Module 3

Cleaning and Disinfection Agents

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Cleaning

What is cleaning?

• **Removal** of non-wanted stuff to secure the safety of foodstuffs
• means reduction of **physical**, **chemical**, and **biological** hazards
• **Food residues** in particular provide a base for the growth of non-wanted microorganisms

Fundamental cleaning procedures

• **Removal** of gross amounts of loose food soils
• Application of cleaning solution
• Rinsing
• Application of disinfection solution
• Rinsing with **drinking water**

Heavy soiling requires gross cleaning
Compounds in cleaners I

Surfactants

• Surface active agents which help to break down the surface tension of water, making it able to wet the soil, and to improve soil removal
• Anionic and nio-surfactants are widely used in cleaners

Complexion agents

• Polyphosphates, phosphonates, EDTA and similar chemicals soften the water by binding calcium and magnesium hardness
• Prevents the deposition of lime and improves the efficiency of surfactants, some also prevent the re-deposition of soil

Oxidative agents

• Peroxide or hypochloride for removal of tough soils, also expose antimicrobial effect (depends on concentration and time)
Compounds in cleaners II

Foam inhibitors

- **Prevent** the occurrence of **foam**, especially important for CIP

Corrosion inhibitors

- **Prevent** **corrosion** in acidic and alkaline cleaners

Other agents

- Stabilisers **prevent clotting and chemical reaction** between the components of a cleaner.
- Chlorine aids peptising (**partial destruction**) of proteins
Types of cleaners

Due to pH regime, there are 3 types of cleaners

- acid cleaners (pH 1-7)
- neutral cleaners (around pH 7)
- alkaline cleaners (pH 7-12)
Acid cleaners

Range of application

- To dissolve organic and inorganic **depositions** like limescale, milk, or beer deposits.
- For cleaning of heating tanks, sanitation areas
- **Corrosive** against certain materials, e.g. aluminium

+ Very good for removal of **mineral deposits**
- **Corrosive** against certain materials, e.g. plastics and aluminium

Typically compounds

- **Inorganic acids** like: sulphuric acid (H$_2$SO$_4$), nitric acid (HNO$_3$), hydrochloric acid (HCl), – **good performance, very corrosive**
- Phosphoric acid (H$_3$PO$_4$), sulfamic acid (H$_3$NSO$_3$) – **good performance, less corrosive**
- **Organic acids** like: acetic acids (CH$_3$COOH), hydroxyacetic acid (C$_2$H$_4$O$_3$), or citric acid (C$_6$H$_8$O$_7$), - **less corrosive, less performance**
Neutral cleaners

Range of application

- **Manual** cleaning processes
- For materials which are **susceptive** against acid or alkaline substances

+ Good for **manual cleaning** procedures (**harmless** pH)
+ Relatively good removal of fats
- Relatively **inefficient against protein** residues

Typical compounds

- Without any acids or alkaline compounds
- Surfactants are mostly non-ionic or anionic surfactants
Alkaline cleaners

Range of application

- **Meat industry**, smoking plants, grills

+ **Good removal of proteins**, to swelling and peptising of proteins
+ **Very good fat removal** properties
- Corrosive against certain materials, e.g. aluminium

Typical compounds

- Sodium or potassium hydroxide (NaOH, KOH) – **good performance, very corrosive**
- Amines and silicates – less **performance, less corrosive**
Disinfection

What is a disinfecting agent?

- Chemical agent that **facilitates reduction** of the number of **microorganisms** in the environment, to a level that does not compromise food safety or suitability
- The aim is to **hamper** or to **kill** the microorganisms

Prerequisite

- **Clean** and **dry** areas without chemical or organic residues
- First cleaning, then disinfection!

Principle techniques

- **Thermal** disinfection
- **Chemical** disinfection
- Combination of thermal and chemical disinfection

Coliform bacteria in a scanning microscope
Requirements for disinfection agents

Requirements

- **Efficient and fast** killing of a broad range of microorganisms
- Non toxic to humans
- Should not cause problems to **skin** or **production facilities**
- High tolerance against **protein residues**
- High tolerance against **surfactant residues**
- **Bio-degradable**
- Long shelf life

Choice of disinfectant

- Must be **proofed** for use in the food industry
- **Only those Products** that have been tested by independent, certified laboratories, or that have been listed by hygiene societies (e.g. VAH, and DVG lists in Germany, SSFH list in France) should be used.
Applied disinfecting agents

Alcohols: ethyl alcohol

Used for hand disinfection and surface disinfection

+ Acts **fast** and **efficiently** against many bacteria
+ **Low toxicity** towards humans
+ Does not leave any residues

