Consultancy and Engineering

Sustainable Water Integrated Management

(SWIM) - Support Mechanism

SUB-REGIONAL WORKSHOP 9-12 July 2012 Israel

Water treatment options

Standard treatment schemes and technologies

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Why treat drinking water?

To give him healthy chance

Water sources

- Surface water (lakes, rivers, rain catchment)
- Aquifer
- Desalination
- Recycled water

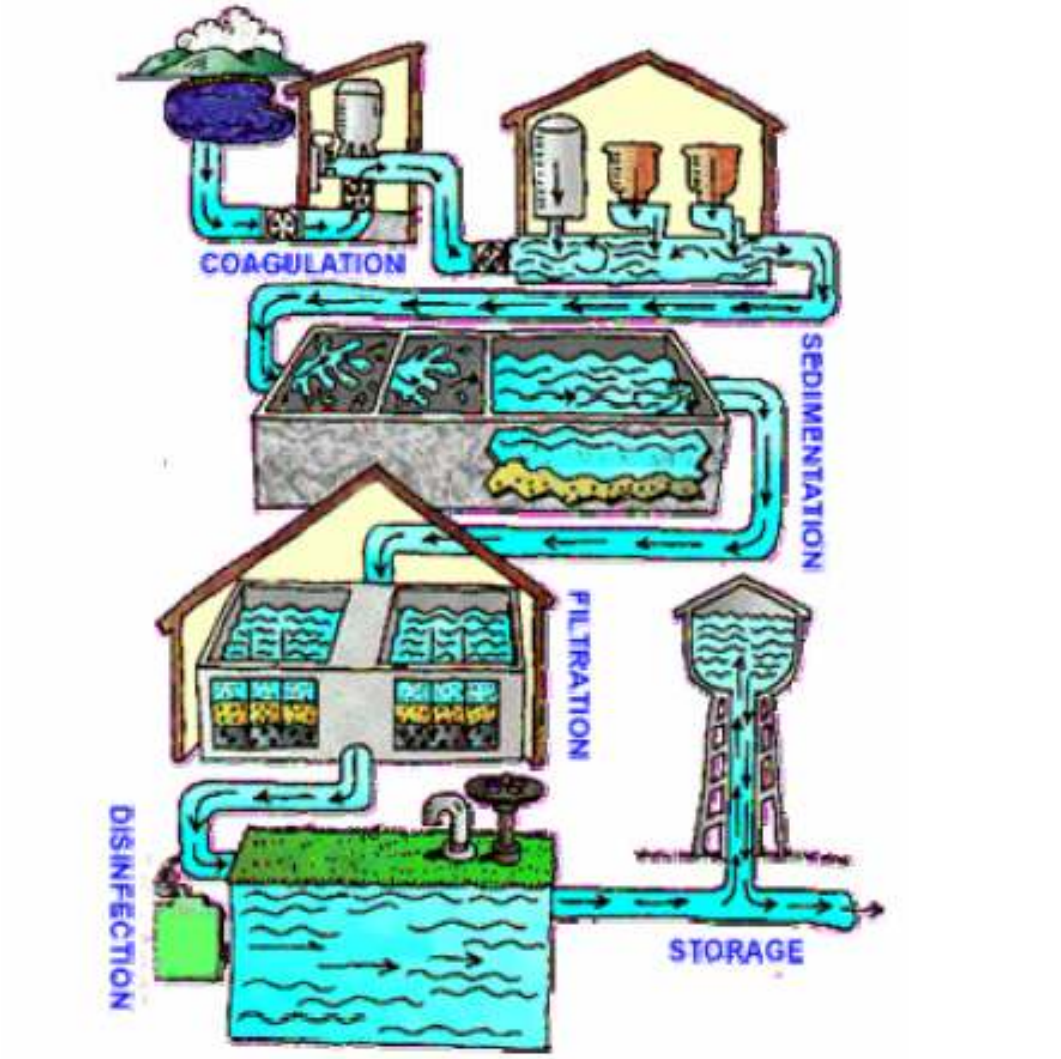
Source water is not H2O!

