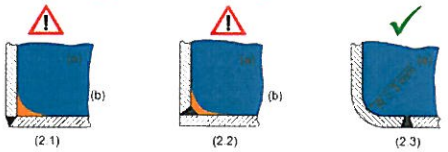
Poor Design | Poor Design | Correct Design



(a) product area, (b) sharp internal angle

Figure 2
Welded joints in corners. (2.1), (2.2) Welded seams in corners create uncleanable areas; (2.3) radiused corners and correctly welded seams in the plain area avoid any hygiene risk.

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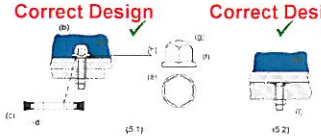
Poor Design Poor Design Poor Design

(a) product area, (b) metal-to-metal contact, (c) dead area, (d) crevice

Figure 4.
Hazards due to unhygienic design of screws exposed to product are caused by metal to metal contact, crevices, gaps and dead areas.

Correct Design Correct Design



(a) product area, (b) domed head, (c) elastomer, (d) metal, (e) circular collar, (f) sloped, (g) domed, (h) hexagon, (i) stud

Figure 5
Hygienic design of screw joints. (5.1) The exposed domed head is easily cleanable and the metal backed gasket is used to seal the thread; (5.2) if applicable, any risk can be avoided by using a stud welded on the non product side.

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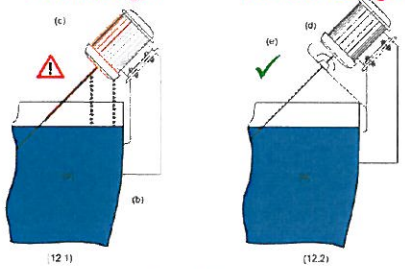
Poor Design Correct Design



(a) product area, (b) contamination [condensate, lubricants], (c) motor with fins [dead areas], (d) thrower ring, (e) self-draining protection sheet with "upstand" [dismountable]

Figure 12
Protection of product. (12.1) Equipment mounted over any exposed product can contaminate it by soil, condensate or lubricants; (12.2) protection sheets, covers, and cowls must be arranged to protect the product.

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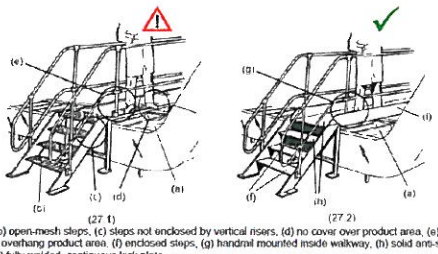
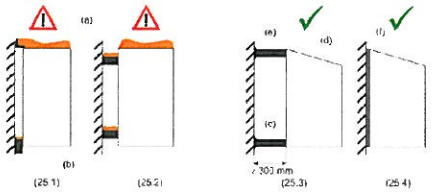
Poor Design Correct Design



(a) product, (b) open-mesh steps, (c) steps not enclosed by vertical risers, (d) no cover over product area, (e) handrail and its mountings overhang product area, (f) enclosed steps, (g) handrail mounted inside walkway, (h) solid anti-slip steps and floor-plates, (i) fully-welded, continuous kick plate

Figure 27
Walkways over exposed product. (27.1) Inadequate protection of product beneath walkway; (27.2) hygienically designed walkway.

Poor Designs Correct Designs



(a) residues of soil, (b) small clearance, (c) clearance, (d) slope, (e) radius, (f) sealing

Figure 25
Equipment fixed to walls. (25.1, 25.2) Horizontal surfaces or ledges retain soil and small clearances impede cleaning between walls and equipment; (25.3) horizontal supports of equipment (see also Figure 23) must be radiused and properly fixed to the wall allowing sufficient clearance; (25.4) equipment can also be directly fixed to the wall if sealing materials are used .

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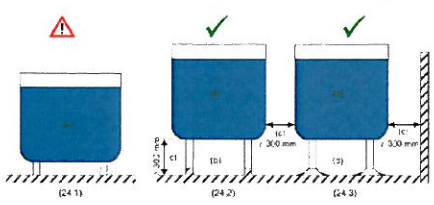
Poor Design Correct Designs



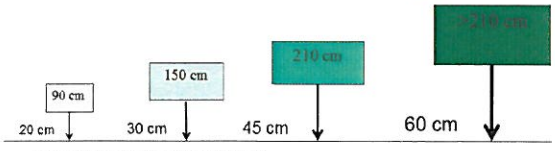
(a) product area, (b) rounded pedestal, (c) clearance, (d) sealed to the floor

Figure 24
Equipment fixed to floors. (24.1) Underneath equipment with a small clearance to the floor, cleaning will be complicated; in addition, unradiused and improperly fixed feet, sharp corners and crevices at the fixing point cause hygiene risks; (24.2) feet properly fixed to rounded pedestals or (24.3) sealed to the floor with sufficient clearance characterise hygienic design.

