Key Hygienic Design Areas

EHEDG – The European Engineering & Design Group

Agenda

- Microbiology and Food Safety incidences
- Microorganisms and equipment surfaces
- Introduction to EHEDG
- EHEDG Services and capability
- Key Hygienic Design Areas
- Hygienic Design and Food Processing – Machine Areas
- Hygienic Design and Food Processing - Processes
- Hygienic design criteria
    - Surface Geometry
    - Welds,
    - Shafts and couplings
    - Drainability,
    - Top rims, covers
-

Key Hygienic Design Areas

Hygienic Building Design	• Hygienic Floors, Walls, Ceilings, Drains, Zoning • Food Defense, e.g. site security, fencing • HVAC, Cabling, ducts, cabinets
Hygienic Utilities	• Water, Steam • Air
Hygienic Equipment and Process Design	• Materials of construction • Hygienic Welding • Maintenance • Cleanability and Drainability
Cleaning and Sanitation (Disinfection)	• Cleaning In Place (CIP) Design • Dry cleaning, Cleaning out Place, Open Plant Cleaning • Cleaning Procedures • Cleaning Validation • Cleaning and Sanitation chemicals
Personnel Hygiene	• Gowning, e.g. Hand/Shoe cleaning devices • Culture • Practices

CERTIFIED HYGIENIC ENGINEERING & DESIGN EHEDG EUROPEAN GROUP
TYPE EL - CLASS I
MAY 2011

What could happen to your business?

Ferrero chocolate linked to multi-country Salmonella outbreak
By Joe Whitworth on April 4, 2022

A multi-country Salmonella outbreak that has mainly sickened young people has been linked to chocolate products made by Ferrero.

Nearly 100 people are thought to be affected in the United Kingdom, Ireland, France, Germany, Sweden and the Netherlands. Italy is also checking if some of its analytical results are connected to the monophasic Salmonella Typhimurium outbreak.

https://www.foodsafetynews.com/2022/04/ferrero-chocolate-linked-to-multi-country-salmonella-outbreak/

What could happen to your business?

Blue Bell Creameries Ordered To Pay $17.25 Million In Criminal Penalties In Connection With 2015 Listeria Contamination

- A federal court in Texas sentenced ice cream manufacturer Blue Bell Creameries L.P. to pay $17.25 million in criminal penalties for shipments of contaminated products linked to a 2015 listeriosis outbreak, the Justice Department announced today.

- Blue Bell pleaded guilty in May 2020 to two misdemeanor counts of distributing adulterated ice cream products. The sentence, imposed by U.S. District Judge Robert Pitman in Austin, Texas, was consistent with the terms of a plea agreement previously filed in the case. The $17.25 million fine and forfeiture amount is the largest-ever criminal penalty following a conviction in a food safety case.

https://www.justice.gov/opa/pr/blue-bell-creameries-ordered-pay-1725-million-criminal-penalties-connection-2015-listeria

What could happen to your business?

Italian officials try to find the source of a deadly Listeria outbreak
By Joe Whitworth on August 23, 2022

Two people have died in a Listeria outbreak in Italy that could be linked to cheese.
Italian officials reported 33 people have been affected and two deaths are part of the outbreak.
Asiago Pressato cheese is one line of inquiry as investigators try and find the source.
An Italian National Institute of Health (ISS) spokesman told **Food Safety News** the outbreak investigation was at an early stage when asked for details.

-FoodSafetyNews.com

What could happen to your business?

English E. coli outbreak caused by milk pasteurization problem

By Joe Whitworth on August 2, 2022
An outbreak of E. coli O157 in England that affected more than 20 people was caused by a milk pasteurization failure, according to researchers.

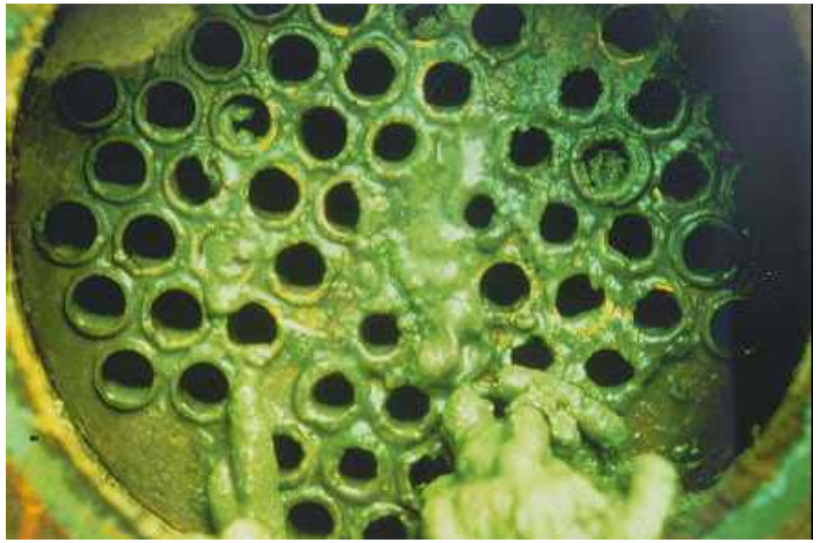
In November 2019, a number of Shiga toxin-producing E. coli (STEC) O157:H7 infections were detected in South Yorkshire.

A sample of pasteurized milk from Darwin's Dairy failed the phosphatase test, indicating contamination by unpasteurized, raw, milk. An inspection of the pasteurizer revealed a damaged seal on the flow divert valve.

