Hygienic aspects of food processing and packaging

From general requirements to hygienic design of machinery and equipment

food & drink technology Africa 2014
March 18, 2014, Johannesburg

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Introduction

Why is it so important to consider hygienic aspects of food processing and packaging?

- today, 7 billion people have to be fed
- In 2030, 75% of the world population is expected to live in cities by FAO*
- In 2050, a world population of 9 billion people is expected by FAO

*) Food and Agriculture Organization of the United Nations
Microorganisms

- In some cases (yoghurt, cheese, meat) wanted and useful
- In most cases unwanted and the main reason for food getting spoiled or people getting ill
- Sometimes only one package / batch affected, e.g. if the equipment was cleaned early enough and well enough
- Worst case: Complete machine or processing line is infected
- Micro-organisms are very small and able to live or to survive under diverse conditions
- They live also in biofilms with several species
- If human beings were as small as micro-organisms, all 7 billion people of the world would fit into one glass of yoghurt!
## Microorganisms: differences between bacteria and humans

<table>
<thead>
<tr>
<th></th>
<th>Bacteria</th>
<th>Humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproduction velocity</td>
<td>20 minutes</td>
<td>25 – 30 years</td>
</tr>
<tr>
<td>Dimension (average value)</td>
<td>8/1000 mm</td>
<td>1.70 m</td>
</tr>
<tr>
<td>Coldness and heat tolerance</td>
<td>- 20 °C – 95 °C</td>
<td>-1 °C – 40 °C</td>
</tr>
<tr>
<td>Resistance to environmental pollutant</td>
<td>Hydrochloric acid, alkali: percentage range</td>
<td>Per mille range</td>
</tr>
<tr>
<td>Elimination by heat at</td>
<td>&gt; 100 °C</td>
<td>&gt; 44 °C</td>
</tr>
</tbody>
</table>
Cleaning: Influencing factors
(„Sinner-Circle“)
## Cleaning: General procedures and methods

<table>
<thead>
<tr>
<th>Steps</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pre-cleaning</td>
</tr>
<tr>
<td></td>
<td>Superficial soil removed by brushing or pre-cleaning</td>
</tr>
<tr>
<td>2.</td>
<td>Main cleaning</td>
</tr>
<tr>
<td></td>
<td>Removing of soil with detergents</td>
</tr>
<tr>
<td>3.</td>
<td>Rinsing</td>
</tr>
<tr>
<td></td>
<td>Loose soil and residual detergents are removed</td>
</tr>
<tr>
<td>4.</td>
<td>Disinfection</td>
</tr>
<tr>
<td></td>
<td>Elimination of microorganisms</td>
</tr>
<tr>
<td>5.</td>
<td>Rinsing</td>
</tr>
<tr>
<td></td>
<td>Removal of residual disinfectant</td>
</tr>
<tr>
<td>6.</td>
<td>Drying</td>
</tr>
<tr>
<td></td>
<td>Removal of residual moisture</td>
</tr>
</tbody>
</table>
What we are talking about
Open processes and components
What we are talking about

Closed processes
Cleaning procedures

- **Cleaning In Place (CIP)**
  - automatic process, no manual intervention
  - without dismantling

- **Washing In Place (WIP)**
  - automatic process like CIP
  - includes some manual intervention (e.g. brush or scrubber)

- **Cleaning Out of place (COP)**
  - equipment items are removed
  - cleaning in an automatic station (e.g. washing cabinet)

- **Washing Out of Place (WOP)**
  - manuell washing after complete dismantling

- **Sterilisation in Place (SIP)**
  - sanitizing, disinfecting or sterilizing without dismantling
  - reduction of microbiological contaminations
Cleaning procedures

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Cleaning: Conclusion

- Cleaning is a complex procedure
- Adaption to expected soil necessary
- Consideration of item(s) which are to be cleaned is necessary
- Right choice of detergents (chemistry) and procedure (temperature, mechanics, time) is necessary
- Use CIP / SIP procedures if possible
What is „hygienic design?“
Hygienic design …