EHEDG Guideline Doc. 44 – Hygienic Design Principles for Food Factories

For cleaning and maintenance purposes **a minimum clearance under the equipment, between equipment and/or from the wall** is suggested as follows:

- 20 cm clearance for ≤ 90 cm sized equipment
- 30 cm clearance for 90 – 150 cm sized equipment
- 45 cm clearance for 150 – 210 cm sized equipment
- ≥ 60 cm clearance for > 210 cm sized equipment



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Hygienic Design in Food Processing with Focus on Control of *Listeria*
Gun Wirtanen, DTU National Food Institute, Lyngby, Denmark

Control of *Listeria monocytogenes*

In the food industry ***L. monocytogenes*** is recognized as a problem, because of its **ability to colonize surfaces and crevices.**

L. monocytogenes **in biofilms can be persistent on food surfaces**. It can form biofilms:

- in cold and in ambient temperated environments,
- on food contact surfaces
  - stainless steel and
  - elastomers
- on non-contact surfaces
- on glass

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Control of *Listeria monocytogenes*

Listeria monocytogenes **may persist in the food processing environment for years** i.e. it can be difficult to eradicate it from the food processing area, when **it once has got into the facilities**.

Here follows some examples of *Listeria* sources in the processing plants are:

- **conveyor belts**
- cutters
- **slicers**
- coolers and freezers
- **brining and packaging machines**
- sinks
- floors
- drains

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Control of *Listeria monocytogenes*

L. monocytogenes **has been isolated from:**

- **unpasteurized and cross-contaminated dairy products** e.g. raw milk, mastitic milk, pasteurized milk, ice-cream, butter and various types of cheeses
- **fresh produces** e.g. melons
- **salads** e.g. coleslaw
- **cross-contaminated RTE-meat products** e.g. sliced cold meat and cold-cut deli meat "rullepølse"
- **RTE-fish products** e.g. rainbow trout roe, cold-smoked and gravad rainbow trout and salmon

These cases show that both **cross-contamination and heat treatments in food production must be strictly controlled** to prevent foodborne *L. monocytogenes* infections.

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Control of *Listeria monocytogenes*

Disinfectants commonly used in the food industry, e.g. quaternary ammonium compounds (QACs), chlorine-based, alcohol-based and peracetic acid-based have been shown to **be effective against *L. monocytogenes* cells in suspension, but the biofilm formation as well as the presence of organic material impair the efficacy of the disinfectants.**

L. monocytogenes **strains can adapt to the disinfectants** in places, where the disinfection after the cleaning is not effective enough e.g. when the agent is used **in suboptimal concentrations at cold temperatures.**

L. monocytogenes can also survive in lubricants used in the food-processing industry, be transferred to stainless steel surfaces from lubricants and vice versa.

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Control of *Listeria monocytogenes*

2010 H. S. YUN *et al.*

Table 2. Susceptibility of Planktonic *L. monocytogenes* to 1% H_2O_2[a]

Strain	Cell numbers (log CFU/mL)[b] (% of Untreated)			
	Untreated	10 min	20 min[c]	30 min
106	9.50 ± 0.00 (100)	9.40 ± 0.01 (98.95)	< 1 (0)	< 1 (0)
V7	9.24 ± 0.07 (100)	8.76 ± 0.00 (94.81)	3.33 ± 0.10 (36.0)	< 1 (0)
17	9.56 ± 0.06 (100)	9.03 ± 0.01 (94.46)	1.50 ± 0.28 (15.69)	< 1 (0)
LCDC	9.41 ± 0.01 (100)	8.68 ± 0.02 (92.24)	< 1 (0)	< 1 (0)
3982	9.27 ± 0.03 (100)	8.36 ± 0.01 (90.18)	1.15 ± 0.21 (12.41)	< 1 (0)
Scott A	9.54 ± 0.05 (100)	8.61 ± 0.00 (90.25)	1.96 ± 0.36 (20.54)	< 1 (0)
18	9.12 ± 0.04 (100)	8.20 ± 0.02 (89.91)	< 1 (0)	< 1 (0)
70	9.07 ± 0.02 (100)	8.14 ± 0.02 (89.75)	< 1 (0)	< 1 (0)
303	9.81 ± 0.00 (100)	8.73 ± 0.03 (80.32)	< 1 (0)	< 1 (0)
Bne 1	9.63 ± 0.00 (100)	8.42 ± 0.06 (87.44)	< 1 (0)	< 1 (0)
3990	9.11 ± 0.01 (100)	7.06 ± 0.01 (77.50)	2.62 ± 0.01 (28.75)	< 1 (0)
V37	9.51 ± 0.00 (100)	6.69 ± 0.01 (70.35)	< 1 (0)	< 1 (0)