Treatment targets

- Physical targets (solids, turbidity)
- Health targets (bacteria, virus, pollution, minerals)
- Aesthetics (odor, color)
- System maintenance (hardness)
- Meet standards

The challenge: fit solution to the requirement

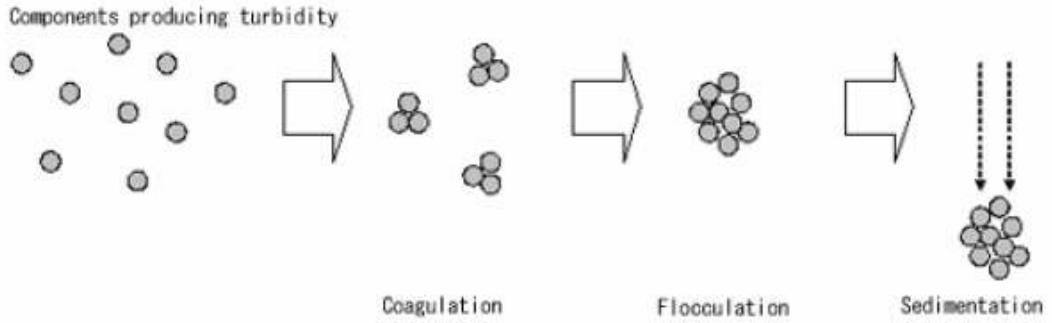
Common water treatment scheme



Coagulation and flocculation

Diameter of Particle	Type of Particle	Settling time through 1 m. of water
10mm	Gravel	1 seconds
1mm	Sand	10 seconds
0.1mm	Fine Sand	2 minutes
10 micron	Protozoa, Algae, Clay	2 hours
1 micron	Bacteria, Algae	8 days
0.1 micron	Viruses, Colloids	2 years
10 nm	Viruses, Colloids	20 years
1 nm	Viruses, Colloids	200 years

Settling Time for Particles of Various Diameters;



