# Sustainability in commercial laundering processes

Module 1
**Usage of water**

Chapter 3 c

# Fresh water disinfection

# Content

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Leonardo da Vinci

- Introduction
- Origin of microbial contamination of water
- Disinfection methods of water
  - Chlorination
  - Peroxyacetic acid
  - Ozone
  - UV irradiation

# Learning targets



After finishing this chapter, you will

- Know the origin of microbiological contamination in wash water
- Know and be able to name the four main disinfection methods for laundry water
- Be able to explain the advantages and disadvantages of each method

# Introduction



- throughout the history, the search for fresh and clean water was a priority
- when the relationship between water-borne diseases and drinking water was established, the technology for water treatment and disinfection developed rapidly and health authorities established standards

first water treatment was a slow sand filtration system developed in New York in 1870

chlorination for microbiological disinfection was introduced at beginning of last century

# Origin of microbial contamination



- water after treatment in softening devices
- water after press extraction
- treated water for pre-washing

# Origin of microbial contamination
## water after treatment in softening devices



**Ion exchange plant**

during use of ion exchange unit microorganisms can settle on surface of synthetic polymers and grow, thus forming a biofilm

# Origin of microbial contamination
## water after treatment in softening devices

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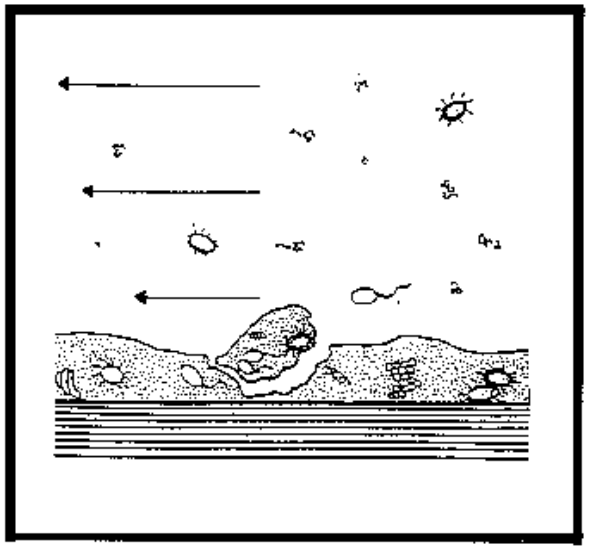
when biofilm reaches a critical size, the microorganisms start to flush into the softened water causing biofouling



growth of microorganisms is prevented by continuously chlorination or addition of peroxyacetic acid

# Origin of microbial contamination
## water after press extraction

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- micro organisms in press water may result from:
  - surviving disinfection on textiles
  - reused water
  - parts of the extract press that came into contact with the textile
- water extract press is an important critical point
- see RABC, EN 14065
- regular cleaning and disinfection measures must be always taken seriously

# Origin of microbial contamination
## water for pre-wash



- for pre-wash water is used from
  - Re-used water from extract press
  - rinse water
  - fresh water

- contamination may arise from
  - storage tanks
  - press

# Decontamination methods for laundry water



- chlorination
- peroxyacetic acid
- UV-irradiation
- ozone generation

# Chlorination



- chlorination is most common method of water disinfection and is used worldwide for the disinfection of textiles/laundry

- chlorine is effective in destroying a variety of bacteria, including
  - *Salmonella*, *Shigella* and *Vibrio cholera*
  - as well as some viruses and protozoa

# Chlorination



- chlorine can be used in disinfection as
  - gas
  - liquid sodium hypochlorite solution
  - solid calcium hypochlorite
  - similar chlorine-based chemicals

- where a large amount of chlorine is needed for disinfection, chlorine gas is preferred instead of sodium hypochlorite due to its costs and effectiveness

# Chlorination

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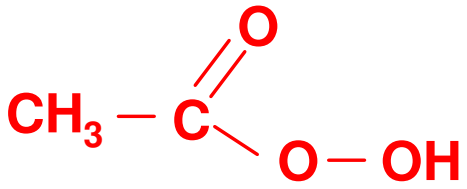
- Advantages
  - effective against a variety of bacteria, viruses, protozoa
  - Application possible as
    - Gas **$Cl_2$**
    - sodium hypochlorite **NaOCl**
    - calcium hypochlorite **$Ca(OCl)_2$**
    - similar chlorine based chemicals
  - against slime bacteria
  - oxidizes iron and manganese to solids

- **Disadvantages**
  - causes bad smell and taste
  - chlorination of organic compounds may cause harmful and/or carcinogenic products
  - tough protozoan cysts are fairly resistant
  - residual chlorine or chloramines may also be capable of chlorinating organic material in the natural aquatic environment

# Peroxyacetic acid



- Peroxyacetic acid is a mixture of acetic acid and hydrogen peroxide in an aqueous solution




- PAA is a strong disinfectant with a wide range of antimicrobial activity
- due to its bactericidal, virucidal, fungicidal, and sporicidal effectiveness it is applied in various industries
- its primary use in water treatment is to replace chlorine and supplement UV disinfection