- Can only be applied on small surfaces (otherwise risk for explosion)
- Low efficiency against **spores**
- **Long incubation time** if applied against viruses
- Needs **high dosage** (70 %)
- Expensive

Alcoholic group

R-\(\text{O}\)-H

Implications of HACCP for cleaning enterprises
Module 3 - Cleaning and Disinfection Agents
Applied disinfecting agents

Halogens: chlorine

**Active chlorine**, applied for CIP, for manual cleaning in sanitary areas, or low pressure foam applications

+ Widely efficient against bacteria, fungi, and viruses
+ Fast action
+ Residues easy to remove by rinsing
+ Cheap

- Protein residues consume chlorine (protein faults)
- Causes skin irritation and attacks certain materials
- Extremely dangerous if combined with acidic products in high dosages due to the emission of chlorine gas!
Applied disinfecting agents

Oxidants: hydrogen peroxide

**Active oxygen**, applied for CIP

+ Widely efficient against bacteria, fungi, and viruses*
+ **Fast** action *
+ **No residuals** left

- Requires **elevated temperatures** for fast action (T > 55°C)
- **Non stable**, dissociated to water and oxygen

* More efficient, less dangerous, and environmentally more friendly than active chlorine,
Applied disinfecting agents

Surface active compounds: quaternary ammonium compounds (QAC)

Have similar properties than surfactants

+ No smell, no taste
+ Low corrosion
+ **Low toxicity** towards humans
+ Can be applied at wide range of pH

- Low efficiency against certain bacteria (**gram negative bacteria**)
- Hampered by anionic surfactant residues - **soap failure**
- Hampered by proteins - **protein failure**
- **Long** incubation time
- Needs **a lot of water** for rinsing
Example for a cleaning and disinfection process

- Perform **gross cleaning** (dry or wet cleaning methods)
- Perform **cleaning** with cleaning solution
- Surfaces to be cleaned must be **completely covered** by cleaning solution
- **Rinse** carefully with water to remove remainders of the cleaning solution
- Apply disinfectant solutions with **clean working tools** (mops, buckets, transportation units …)
- Surfaces must be completely covered by the disinfectant solution
- Check for the **correct concentration** of the disinfectant – remember that remaining water will dilute the disinfectant
- Keep the **contact time**
- Rinse with **clean water**
Quality control

Success of cleaning and disinfection process will be controlled!

• According to the rules of the cleaning company’s internal QM system
• According to the rules of the food producer’s internal QM system

Who controls?

• Personal with a professional background in hygiene or microbiology

Documentation of the cleaning and disinfection process

• According to the food producers HACCP system
Important aspects

When applying cleaners and disinfectants

- **Never mix** cleaners and disinfectants!* Risk for explosions
- Apply disinfectants **after** cleaning processes
- Apply disinfectants on **dry** and **clean** surfaces
- Microorganisms generally do **not** become resistant against disinfectants, but
- **Viruses** have a high tolerance against disinfectants
- Low efficiency of disinfectants mostly caused by **malfunction of processes**, e.g. wrong incubation time
- Some disinfectants like QAC do not work on certain organisms

* Only use **manufactured articles**, e.g. on lightly soiled systems
Common problems

Corrosion after use of cleaners and disinfectants

- **Harmful effect** of agents on material (pH too high or too low, low Resistance towards organic solvents)

**Examples**
- Irreversible **yellow stains** on Linoleum due to application of alkaline
- **Foaming of marble** due to the use of acids
- Some plastics and dyes **dissolve** upon contact with organic solvents

**Solution**

- **Read** the instructions carefully, **investigate** what types of materials are present and how to clean and disinfect them
Common problems

Residues after use of cleaners and disinfectants

- Reduce the **functionality** of surfaces (roughness, stickiness)

**Examples**
- QAC leave **sticky remainders** (have to be removed regularly)
- Silicon junctions often cause **slickness** and increase surface tensions
- Some plastics **macerate** and may **dissolve** upon contact with organic solvents

**Solution**
- Read the instructions carefully, **investigate** what **types of materials** are **present** and how to clean and disinfect them
Occupations health

Before starting to work with cleaners and disinfectants

- Read the **standard operating procedure** (SOP) for your working area (storage, processes, safety measures, disposal, legal requirements on the safety of chemicals)

- Read the **safety instructions**, e.g. material safety data sheet before applying chemicals the first time

- Apply **skin care products** before and after work

- Use **personal protective equipment** (gloves, overalls, glasses) whenever appropriate, see SOP
End of module

The modules and additional information on cleaning and disinfection agents can be obtained from

• www.hygieneforcleaners.eu

„Though I know a lot, I want to know everything."

J. W. v. Goethe (1748 – 1832)
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Further on with module 4!