

Sustainability in commercial laundering processes

Module 1
Usage of water

Chapter 3 c

Fresh water disinfection

- 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 the beginning of the 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

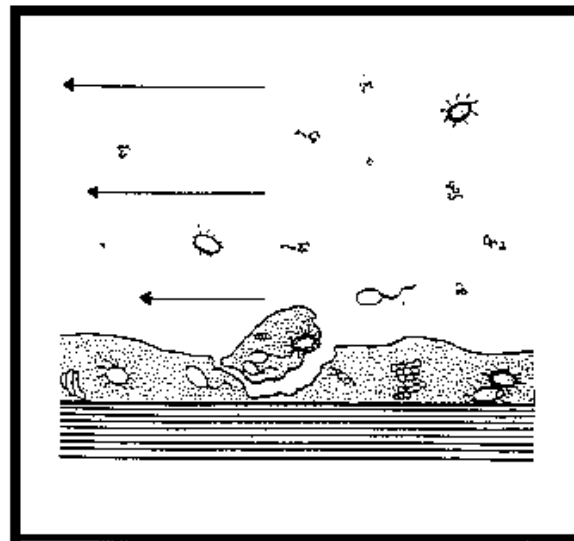


Ion exchange plant

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

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

- micro organisms in press water may result from:
 - surviving disinfection on textiles
 - reused water
 - parts of the extract press that contacted 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

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

- chlorination is the 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

- 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

- Advantages

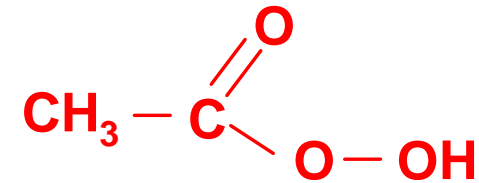
- effective against a variety of bacteria, viruses, protozoa
- Application possible as
 - Gas Cl_2
 - sodium hypochlorite NaOCl
 - calcium hypochlorite Ca(OCl)_2
 - similar chlorine based chemicals
- against slime bacteria
- oxidizes iron and manganese to solids

▪ 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 application in water treatment is to replace chlorine and supplement UV disinfection

- **Advantages**

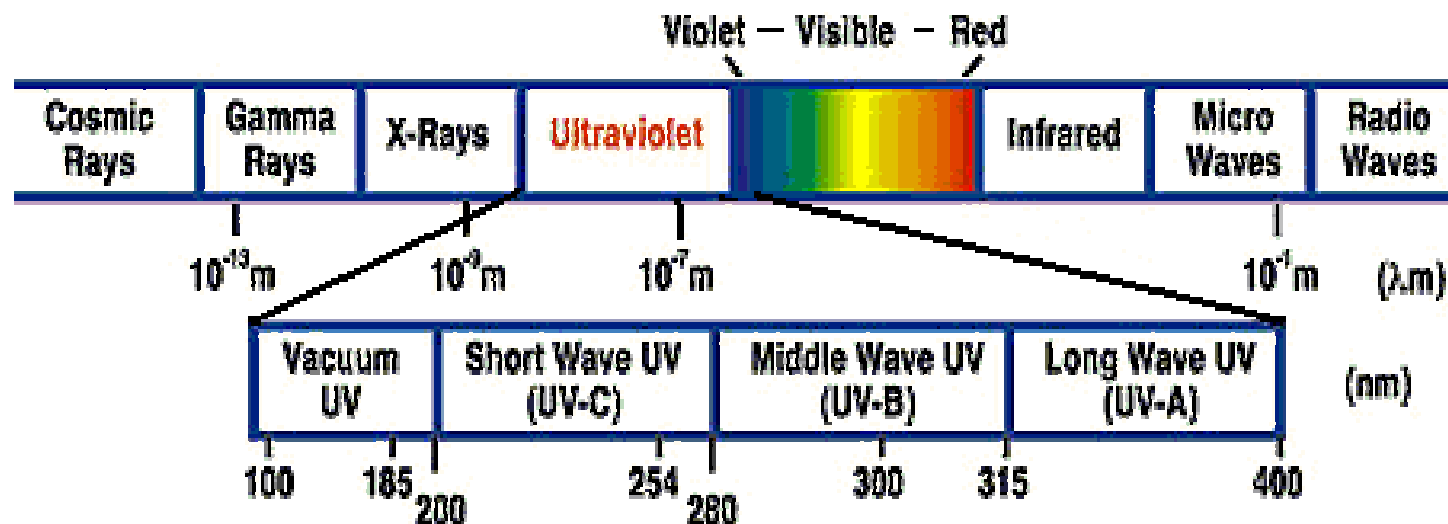
- stronger oxidising potential than chlorine or chlorine dioxide
- no known carcinogenic, mutagenic, toxicogenic properties
- Quickly degradation without potential to bioaccumulate
- high activity against a wide spectrum of micro organisms

- **Disadvantages**

- not stable: it needs to be mixed on-site and on 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-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**

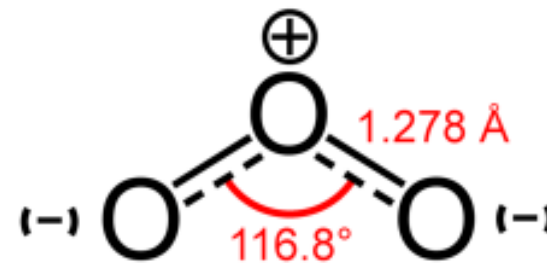
- can destroy a wide range of micro organisms by high UV-dose
- no known toxic or non-toxic by-products generated

- **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

- **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