Process of Coagulation, Flocculation and Sedimentation

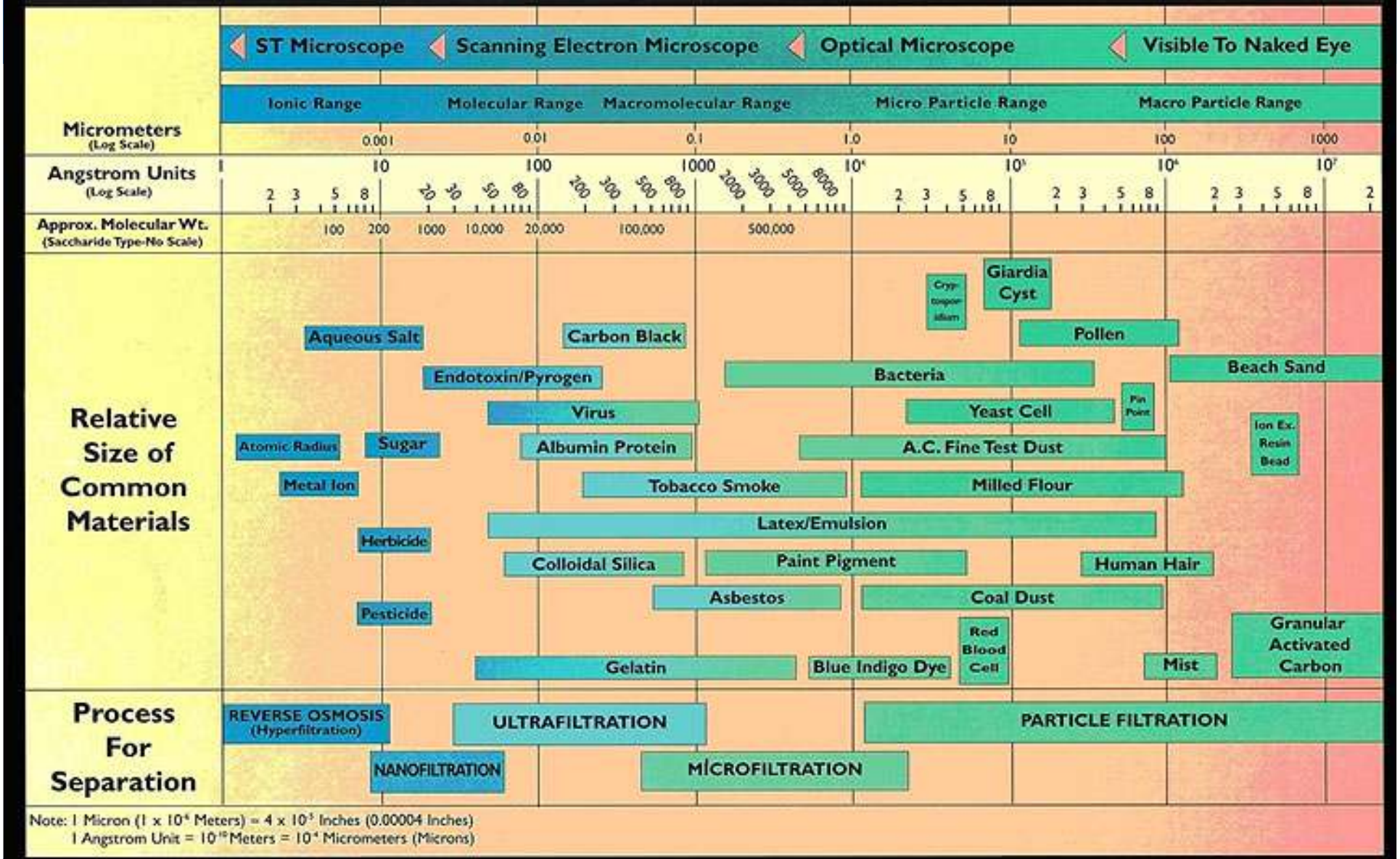
- Adding ferric salt to the raw water (like sodium aluminate)
- Mixing and contact for reaction
- Generation of flocs that settle in a clarifier

Settling

Filtration

- Types:
  - Granular (slow, fast)
  - Cake (precoated)
  - Membrane
- Backwash
- A polishing step
- Other actions – biodegradation, absorption