[a]Values within each column with the same letters (a)–(c) are not significantly different ($p < 0.05$).
[b]Cell number is given in log_{10} cells/mL ± standard deviation.
[c]Susceptibility groups of *L. monocytogenes* strains were classified by survival rate after an H_2O_2 treatment for 20 min.

Yun, H.S., Kim, Y., Oh, S., Jeon, W.M., Frank, J.F., Kim, S.H., 2012. Susceptibility of Listeria monocytogenes biofilms and planktonic cultures to hydrogen peroxide in food processing environments. Bioscience, Biotechnology, and Biochemistry 76, 2008-2013.

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Control of *Listeria monocytogenes*

Hydrogen Peroxide Susceptibility of *L. monocytogenes* Biofilms 2011

Table 3. Susceptibility of *L. monocytogenes* Biofilms to Repeated Exposure to 1% H_2O_2 for 10 min Followed by Re-Growth in TSBYE for 24 h at 25 °C[a]

Strain	Cell numbers (log CFU/CFF)[b] (% of Untreated)						
	Untreated	1st treatment[c]	1st re-growth	2nd treatment	2nd re-growth	3rd treatment	3rd re-growth
3982	9.02 ± 0.04 (100)	8.28 ± 0.07 (91.8)	8.80 ± 0.02 (97.56)	8.22 ± 0.12 (91.13)	8.65 ± 0.06 (95.90)	8.21 ± 0.04 (91.02)	8.85 ± 0.16 (98.12)
3990	9.16 ± 0.00 (100)	7.97 ± 0.00 (87.01)	9.01 ± 0.00 (98.34)	7.90 ± 0.02 (86.24)	8.65 ± 0.08 (94.43)	7.92 ± 0.01 (86.46)	8.93 ± 0.07 (97.49)
17	9.20 ± 0.04 (100)	7.96 ± 0.00 (86.74)	8.95 ± 0.12 (97.26)	7.96 ± 0.13 (86.52)	9.01 ± 0.08 (97.93)	8.01 ± 0.00 (87.07)	9.25 ± 0.08 (100.54)
LCDC	9.76 ± 0.07 (100)	7.80 ± 0.09 (79.92)	9.36 ± 0.03 (95.90)	7.80 ± 0.01 (79.92)	9.36 ± 0.01 (95.90)	8.99 ± 0.01 (92.11)	9.32 ± 0.04 (95.49)
18	9.38 ± 0.06 (100)	7.21 ± 0.02 (76.87)	7.39 ± 0.01 (78.78)	5.18 ± 0.07 (55.22)	7.25 ± 0.02 (77.29)	4.17 ± 0.01 (44.46)	7.56 ± 0.09 (80.60)
Scott A	10.03 ± 0.01 (100)	7.58 ± 0.07 (75.57)	8.18 ± 0.09 (81.56)	6.15 ± 0.01 (61.32)	9.09 ± 0.03 (90.63)	5.88 ± 0.34 (58.62)	6.18 ± 0.09 (61.62)
303	9.15 ± 0.06 (100)	6.25 ± 0.04 (68.31)	6.75 ± 0.02 (73.77)	4.40 ± 0.06 (48.09)	7.60 ± 0.08 (83.06)	4.43 ± 0.12 (48.42)	7.79 ± 0.01 (85.14)
106	9.39 ± 0.03 (100)	6.37 ± 0.14 (67.84)	9.15 ± 0.01 (97.44)	7.87 ± 0.07 (83.81)	9.00 ± 0.02 (95.91)	8.13 ± 0.01 (86.58)	8.18 ± 0.07 (87.11)
V7	9.32 ± 0.05 (100)	6.22 ± 0.04 (66.74)	7.14 ± 0.01 (76.61)	3.96 ± 0.11 (42.49)	8.87 ± 0.01 (95.17)	7.19 ± 0.41 (77.15)	6.10 ± 0.09 (65.45)
70	9.55 ± 0.01 (100)	6.25 ± 0.09 (65.45)	7.60 ± 0.24 (79.58)	5.41 ± 0.12 (56.65)	4.85 ± 0.16 (50.55)	< 1 (0)	3.96 ± 0.08 (41.47)
V37	9.81 ± 0.09 (100)	5.12 ± 0.14 (52.19)	8.27 ± 0.13 (84.30)	6.01 ± 0.02 (61.26)	7.79 ± 0.03 (79.41)	3.90 ± 0.49 (39.53)	1.55 ± 0.14 [illegible]
Bne-1	9.96 ± 0.02 (100)	3.99 ± 0.05 (40.06)	6.88 ± 0.02 (69.08)	1.70 ± 0.00 (17.07)	5.18 ± 0.01 (52.01)	3.18 ± 0.00 (31.93)	5.95 ± 0.06 (59.74)