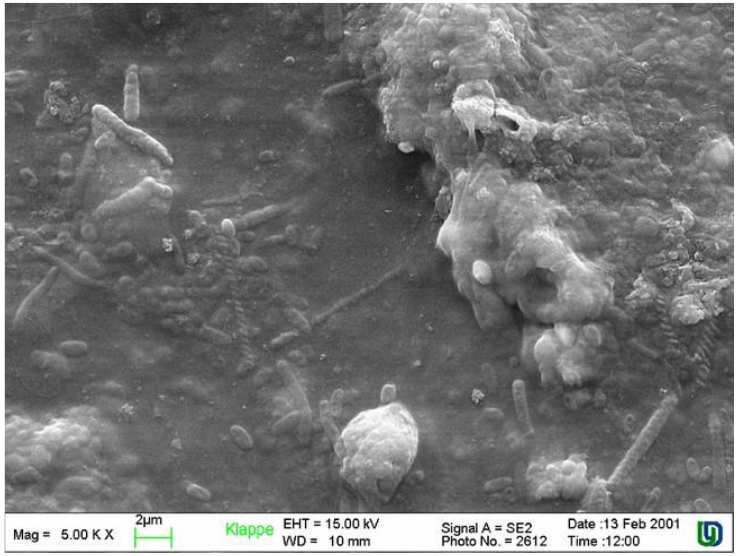
Gruber, et al., **2021**

Microorganisms and equipment surfaces

Bio-fouling

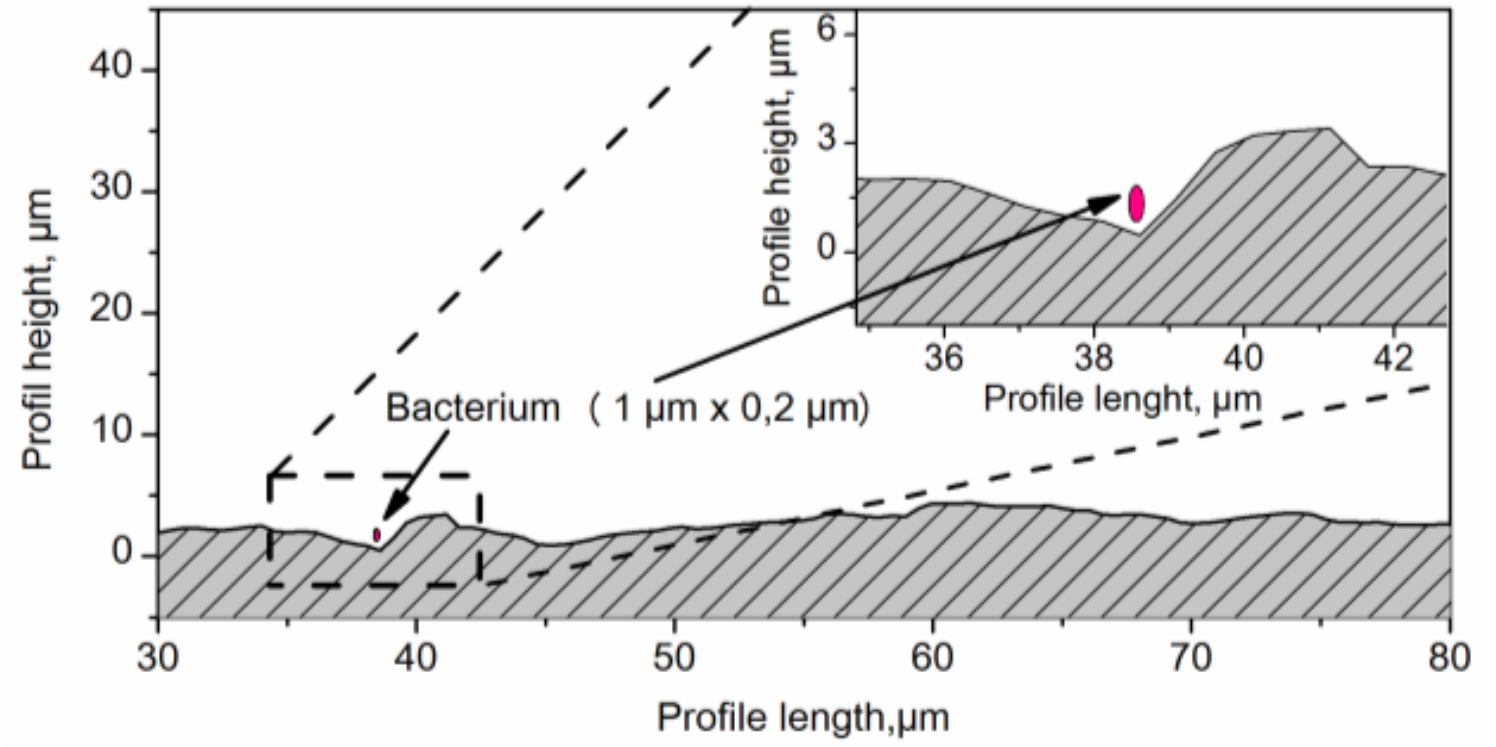


Irreversible bio-fouling on a reverse osmosis membrane - has survived hundreds of cleaning and disinfection cycles



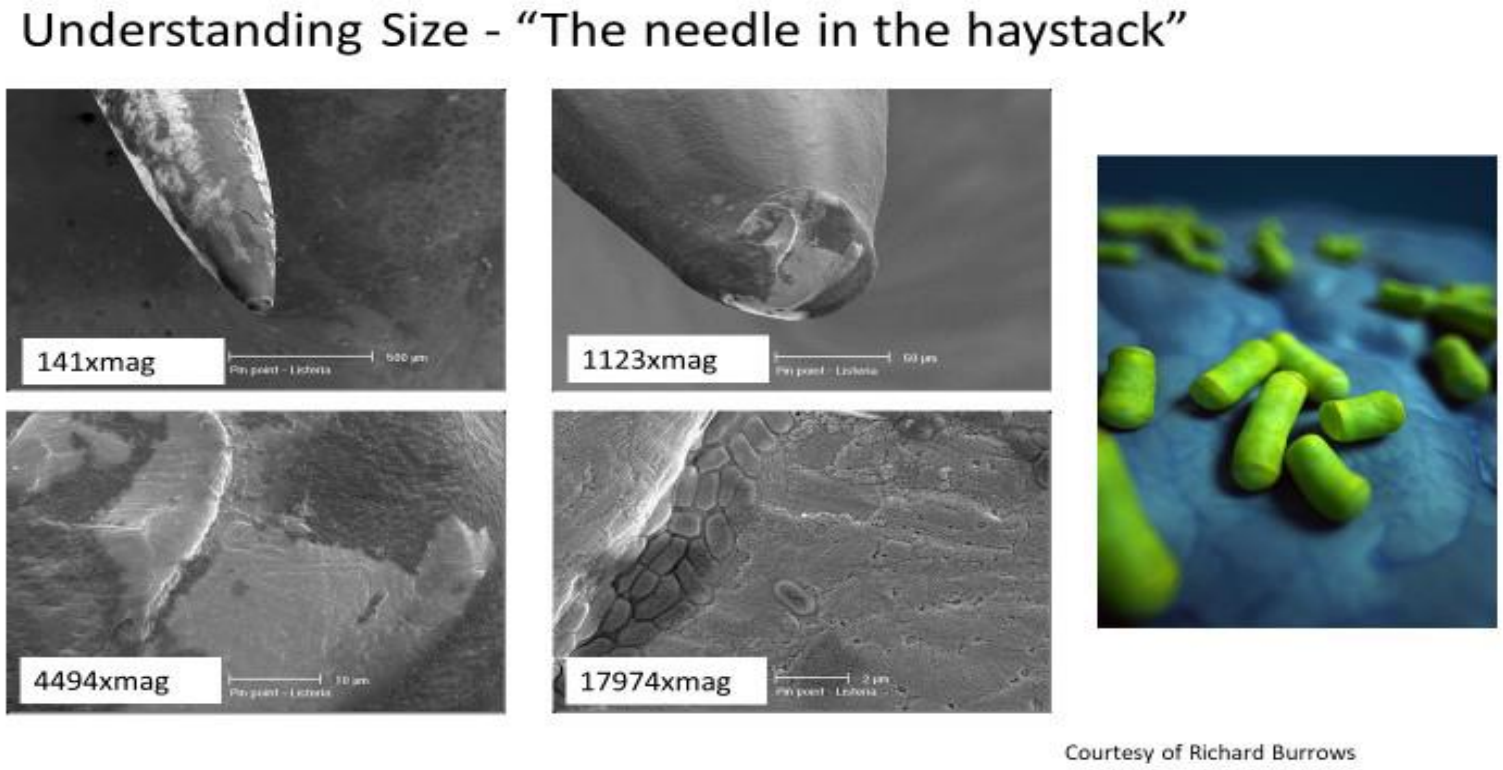
Heat exchanger with massive bio-fouling

Microorganisms and equipment surfaces



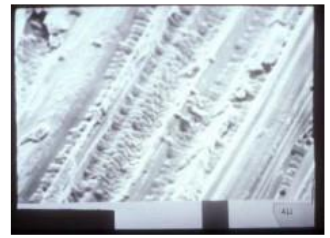
- Typical representation of a stainless steel surface profile of Ra <0.6 µm roughness achieved by 240 grit mechanical polish.
- No surface defects or damage.

Microorganisms and equipment surfaces



Lowry Food Consulting –personal slide

Microorganisms and equipment surfaces



- Natural microbial growth and survival mode

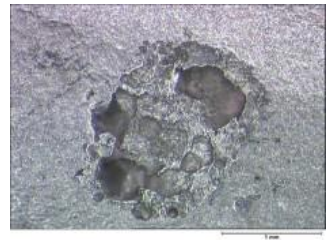
- From adhered single cells to biofilms dependent on moisture and nutrient levels (few µm to mm thick)

- Processing equipment has many surfaces suitable for colonisation –SS, plastics, rubber, even PTFE

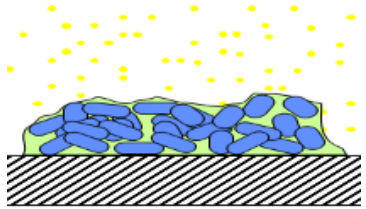
- If surfaces are exposed to (frequent) cleaning, microbial adhesion can be controlled

- Surface attached microorganisms have enhanced resistance to chemical disinfection