The Filtration Spectrum



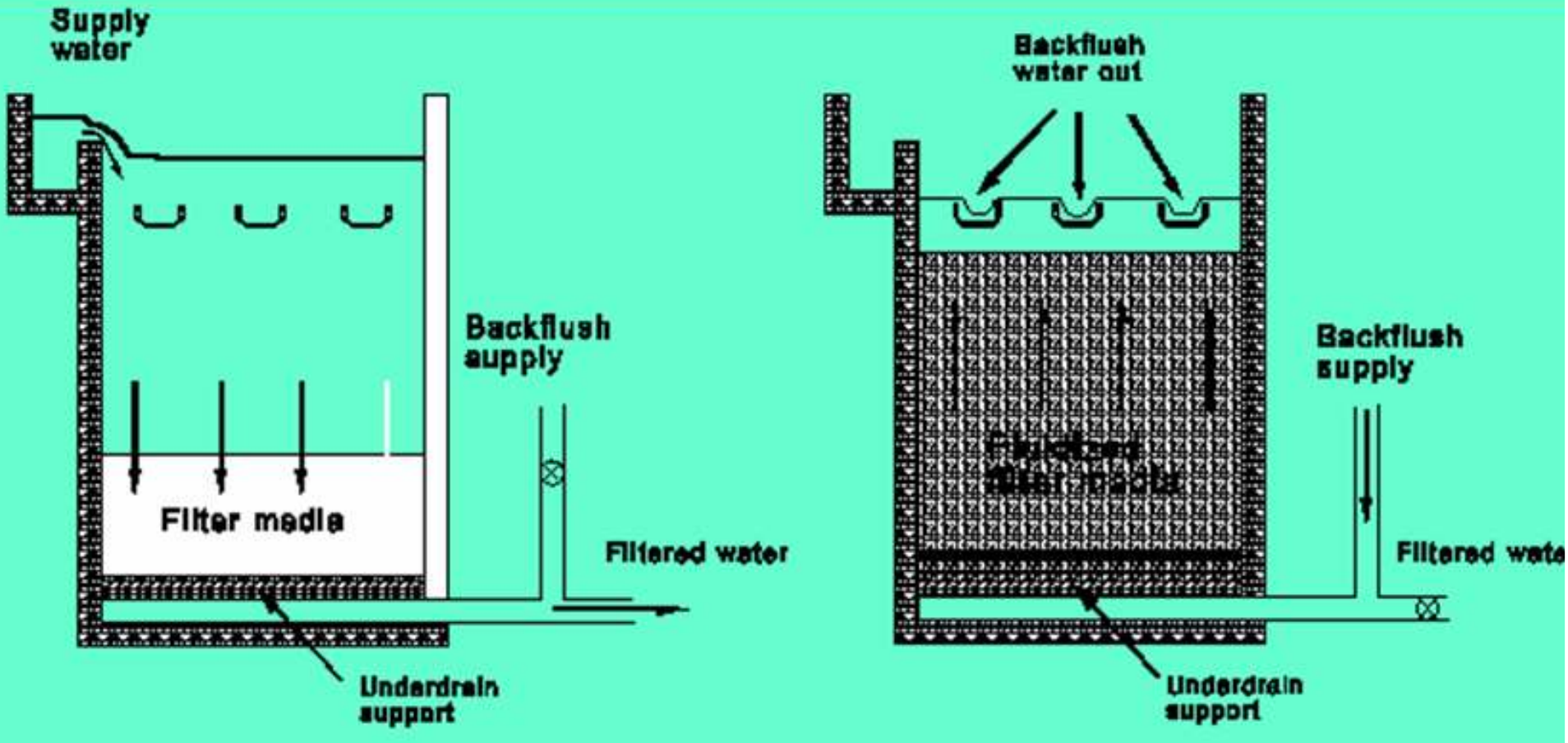
Note: 1 Micron (1 x 10^{-4} Meters) = 4 x 10^{-5} Inches (0.00004 Inches)
1 Angstrom Unit = 10^{-10} Meters = 10^{-4} Micrometers (Microns)

Gateway to solutions

Filter classification

Type	Filtr. Rate (m/hr)	Media Size (mm)	Bed Depth (m)
Slow Sand	0.04-0.4	0.25-0.35	1.0
Rapid Sand	5-10	0.45-1.0	0.5-1.0
High-rate	10-35	0.8-2.0	1.2-2.5
Diatom. Earth	2.5-7.5	0.01-0.05	

Filter operation



Membrane filtration

- Membrane filtration spectrum
  - Micro-filtration (MF)
  - Ultra-filtration (UF)
  - Nano filtration (NF)
  - Reverse Osmosys (RO)
- Pre-treatment
- Trans membrane pressure (TMP)
- Backwash and routine cleaning procedures, CIP
- Related O&M costs – energy, replacement and operation