[a]Values within each column with the same letters (a)–(i) are not significantly different ($p < 0.05$).
[b]Cell number is given in log cells/CFF ± standard deviation.
[c]Susceptibility groups of *L. monocytogenes* strains were classified by survival rate after the first H_2O_2 treatment.

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Table 4. Susceptibility of *L. monocytogenes* Biofilms to Repeated Exposure to 10% H_2O_2 for 10 min Followed by Re-Growth in TSBYE for 24 h at 25 °C[a]

Strain	Cell numbers (log CFU/GFF)[b] (% of Untreated)						
	Untreated	1st treatment[c]	1st re-growth	2nd treatment	2nd re-growth	3rd treatment	3rd re-growth
1982	9.02 ± 0.04 (100)	6.73 ± 0.01 (74.61)	7.55 ± 0.07 (83.70)	7.50 ± 0.13 (83.15)	8.94 ± 0.06 (99.11)	7.12 ± 0.06 (78.94)	8.94 ± 0.01 (99.11)
1990	9.16 ± 0.00 (100)	5.22 ± 0.44 (56.99)	7.54 ± 0.02 (82.31)	6.36 ± 0.04 (69.43)	8.13 ± 0.01 (88.76)	7.18 ± 1.00 (78.38)	8.79 ± 0.05 (95.96)
303	9.15 ± 0.06 (100)	3.70 ± 0.07 (40.44)	6.47 ± 0.01 (70.71)	<1 (0)	6.40 ± 0.06 (69.95)	2.18 ± 0.00 (23.83)	5.78 ± 0.00 (63.17)
70	9.55 ± 0.01 (100)	3.38 ± 0.28 (35.39)	4.80 ± 0.03 (50.26)	<1 (0)	<1 (0)	<1 (0)	<1 (0)
LCDC	9.76 ± 0.07 (100)	3.44 ± 0.12 (35.25)	5.29 ± 0.05 (54.20)	<1 (0)	<1 (0)	<1 (0)	3.22 ± 0.00 (32.99)
V7	9.32 ± 0.05 (100)	2.83 ± 0.92 (30.36)	5.74 ± 0.19 (61.59)	2.41 ± 0.34 (25.86)	8.67 ± 0.00 (93.03)	3.34 ± 0.12 (35.84)	4.11 ± 0.01 (44.10)
18	9.38 ± 0.06 (100)	2.72 ± 0.34 (29.00)	6.63 ± 0.18 (70.68)	4.18 ± 0.00 (44.56)	7.01 ± 0.05 (74.73)	3.35 ± 0.18 (35.71)	7.18 ± 0.00 (76.55)
17	9.20 ± 0.04 (100)	2.63 ± 0.31 (28.59)	7.60 ± 0.09 (82.61)	5.27 ± 0.05 (57.28)	7.96 ± 0.02 (86.52)	3.76 ± 0.13 (40.87)	7.99 ± 0.07 (86.85)
Scott A	10.03 ± 0.01 (100)	2.39 ± 0.55 (23.83)	8.88 ± 0.07 (88.53)	4.56 ± 0.06 (45.46)	7.18 ± 0.00 (71.59)	2.33 ± 0.21 (23.23)	6.18 ± 0.00 (61.62)
V37	9.81 ± 0.09 (100)	2.33 ± 0.21 (23.75)	7.61 ± 0.05 (77.57)	2.53 ± 0.21 (25.79)	8.10 ± 0.21 (82.57)	3.07 ± 0.16 (31.29)	5.67 ± 0.04 (57.80)
106	9.39 ± 0.03 (100)	<1 (0)	8.70 ± 0.03 (92.65)	4.83 ± 0.03 (51.44)	7.50 ± 0.05 (79.87)	4.61 ± 0.01 (49.09)	6.18 ± 0.00 (65.81)
Brie 1	9.96 ± 0.02 (100)	<1 (0)	4.18 ± 0.00 (41.97)	<1 (0)	4.99 ± 0.05 (50.10)	2.57 ± 0.12 (25.80)	7.12 ± 0.01 (71.49)

