Hygienic Design as a Tool in Improving (Equipment) Surface Hygiene

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Factors Affecting the Hygiene e.g. in Milking Equipment

Contamination e.g.
- microbes
- soil

Product

Constructions

Lay-out of process lines and equipment

Equipment surfaces

HYGIENE

GMP & Employees

Cleaning & disinfecting practices

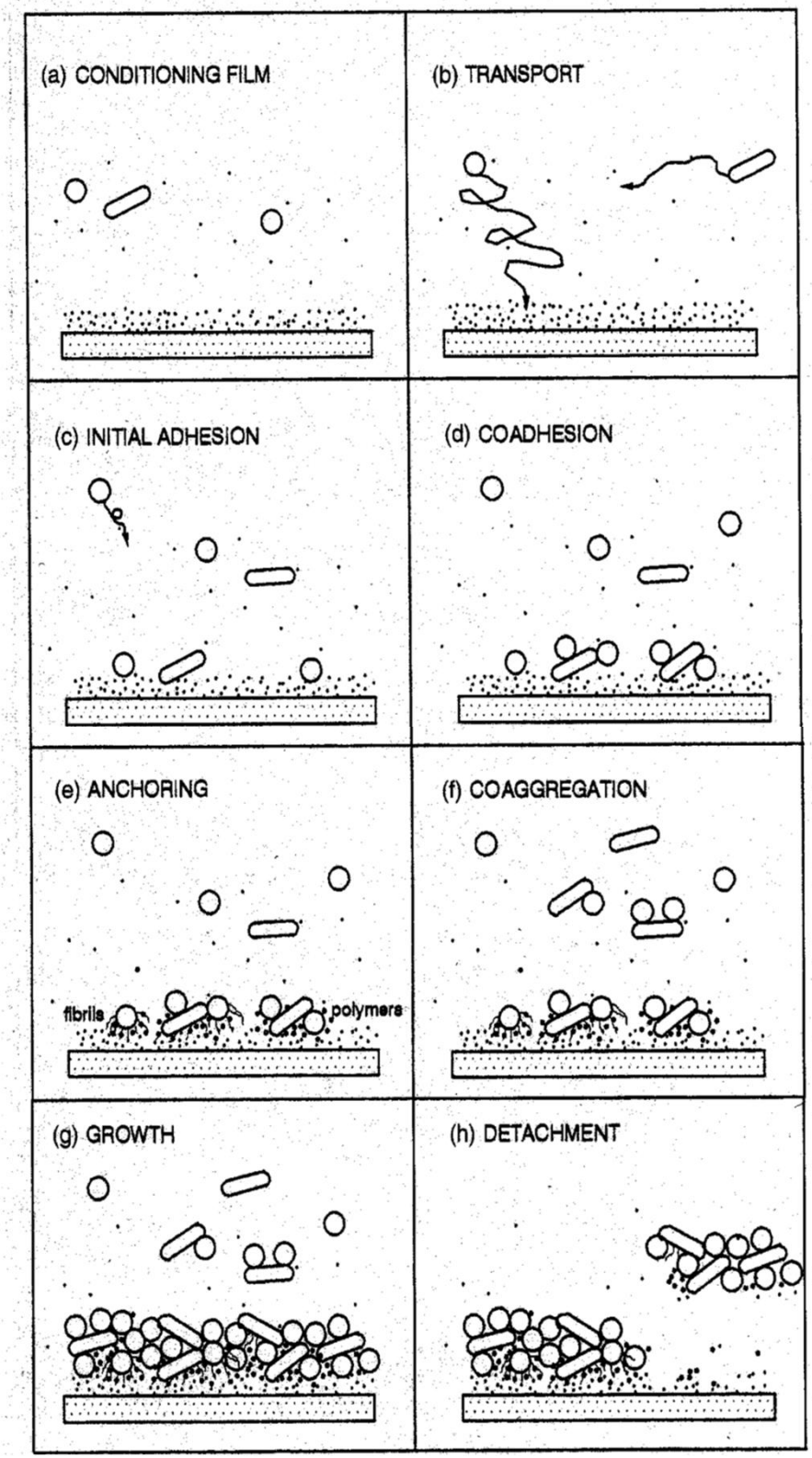