- Some microorganisms may cause corrosion



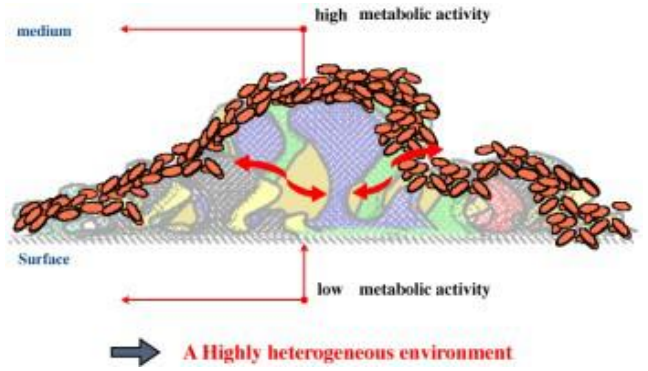
Microorganisms and equipment surfaces



Biofilms

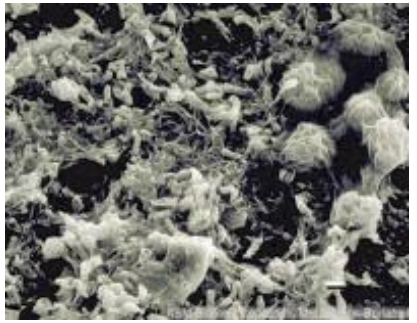
• Layer of bacterial micro-colonies associated with an inert surface
attached by a matrix of complex polysaccharide-like material (glue)
in which other debris including nutrients and other microorganisms may be trapped

- Stage 1: electrostatic attraction (reversible)
- Stage 2: exudation of extracellular polysaccharides (EPS)



• Unique environment established, increased resistance to many chemical sanitizing agents (up to 1000x).
No increased resistance to heat. Teflon easier to clean than SS.
• New microorganisms attach themselves with
the aid of filaments and tendrils.
• Can behave like a tough plastic film
• For cleaning, the most important task is the detachment from the surface to be cleaned

Microorganisms and equipment surfaces

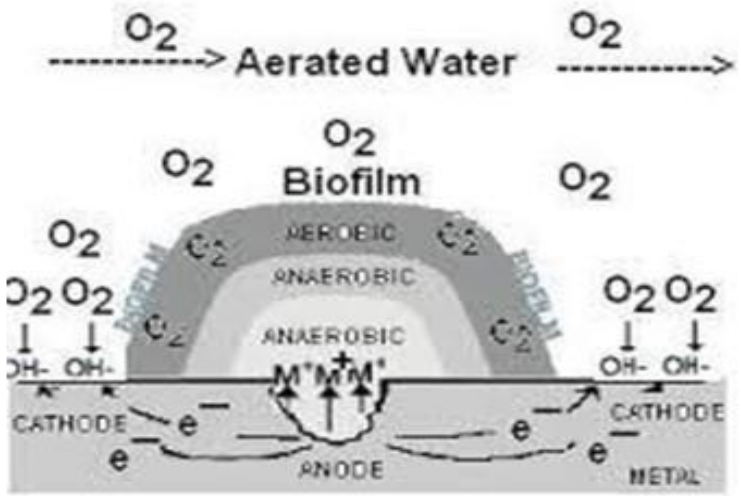


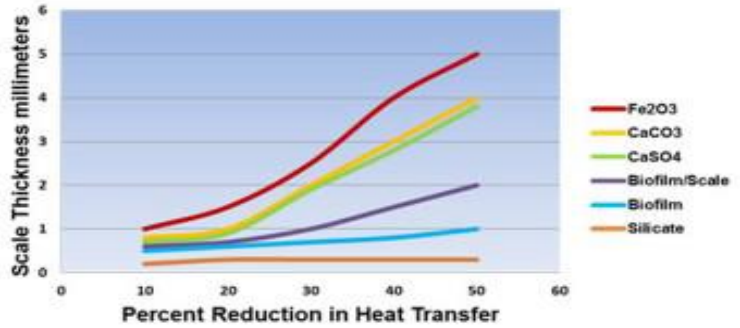
Advantages of Life in a Biofilm

- Concentration of nutrients increased at surface
- Decreased turbulence and scouring (persistence)
- Diffusion of exo-enzymes decreased
- Often mixed species biofilms
- Possibility of organization -quorum signaling
- Transfer of genetic information –resistance genes
- Protection from bulk phase environment
- Toxins, detergents, sanitizers, antibiotics

Microorganisms and equipment surfaces

Bio-fouling





Biofilm corrosion

Lowry Food Consulting –personal slide

Microorganisms and equipment surfaces

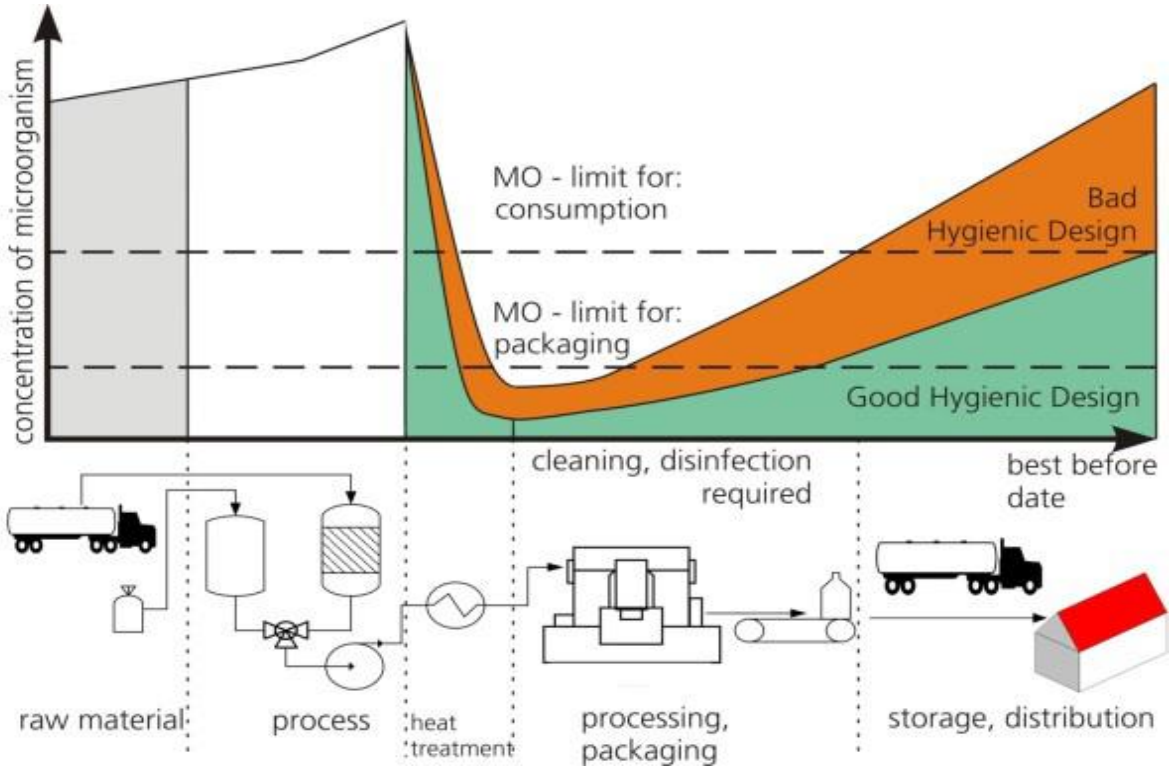
Examples of Microbially Induced Corrosion (MIC)

Mechanically damaged heat exchanger plate

Source: Barnickel, LfL

Hygienic Design and Shelf life

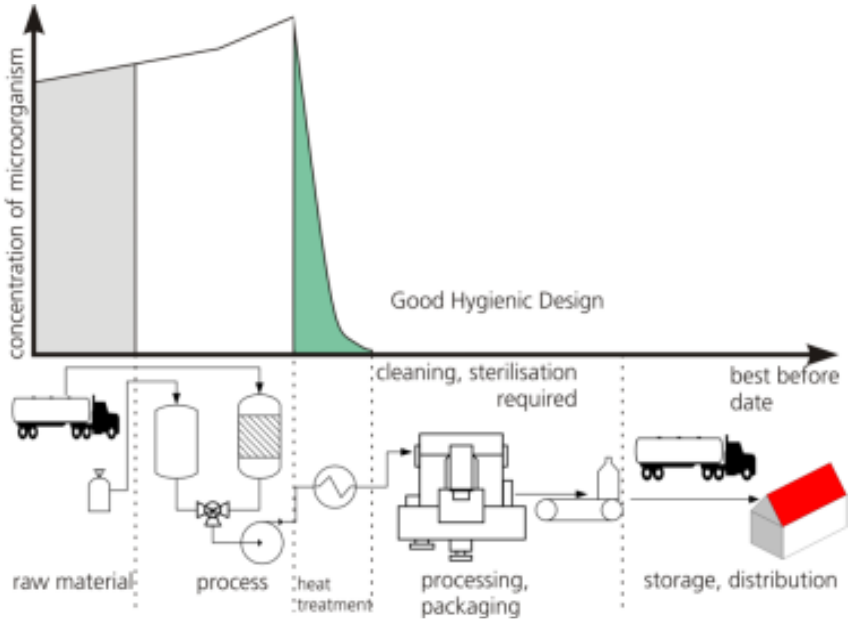
Growth of microorganisms after pasteurization