[a] Values within each column with the same letters (a–g) are not significantly different (p < 0.05).
[b] Cell number is given in $\log_{10}$ cells/GFF ± standard deviation.
[c] Susceptibility groups of *L. monocytogenes* strains were classified by survival rate after the first H_2O_2 treatment.

Yun, H.S., Kim, Y., Oh, S., Jeon, W.M., Frank, J.F., Kim, S.H., 2012. Susceptibility of Listeria monocytogenes biofilms and planktonic cultures to hydrogen peroxide in food processing environments. Bioscience, Biotechnology, and Biochemistry 76, 2008-2013.

Activities at DTU Hygienic Design Centre

DTU

- **Consulting** equipment manufacturers and food producers
  - **Testing based on EHEDG GL Doc 2 of closed processes**, which is in most cases a part of the certification procedure
  - **Evaluation of hygienic design** in food and biotech processes **from 2016-17**
- **Training and education** in hygienic design
- **Development of test method(s)** for certification **of open process equipment**

Courses at DTU Hygienic Design Centre

DTU

- **2 d basic course** in hygienic design (HD) on equipment for Equipment Manufacturers once a year at DTU in late-September 2016
- The **basic course** can be **tailored** (1 d or 2 d) **for food producers and food building designers** in and held in the premises of the client
- 2 d course **"Inspection Procedures in Food/Biotech Process Design"** held at DTU by **Dr. Roland Cocker** in English March 8-9, 2016
- **4 d Advanced course in hygienic design** (with exam) is held at DTU once a year; next possibility June 6-9, 2016
- More information at the home page: **www.hdc.food.dtu.dk**

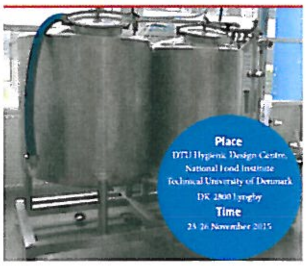
DTU Center for Hygienic Design

EHEDG

High Level International Advanced Course

Hygienic Engineering and Contamination Control

- for the food and pharmaceutical industry as well as equipment manufacturers



DTU

Registration form

Course on Hygienic Engineering and Contamination Control

Next opportunity: 6-9 June 2016

Name ______
Company ______
Adress / P.O. Box ______
Zip code, city/town & country ______
Phone direct/GSM ______
E-mail ______
EHEDG Member
Invoicing adress (if different from above given adress)
______
______

DTU

Day 1	
10.00 - 10.30	Registration and coffee/tea
10.30 - 11.15	Introduction and participant presentation
11.15 - 12.00	Legal requirements
12.00 - 13.15	Lunch break
13.15 - 14.00	Scientific background to EHEDG documents
14.00 - 14.45	Hygienic design of open process equipment
14.45 - 15.30	Hygienic design of closed process equipment
15.30 - 16.00	Coffee/tea break
16.00 - 16.45	Summary of the day and participant expectations
19.30 -	Dinner

Day 2	
08.15 - 08.30	Registration and coffee/tea
08.30 - 09.15	Certification procedure including EHEDG test procedure for closed equipment
09.15 - 10.00	Food microbiology
10.00 - 10.30	Coffee/tea break
10.30 - 11.15	Surface and air microbiology
11.15 - 12.00	Equipment material - stainless steel and polymers
12.00 - 13.15	Lunch break
13.15 - 14.00	Welding stainless steel
14.00 - 15.30	Common demonstration on hygienic design
15.30 - 16.00	Coffee/tea break
16.00 - 17.30	Group work 1 - 3: Hygienic design of various process items, surface hygiene and EHEDG test procedure for closed equipment
19.30 -	Dinner