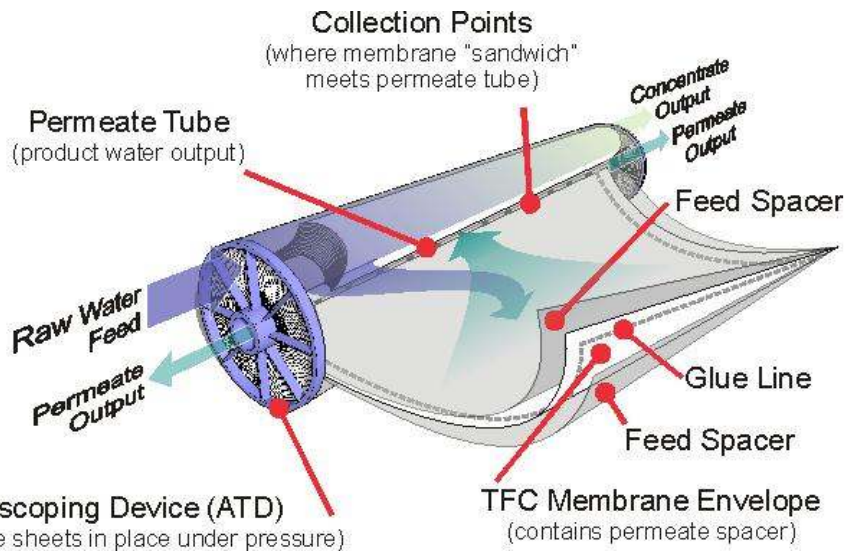
Water treatment membrane structure

Hollow fibers

Flat sheet

Tubular

Spiral wound



Microfiltration

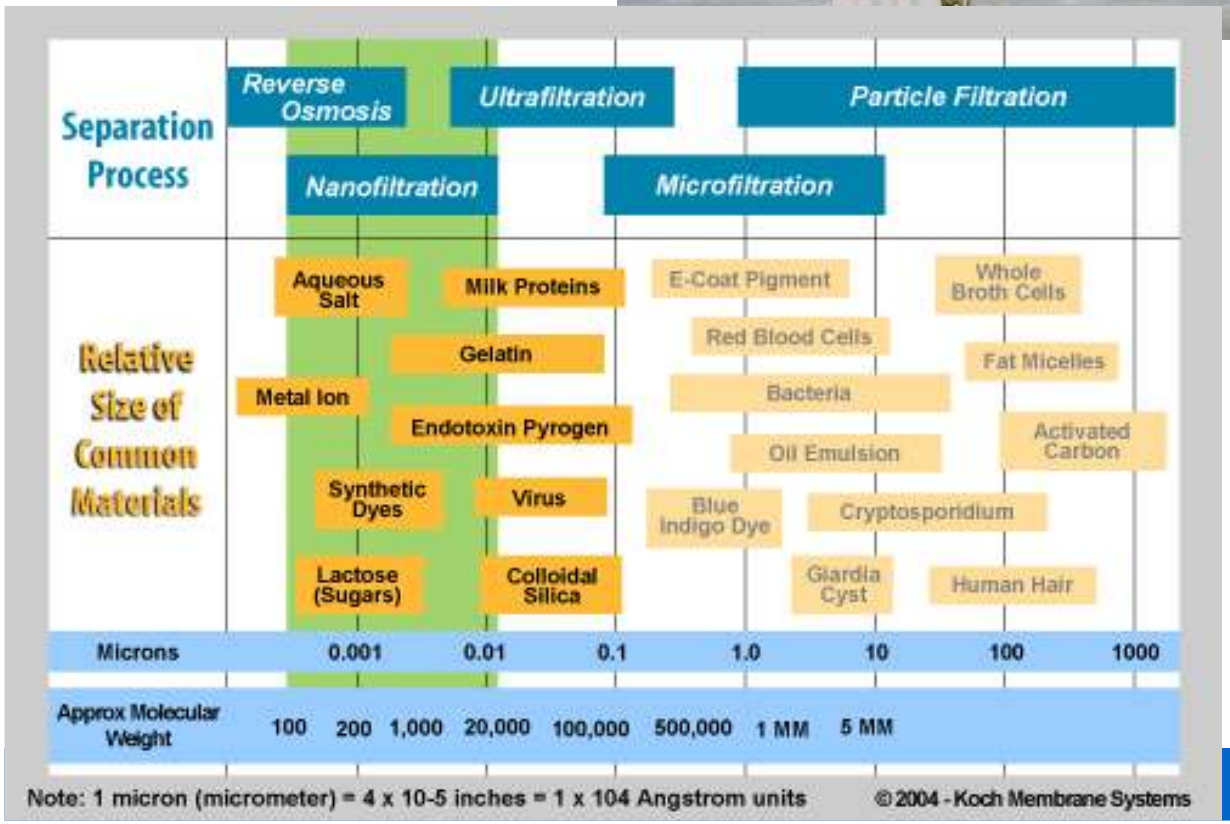
- At level of 1 micron (=1/1000 mm)
- Mainly out of tank
- Low TMP < 1 mWC
- All types of membrane structure
- Partial bacteria removal
- Protozoa as an example, easy to filter out using MF, difficult to kill with chemicals