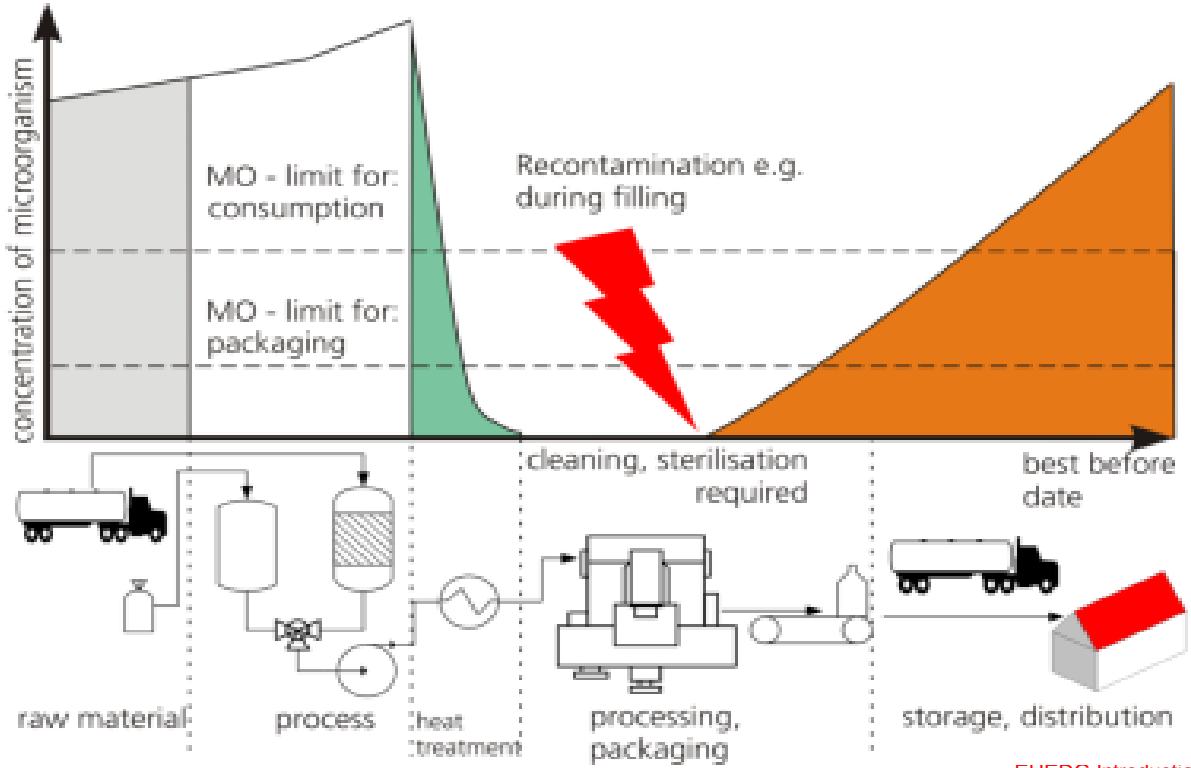
Hygienic Design and Shelf life

Growth of microorganisms after sterilization + recontamination

No Contamination



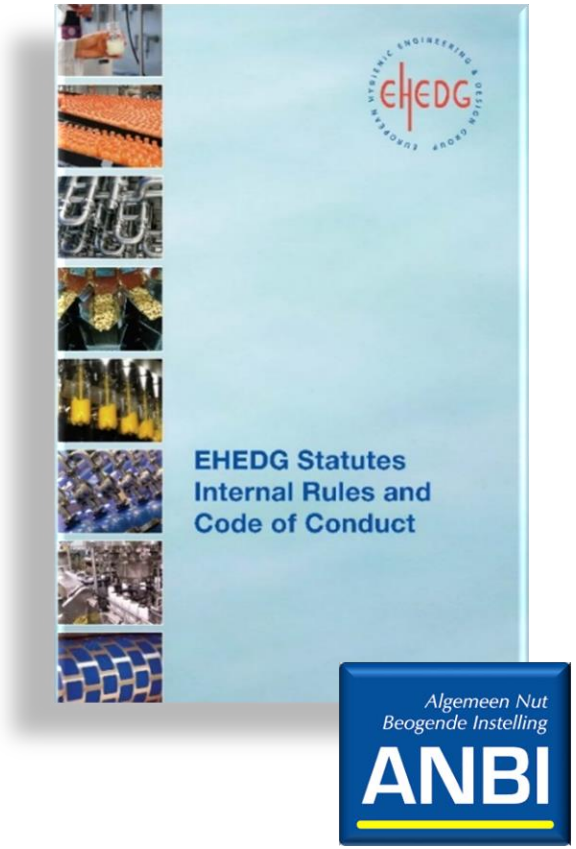
With Contamination



EHEDG – The European Hygienic Engineering & Design Group

- Stichting EHEDG - a Dutch "Institution for General Benefit"
- Founded 1989 as a non-profit consortium by the food industry for the food industry
- Funded by a growing number of strongly committed members

Our mission: EHEDG enables safe food production by providing guidance as an authority on hygienic engineering and design.

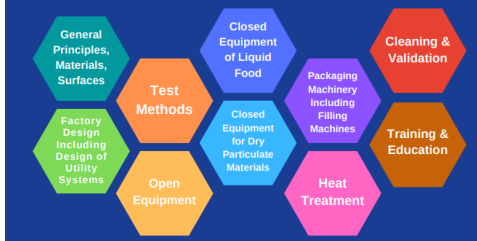


Organisational Fact Sheet | 2021

OUR VISION

To be recognized as the leading source of hygienic engineering expertise and its application, focused on solutions for enhancing food safety and quality across the food industry

OUR PRODUCT PORTFOLIO



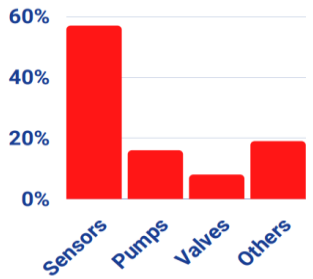
10 Focus Areas
29 Working Groups
50+ Guidelines
50+ Authorised Trainers