Lubricants

Cleanliness of process facilities, Water, steam and air quality

Phases in the Biofilm Formation

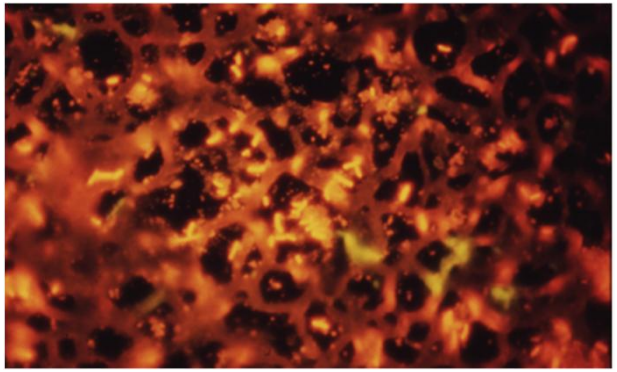
Acc. to Busscer & van der Mei (2000) in "Initial microbial adhesion events: mechanisms and implications".

In Proc. 59th SGM Symposium, p. 25-36, Cambridge University Press, ISBN 0 521 79302 5.

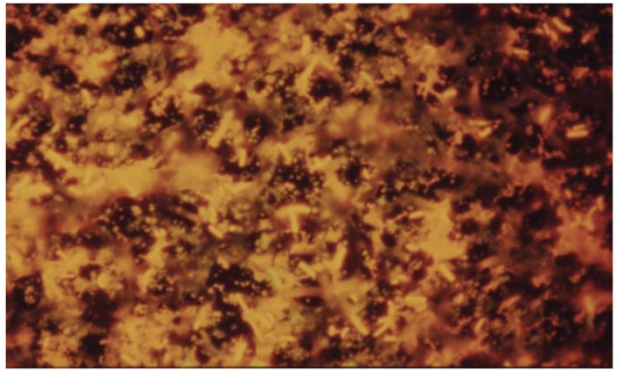


Biofilm Consists of:

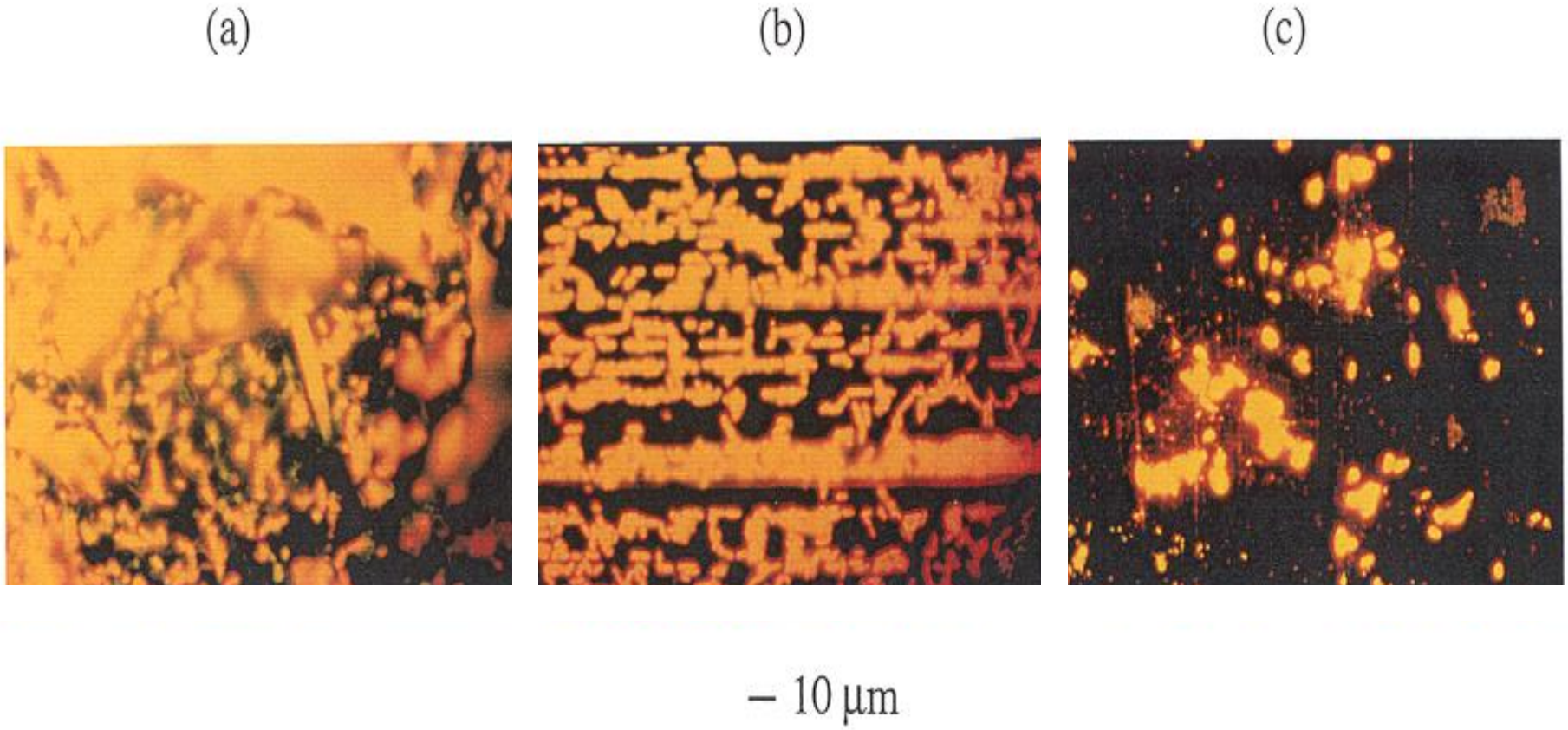
- **Microbes**
- **Extracellular polymers (EPS**; polysaccarides, glycoproteins etc. from microbes)
- **Water** (85 - 98%)
- **Captured particles** and other dissolved materials from the process stream



a) 6 d biofilm of *Lactobacillus brevis*



b) the same biofilm after swabbing



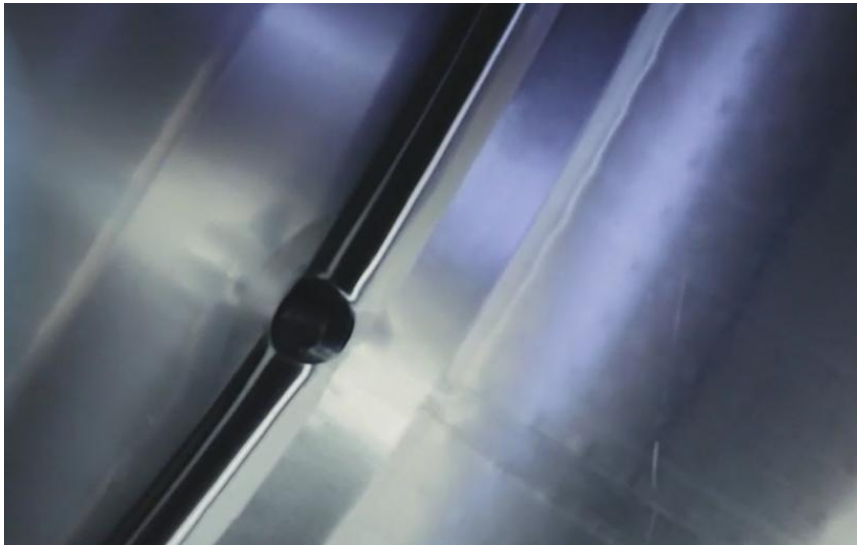
Microscopying of 5 d* Pseudomonas fragi *biofilm stained with acridine orange on various stainless steel surfaces (AISI 304): (a) glass blasted, b) lapped and c) mechanically polished

(acc. to Wirtanen, Saarela, Mattila-Sandholm. 2000. Biofilms – Impact on hygiene in food industries. In: Bryers (Ed.) Biofilms II: Process analysis and applications. Wiley-Liss Inc. Pp. 327-372.)