Ultrafiltration

- At level of 0.01-0.1 micron
- Removal of most bacteria
- TMP few mWC
- More intensive cleaning

Immersed UF

Nanofiltration



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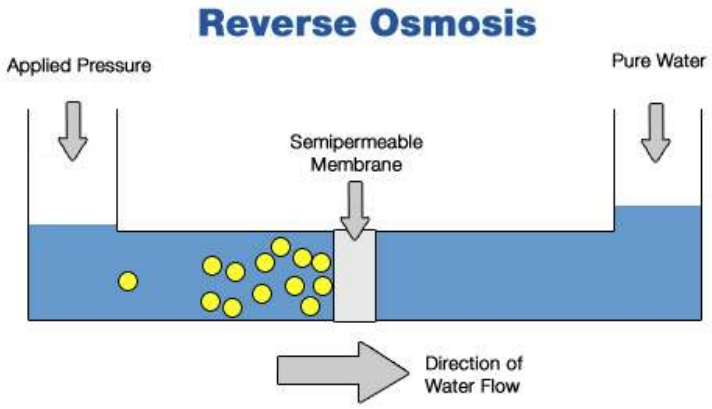
Desalination (RO)

Gateway to solutions

Desalination

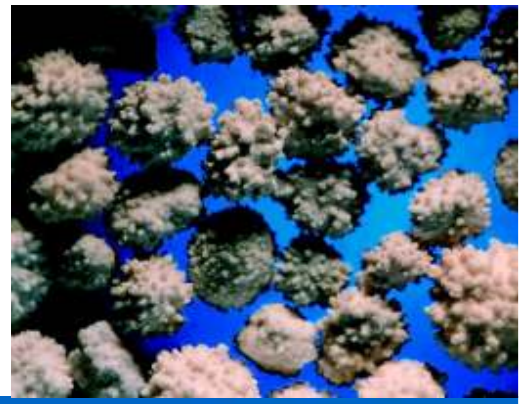
- Saline and sea water as drinking source
- Osmotic pressure
- Reverse osmosis
- Thermal methods
- BWRO and SWRO

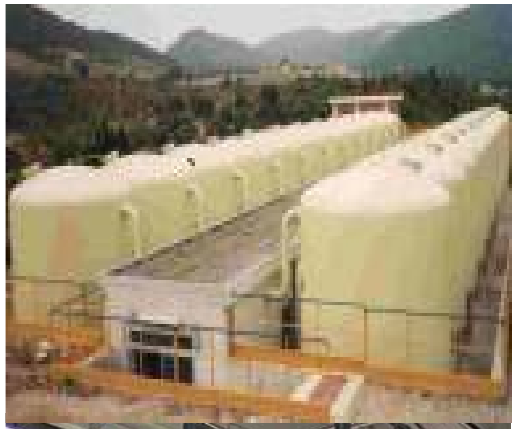


Softening

WATER TREATMENT PLANT

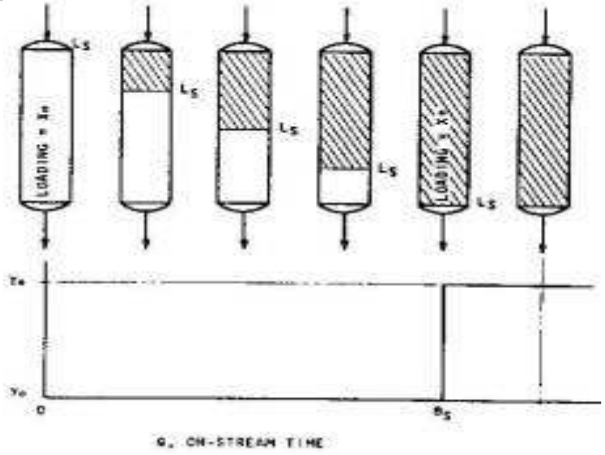
- To prevent scaling
- To improve health (not mandatory in all countries)
- Technologies:
  - Ion exchange
  - Crystallization
  - Reverse Osmosis