OUR CERTIFICATION PROGRAMME

400
Certified equipment components

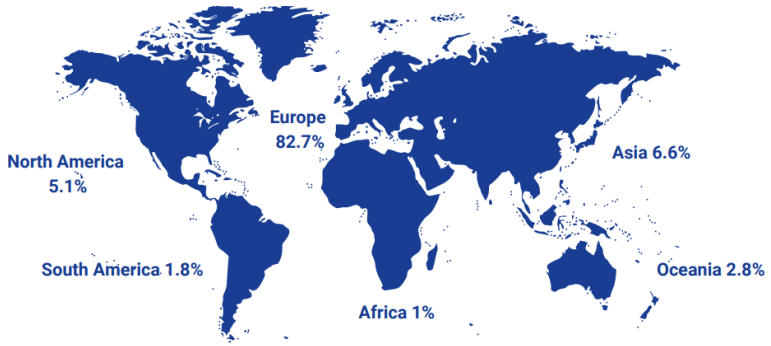
12
Authorised Evaluation Officers

8
Authorised Testing Laboratories

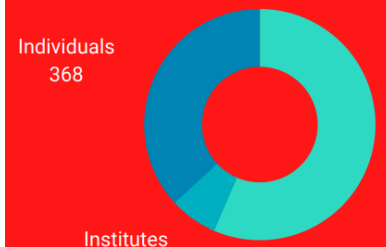


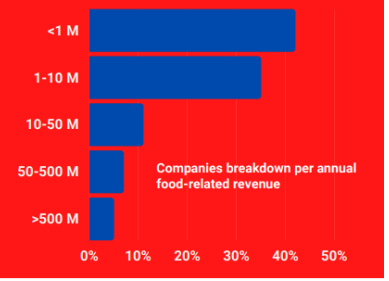
Certified components breakdown

OUR GEOGRAPHICAL PRESENCE



OUR MEMBERS



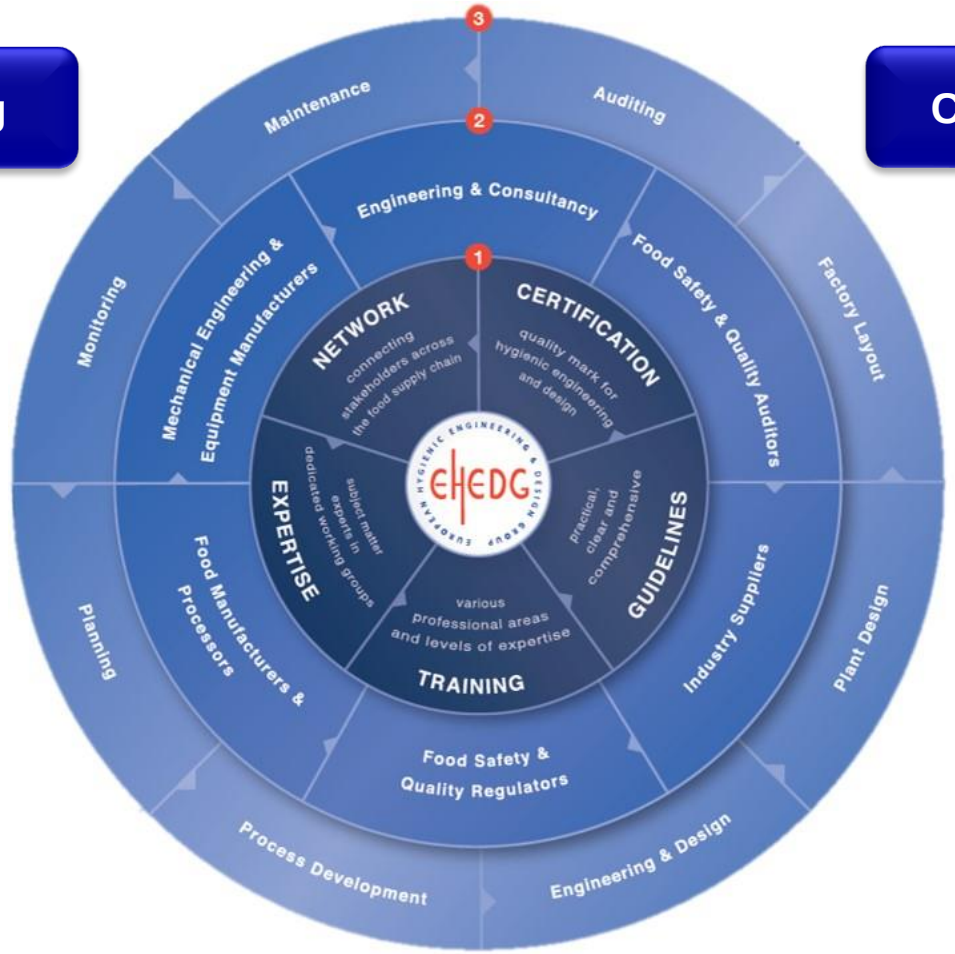


Companies breakdown per annual food-related revenue

EHEDG Services & Capabilities

Networking

Certification



Expertise

Guidelines

Training

Key Hygienic Design Areas

Hygienic Building Design	• Hygienic Floors, Walls, Ceilings, Drains, Zoning • Food Defense, e.g. site security, fencing • HVAC, Cabling, ducts, cabinets
Hygienic Utilities	• Water, Steam • Air
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Personnel Hygiene	• Gowning, e.g. Hand/Shoe cleaning devices • Culture • Practices

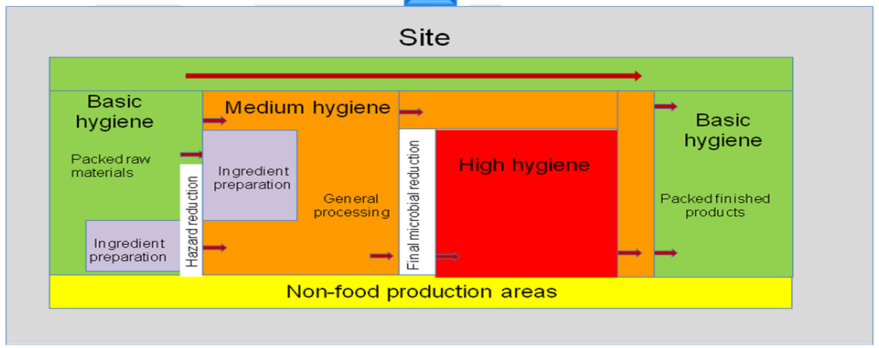
CERTIFIED HYGIENIC ENGINEERING & DESIGN EHEDG EUROPEAN GROUP
TYPE EL - CLASS I
MAY 2011

Key Hygienic Design Areas

Cleaning & Disinfection Requirements

Hygienic Food Production Plant

Building & Service Requirements

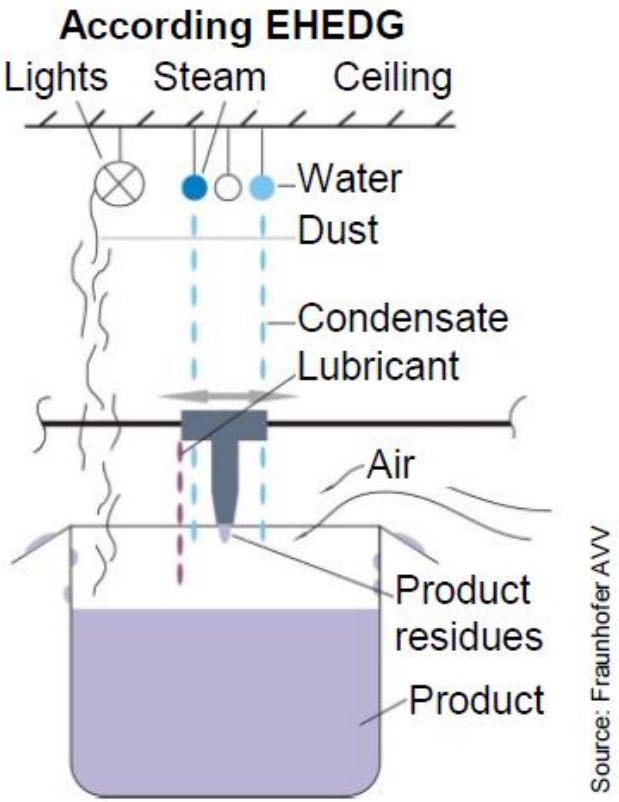


Process & Utility Requirements

Hygienic Design and Food Processing – Machine Areas

Product contact surfaces

The machinery surface which are exposed to the product (**direct**) and from which the product or other materials can drain, drip, or be drawn into the product or product container (**indirect**).



Hygienic Design and Food Processing - Processes

Definition

Open processes

- Product and product contact surfaces are exposed to the environment around the equipment.

Closed processes

- Product and product contact surfaces are NOT exposed to the environment around the equipment during normal processing.

Hygienic equipment class I

- Equipment class I that can be cleaned in-place and be cleaned from soil without dismantling.

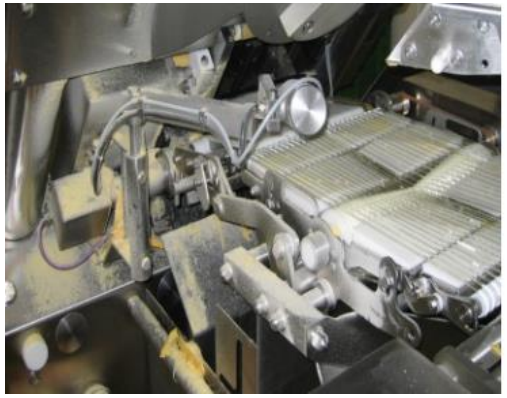
Hygienic equipment class II

- Equipment that is cleanable after dismantling and can be freed from soil after reassembly.