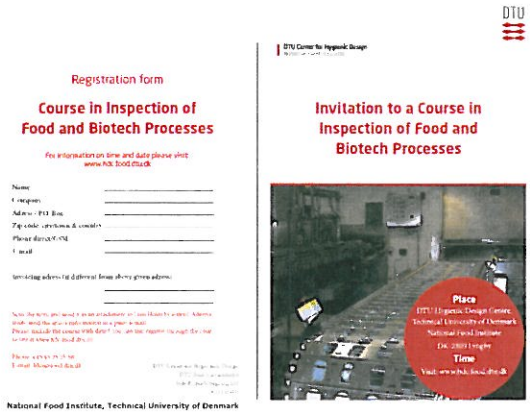
DTU

Day 3	
08.15 - 08.30	Registration and coffee/tea
08.30 - 09.15	Static seals and couplings
09.15 - 10.00	Fluid dynamics
10.00 - 10.30	Coffee/tea break
10.30 - 11.15	Valves
11.15 - 12.00	Pumps (dynamic seals) and case study on pumps
12.00 - 13.15	Lunch break
13.15 - 14.00	Heat treatment (heat transfer)
14.00 - 15.30	Group work 2 - 3: Hygienic design of various process items, surface hygiene and EHEDG test procedure for closed equipment
15.30 - 16.00	Coffee/Tea Break
16.00 - 17.30	Group work 3 - 3: Hygienic design of various process items, surface hygiene and EHEDG test procedure for closed equipment
19.30 -	Dinner

Day 4	
08.15 - 08.30	Registration and coffee/tea
08.30 - 09.15	Cleaning & Disinfection - Cleaning Procedures in Open and Closed Processes
09.15 - 10.00	Cleaning and disinfection - Cleaning agents & disinfectants
10.00 - 10.30	Coffee/tea break
10.30 - 11.15	Foodgrade lubricants
11.15 - 12.00	Exam (aids allowed)
12.00 - 13.15	Lunch break
13.15 - 14.00	Integration, installation and maintenance
14.00 - 14.45	Building and process layout
14.45 - 15.30	Concluding remarks, course certificates and course evaluation by participants
15.30 - 16.00	Coffee/tea break with sandwiches
16.00 - 16.45	Bus to Copenhagen and thereafter to the hotel for those who are staying until Friday

Hygienic Design in Food Processing with Focus on Control of *Listeria*

Gun Wirtanen, DTU National Food Institute, Lyngby, Denmark



Registration form

Course in Inspection of Food and Biotech Processes

For information on time and date please visit www.fdt.food.dtu.dk

Name: _____

Company: _____

Address - P.O. Box: _____

Zip code - city/town & country: _____

Phone daytime/Cell: _____

E-mail: _____

Invoicing address (if different from above given address): _____

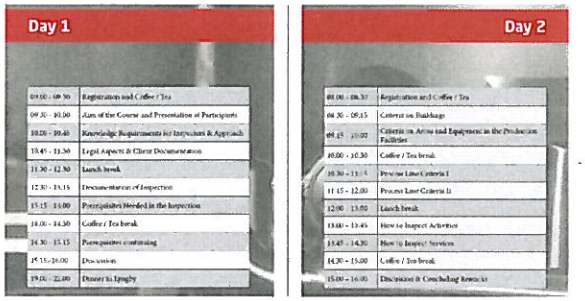
_____

_____

DTU Center for Hygienic Design

Invitation to a Course in Inspection of Food and Biotech Processes

National Food Institute, Technical University of Denmark



National Food Institute, Technical University of Denmark

SUMMARY

- Hygiene aspects should be in focus when designing both equipment and process lines - saving money & time
- Legislation do not contain any detailed instructions for hygienic design. There are guidelines and standards available e.g. by EHEDG, 3-A SSI, NSF, ISO and BRC.
- Wrongly designed constructions are the major reason for poor hygiene in equipment; attention should be paid to hygienic design when purchasing equipment.
- *Listeria monocytogenes* must not be allowed to build biofilms because it is a very hard microbe to eradicate from the facilities.

National Food Institute, Technical University of Denmark

Thank You for Your Attention!

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National Food Institute, Technical University of Denmark