Adsorption

- Mainly GAC
- Adsorption bed
- Adsorption front progress
- Sizing
- Replacement / regeneration



Disinfection

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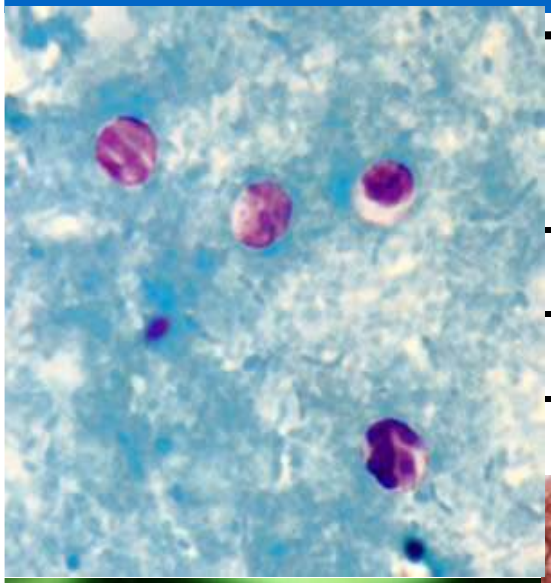
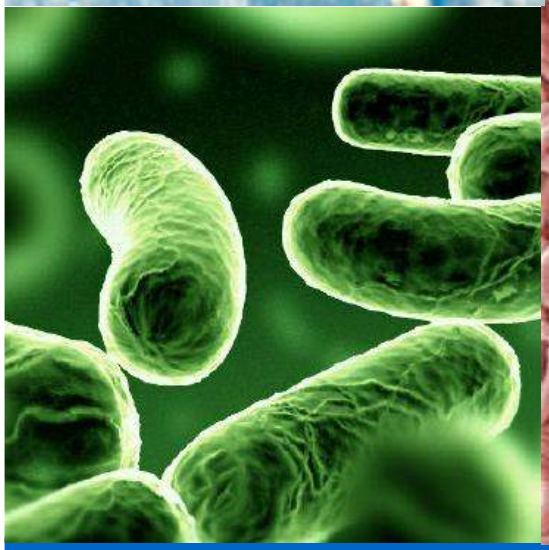