Hygienic Design and Food Processing

Open process (GL: 8, 10, 13, 22)

- product in (limited) contact with environment / surroundings
- often large product contact surfaces with complex geometries
- design of equipment plus environment must prevent any increase in soil and microbial concentration



Closed process

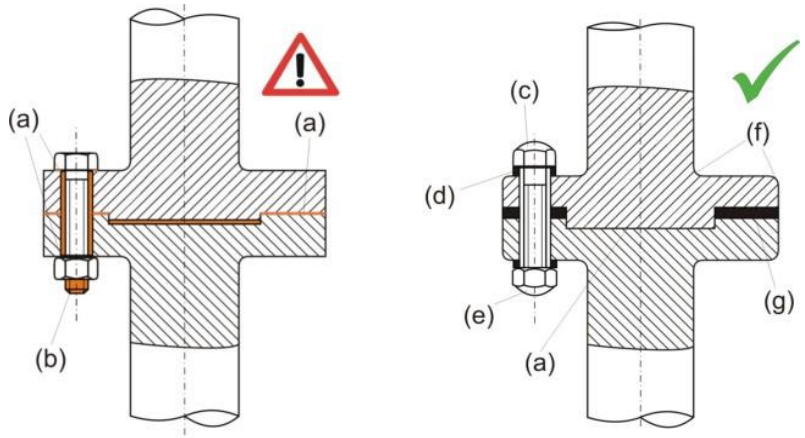
Hygienic Design and Food Processing

General Requirements

- drainability
- avoid sharp edges and corners (r > 3mm)
- cabinets slope away from product
- no overlap joints
- joints continuously welded, sealed
- avoid soil or microbial build-up
- make it close if possible
- keep it covered

Hygienic Design and Food Processing – Surface Geometry

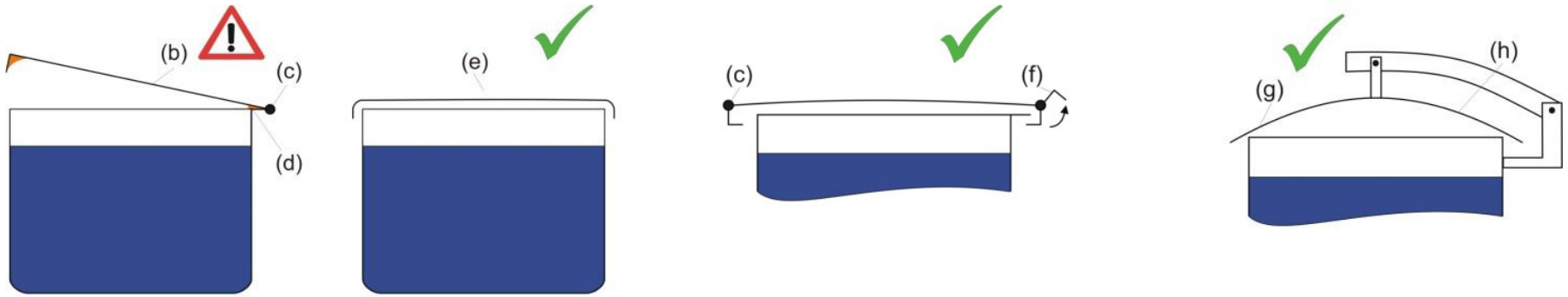
Shaft end and couplings



(a) metal to metal contact,
(b) exposed thread,
(c) domed screw head,
(d) metal-backed gasket,
(e) domed nut,
(f) radius,
(g) seal

Hygienic Design and Food Processing – Surface Geometry

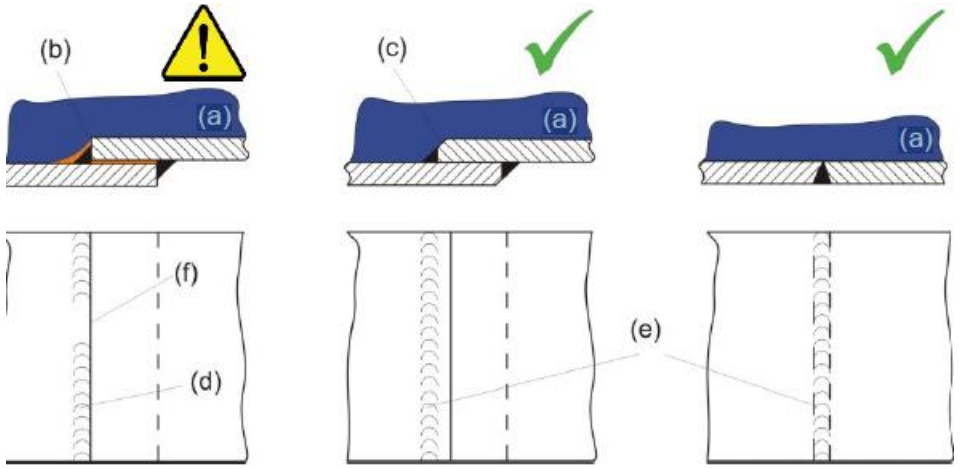
Covers



(a) product area,(b) pivoted cover,
(c) hinge, (d) dead area,
(e) not fixed,(f) hook,
(g) self draining cover,(h) domed

Hygienic Design and Food Processing – Surface Geometry

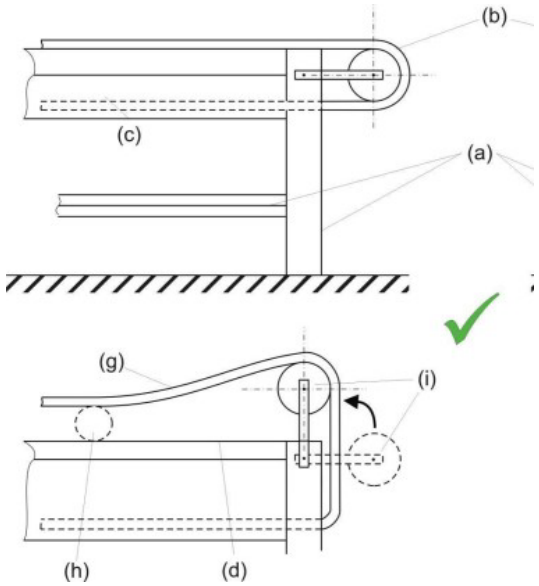
Welding



(a) product area, (b) step, (c) sloped edge, (d) intermittent welding, (e) continuous welding, (f) crevice due to metal-to-metal contact

Hygienic Design and Food Processing – Surface Geometry

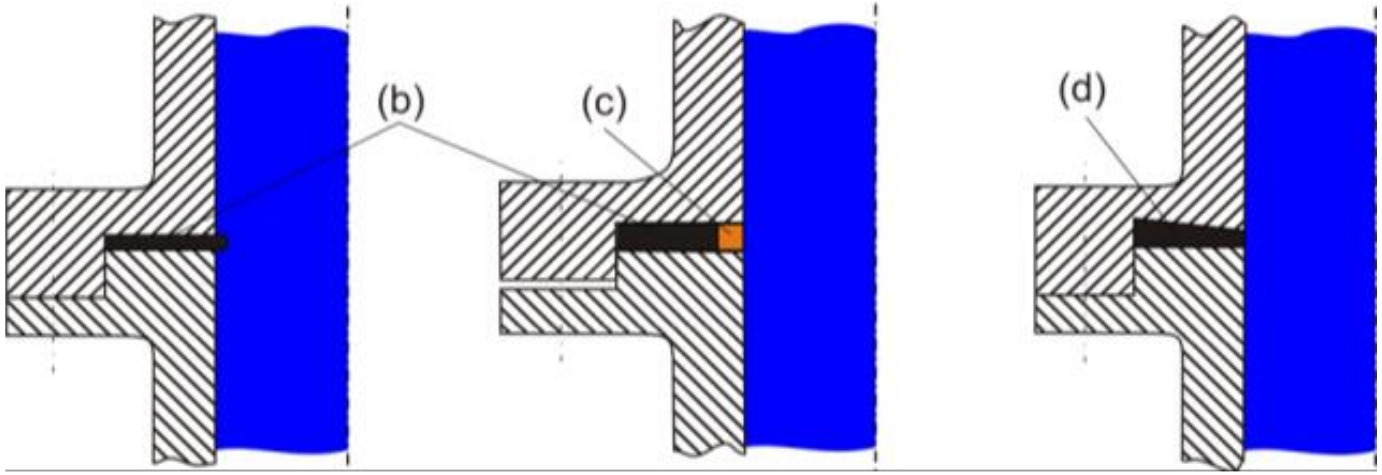
Conveyor Belt design

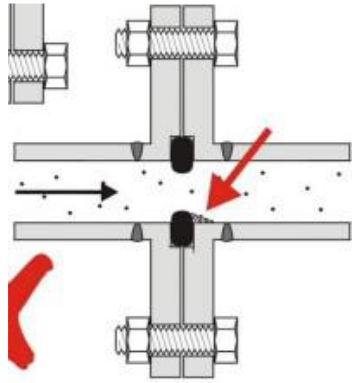


(a) framework, (b) overhanging belt sides, (c) cladding, (d) stainless steel table, (e) roller, (f) belt, (g) released tension, (h) support roller, (i) swivel-mounted roller