# Peroxyacetic acid

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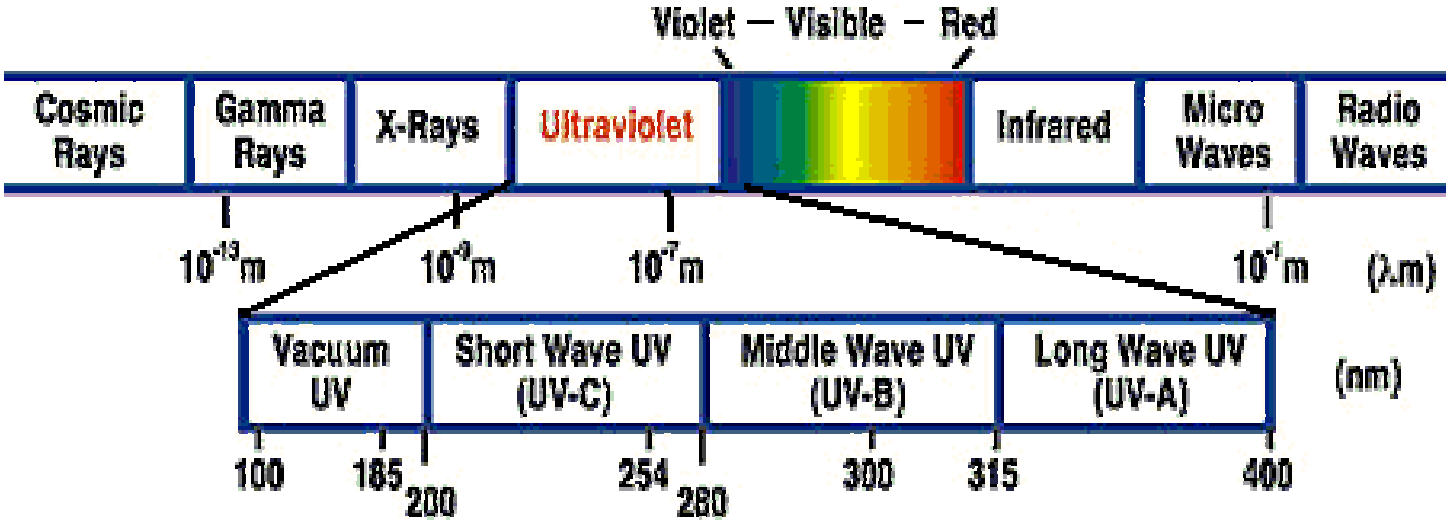
- **Advantages**
  - stronger oxidising potential than chlorine or chlorine dioxide
  - no known carcinogenic, mutagenic, toxicogenic properties
  - Quickly degradation without potential to bioaccumulate
  - high activity against a wide spectrum of micro organisms

- **Disadvantages**
  - not stable: it needs to be mixed on-site and as-needed basis

# UV irradiation

- ultraviolet (UV) light is electromagnetic radiation
- wavelength is shorter than that of visible light, but longer than X-rays



# UV Irradiation



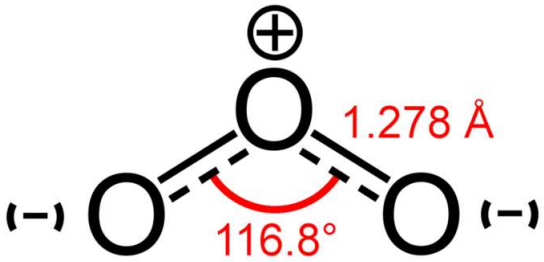
- UV-rays destroy in a concentrated dose a wide range of micro organisms
  - genetic material (DNA) in cells becomes altered
  - micro organisms can no longer reproduce
- UV light is produced by germicidal lamps that are submerged in an open channel for the wastewater
- Passing the UV lamps, the micro organisms in the waste water are exposed to a lethal dose of UV energy

- **Advantages**
  - can destroy a wide range of micro organisms by high UV-dose
  - no known toxic or non-toxic by-products generated
- **Disadvantages**
  - not suitable in water with high turbidity, organic material or suspended solids
  - not effective against any non-living contamination
  - tough cysts are fairly resistant

# Ozonation



- ozone consists of 3 atoms of oxygen and is a powerful oxidizing agent




- formed in nature by UV irradiation and lightning discharges
- destroying harmful bacteria, it generates no by-products unlike most disinfectants
- commercial ozone generators are connected to pressurized wastewater pipelines and use high electrical voltage to generate ozone

# Ozonation

- **Advantages**
  - reverts to pure oxygen without trace
  - oxidizes and precipitates iron, sulphur, manganese
  - higher sporicidal efficiency than hydrogen peroxide
- **Disadvantages**
  - may produce harmful compounds such as formaldehyde
  - form nitric oxides and acids that may cause corrosion
  - is chemically unstable
  - needs to be produced on-site and used immediately