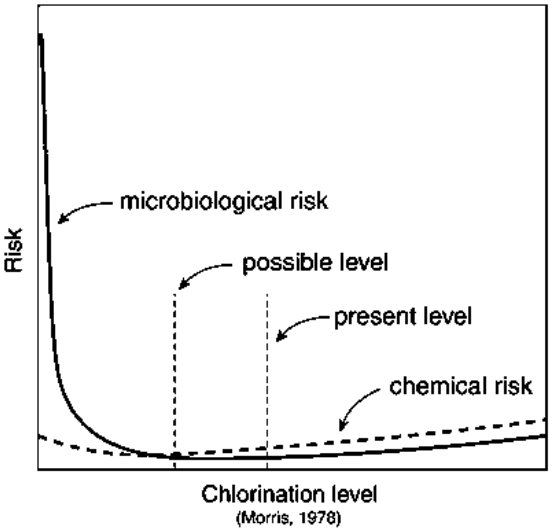


The enemy – bacteria and virus

- Cryptosporidium
- Legionella
- And many more

Chemical disinfection

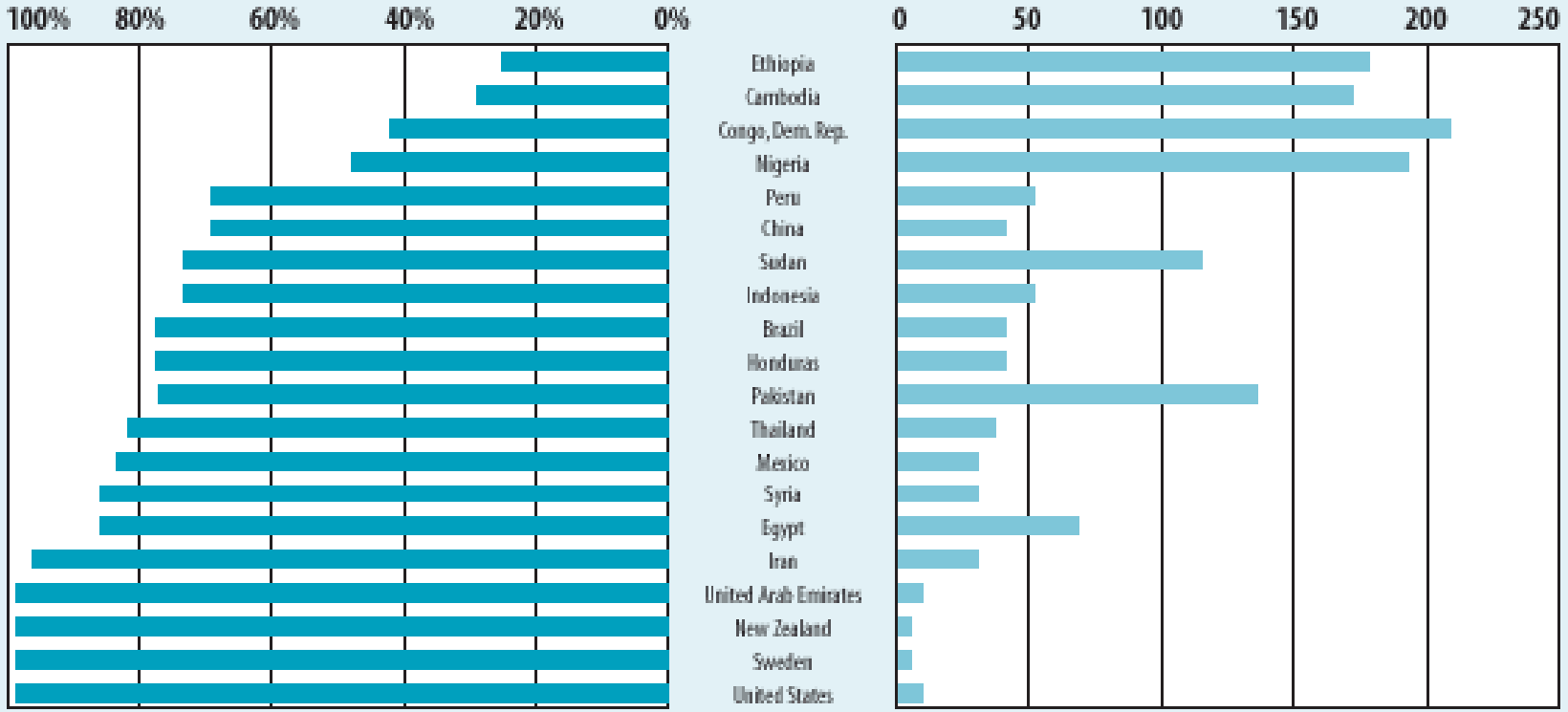
- Contact reaction oxidation
- Residual action
- Most frequent chemical – chlorine
- Managing the health and environment risk
- Pretreatment required



UV radiation disinfection

- Inactivation of pathogen DNA (bacteria & virus), radiation dose
- Application closed reactor
- Lamp cleaning
- Combination with chemical treatment (odor and color removal by advanced oxidation)

Access to Safe Drinking Water Saves Lives



Thanks

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Gateway to solutions