Hygienic Design and Food Processing – Surface Geometry

Static Seales

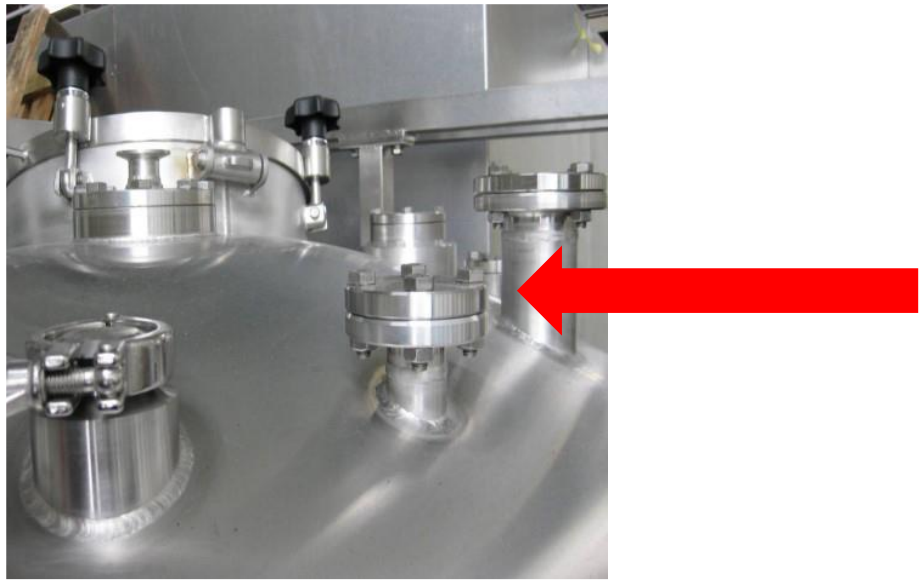




(a) product area, (b) elastomeric seal, (c) crevice, (d) sealing at the product area

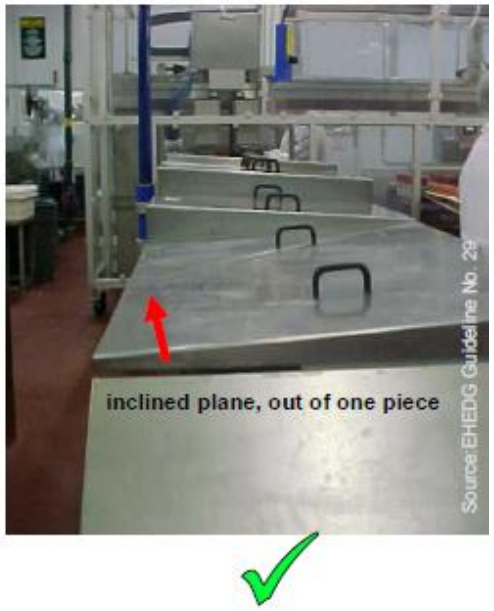
Hygienic Design and Food Processing – Surface Geometry

Cleaning challenges



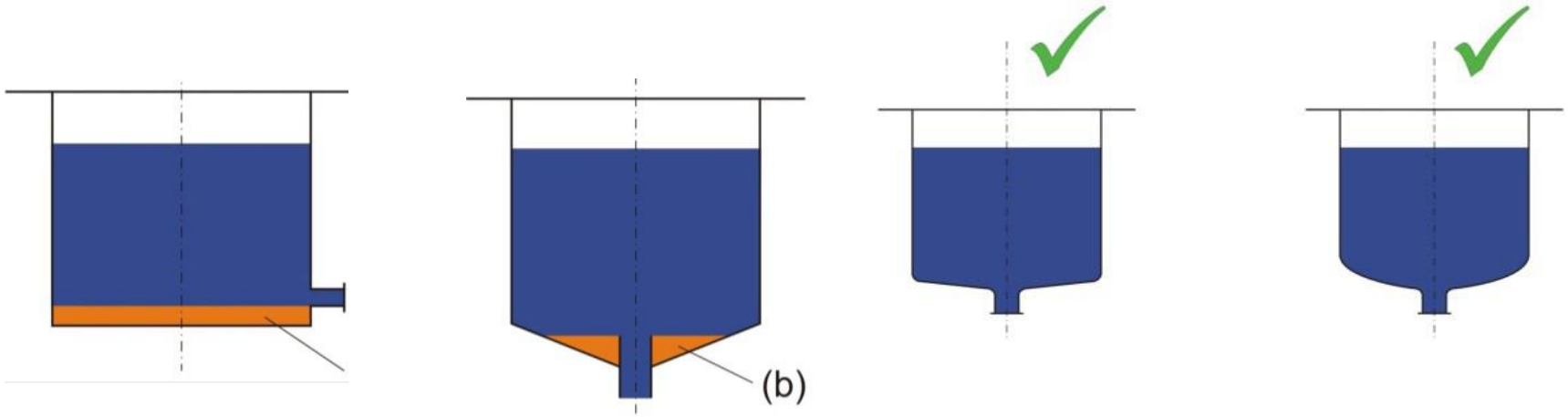
Hygienic Design and Food Processing – Drainability & Layout

- The exterior and interior of all equipment and pipework must be:
  - self-draining or drainable
  - easily cleanable
- horizontal surfaces(upwards or downward facing) must be avoided
- surfaces should always slope away from product
- in case of external surfaces: slope away from the main product area

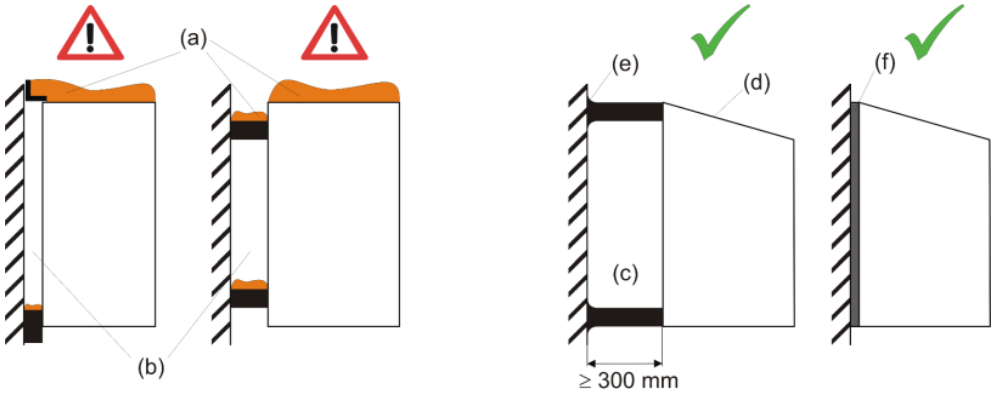


Hygienic Design and Food Processing – Drainability & Layout

Vessels



Horisontal surfaces

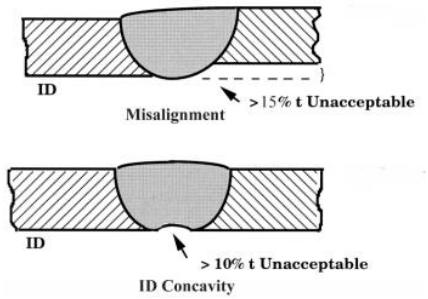


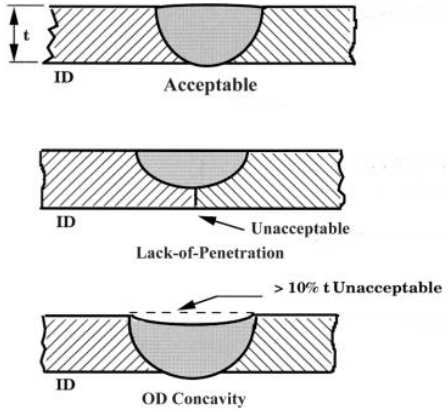
(a) residues of soil, (b) small clearance, (c) clearance, (d) slope, (e) radius, (f) sealing