… is **understanding**

how a **certain** product

- can be processed and packed,
- within a production plant and production site,
- with food processing and packaging machinery,
- by skilled (!) operators,
- in a way that ensures the product is not affected by
  - unwanted objects (e.g. insects)
  - harmful substances (e.g. machine oil or glass particles)
  - pathogen micro-organisms (e.g. salmonella)
  - quality affecting micro-organisms
General Requirements

a) machinery for foodstuffs must be designed and constructed in a way:
   - to avoid any risk of infection, sickness or contagion;
   - that these materials can be cleaned before each use;
   - that where cleaning is not possible disposable parts have to be used;

b) all surfaces and joints in contact with foodstuffs:
   - must be smooth (no ridges, no crevices which could harbour organic materials);
   - minimize projections, edges and recesses;
   - must be easily accessible for cleaning and disinfection;
   - inside surfaces must have curves with a radius sufficient for cleaning;
General Requirements

c) **liquids, gases and aerosols** from all:
   - foodstuffs
   - cleaning, disinfecting and rinsing fluids
   must be completely dischargeable ("self draining")

   d) **prevent any unwanted substances** (living creatures, insects, any organic matter) from entering areas that cannot be cleaned

   e) no ancillary substances hazardous to health, including lubricants, may come into contact with foodstuffs

   f) material and product combination must be suitable to avoid migration from material compounds into food
Hygienic Design
Pay attention to: Surfaces

Left:
Tube 50.80 x 1.65 mm;
Ground inside in 3 stages:
grain 180/240/320;
Ra = 0.24 µm ; source:
HENKEL Neustadt-Glewe

Right:
tube 50.80 x 1.65 mm;
Electropolished inside;
Material removal approx. 25 µm;
Ra = 0.22 µm ; Source:
HENKEL Neustadt-Glewe

- Should be „smooth“ to avoid growth of micro-organisms

Surface defect on the inside surface of a seamless pipe, material 1.4435
Source: HENKEL Neustadt-Glewe

Cells on a surface
Source: PathogenCombat
Hygienic Design
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Cells on a surface
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Hygienic Design
Pay attention to: Surfaces

- Should be treated well
- Should be free of scratches to avoid growth of micro-organisms

Yeast cells on ground stainless steel

Source: Research Project AiF 13586 N II, 2003 - 2005
Hygienic Design
Pay attention to: Welding

Source: Polysoude
Hygienic Design
Pay attention to: Welding

Source: Polysoude
Hygienic Design
Pay attention to: Seals

Food sector (“product side”)
- Expansion possible under thermal impact
- Seal is aligned towards product side
- Best possible alignment of sealing components

Non-food sector
- Definite free space available for expansion under thermal impact
- Firm compression through axial stop

Source: GEA
Pay attention to: Position and drain

Pictures: VDMA FS 04/2002
Pay attention to:
Radius, corners, screws
Pay attention to: Lubricants, soil entry
Hygienic Design
Pay attention to: Cleanability

- **Cleaning duration** takes about 20 – 30 %*) of the available production time
  - if hygienic design „basics“ are used …
  - if not, the duration will be longer!
  - if the design is improved, the duration can be shorter!!!

> „save time, save money“

*) Estimation 2012 from VDMA Food Processing and Packaging Machinery Association.
Hygienic Design
Pay attention to: Cleanability

- **Water** is the most important „food“.
  - if hygienic design „basics“ are adhered to, less water is needed for cleaning
  - if not, water consumption will be higher!
  - if the design is improved, water consumption can be reduced!!!
  - Also detergent consumption can be reduced

„save resources!“
Summary

- There are many things in building Food Processing or Packaging Machinery, you can do **wrong**.
- And there are a few things, you should pay attention to …
- …or trust in manufacturers, which deliver **The right machines**

*Live a better life with smart technology*
From general requirements to hygienic design of machinery and equipment

Thank you for your attention!

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