Design & Construction -

process lines and surfaces must be:

- **Accessible**
- **Cleanable**
  - Smooth surfaces
  - No metal-to-metal contact
  - No steps/misalignment
  - Crevice free
  - Use rounded corners
  - Inclined
- **Drainable**



Biofilm Effects in Food Processing

- **cleaning and disinfection processes** are affected and the **choice of chemicals, flow, time and temperature** must be altered
- **increased** need of **maintenance** in process lines and equipment e.g. prolonged down-time or **laborious demounting of equipment** e.g. in heat exchangers, in water supply systems, in granular activated carbon columns, in reverse osmosis membranes, in ion exchange systems, in water storage tanks and in microporous membrane filters **due to cleaning and hygiene, energy losses & blockages**.

Biofilm Effects in Food Processing

- **energy losses** in processing e.g. prolonged pasteurization
- **deterioration on specific chemical reactions** e.g. contamination of immobilized cell systems
- **deterioration of products** e.g. the product can be of lowered quality already after production
- **limited shelf-life** of the products
- occurrence of **pathogenic microbes** which increase the risks of **foodborne poisoning**

What to Remove?
Physically

- remove visible **organic gross soil**
  e.g. fat, protein, sugar & carbohydrates
- remove visible **inorganic residues**
  e.g. mineral salts (milk stone)

What to Remove?
Chemically

- remove **crust** e.g. milkstone
- remove **allergens**
  - allergens can be determined by using specific protein assessment kits
- remove **cleaning agents** through rinsing
- remove **disinfectants** through evaporation or final rinsing (with potable)

What to Remove?
Microbiologically

- reduce number of **spoilage microbes** to an acceptable level
  - can be determined using
    - **culturing on agar plates** (nutrient or specific)
    - **rapid tests** (adenosine tri-phosphate (ATP), protein residues etc.)
    - **visual** or organoleptic inspection
- free surfaces from **pathogens**

When to Clean Wet Surfaces?

After production – daily cleaning

but also

cleaning during production –

a) always when visible soil is seen in the process or

b) when microbial growth is estimated to reduce quality of products produced

and **periodic cleanings** –

c) of both process facilities and equipment

How to Clean?

Ensure high quality and safe products of **high quality** raw materials by:

1. **removing soil from**
2. **removing / killing microorganisms from**
3. **avoiding recontamination of surfaces**

by combining proper design and effective cleaning & disinfection through the whole processing.

Phases in Open & Wet Cleaning e.g. Milk Tank Area

- è **Manual dry cleaning** e.g. brushing or vacuum cleaning
- è **Removal of gross soil** from process **facilities** through **rinsing**
- è **Removal of visible soil** from process **facilities** through **cleaning and rinsing**
- è **Cleaning of equipment**
- è **Rinsing of equipment**

Phases in Open & Wet Cleaning e.g. Milk Tank Area

- è **Disinfection of equipment surfaces** to kill living residual microbes
- è **Fogging** i.e. disinfection of process facilities
- è **Drying of equipment and processing facilities** using efficient air conditioning
- è **Keep** cleaned and disinfected process equipment **as dry and cool as possible** to reduce regrowth.
- è **Equipment parts should be stored on shelfs**

NOT on the floor.

Cleaning & Design as Tools in Process & Equipment Hygiene

- An **optimal solution** is to have equipment exactly designed according to hygienic design principles:
- which is **usually NOT feasible in practice** - there will always be compromises
- **therefore, devices** that as much as possible **follow the hygienic design principles** should **be used**
- **It is also important to know the risks *e.g.***:
  - to deside when there is need for extra cleaning
  - use hard to clean places as control points when checking cleaning efficacy

Parties Involved in Improved Food Processing Hygiene

Constructors & Equipment Manufacturers

Food Producers – both Primary Production and Food Processing

Hygienic Process Solutions

Cleaning Agent & Disinfectant Manufacturers

Cleaning & Maintenance Services