Hygienic Design and Food Processing – Surface Geometry

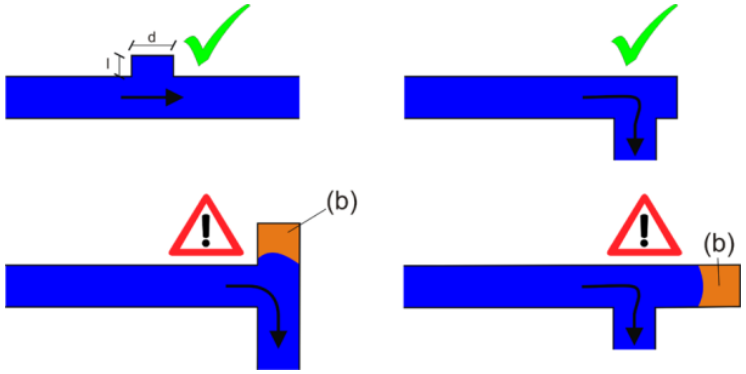
Closed Systems

Welding Requirements
- be free of edges (no mismatch)
- be free of cracks
- no porosity
- if necessary after-treatment



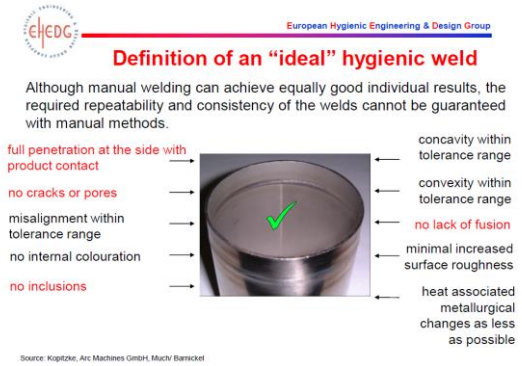


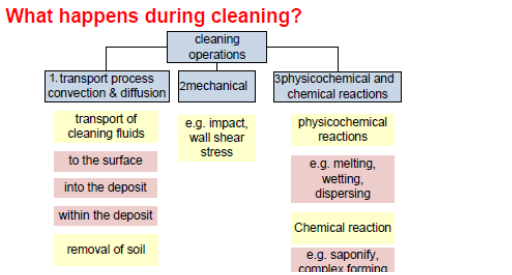
T-Piece Requirements
- avoid deadlegs

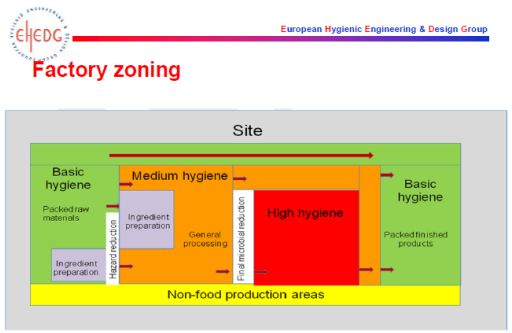


Hygienic Engineering and Design

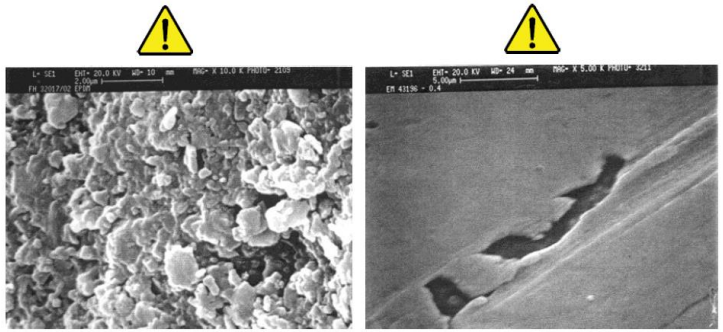
- Mod.03 - Hazards_In_Hygienic_Processing_03-22
- Mod.04 - Cleaning_and_Disinfection_03_2021
- Mod.05 - Hygienic_Design_Criteria_07_2018
- Mod.06 - Materials_of_Construction_10_2020
- Mod.07 - Welding_2018_10
- Mod.08 - Weldinginspection_09_2021
- Mod.09 - Static_Seals_and_Couplings_07_2021
- Mod.10 - Installation_and_Maintenance_Version_One
- Mod.11 - Pumps_and_Homogenizers_06_2018
- Mod.12 - Valves_07_2021
- Mod.13 - Chemical_Treatment_of_SS_Doc.18
- Mod.14 - Dry_Materials_General_04_2017
- Mod.15 - Packaging_ENG
- Mod.16 - Building_layout_07_2018
- Mod.17 - Verification_and_Test_Procedures_05_2021
- Mod.18 - Conveyor_Systems_09_2019





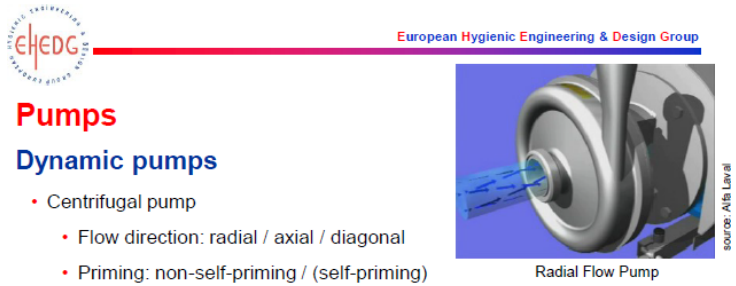


Seal Surface Finish and Defects



The presence of pores in the material and location of split lines/mould flashings is important due to loss of cleanability.

Source: Timberley Consulting



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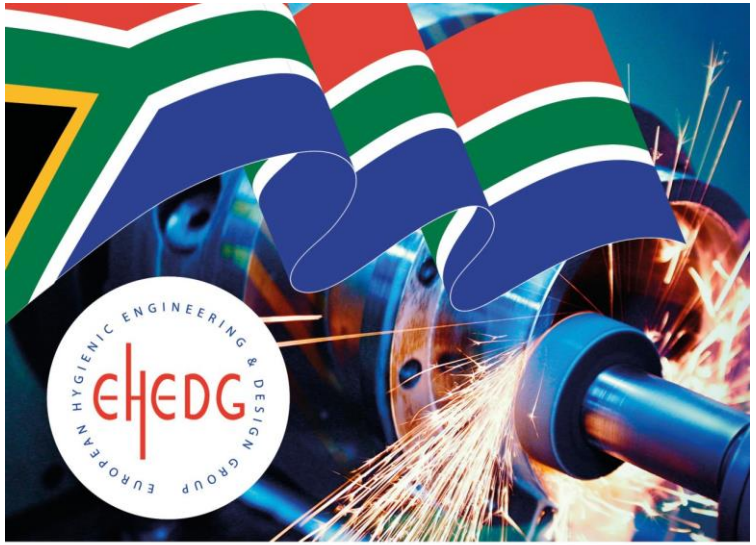

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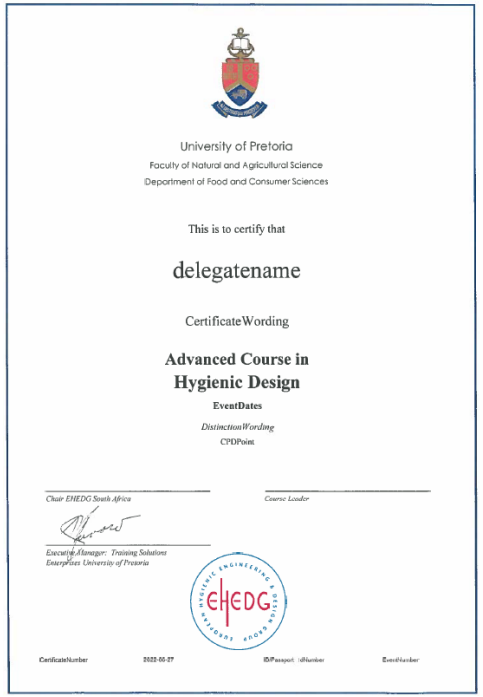

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Thank You!

Any Questions?