

Multiple Barrier Approach to Public Health Protection

Surface Water Sources

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Multiple Barrier Approach - From Source to Tap



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Multiple Barrier Approach - Source Water and Intake

- Assessment, selection, location
 - Reliable quality and quantity
 - Treatment needs
- Watershed protection

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Multiple Barrier Approach - Treatment Barriers

- Technology selection
 - Removal by coagulation, flocculation, sedimentation, and filtration with disinfection
 - Watershed control with disinfection

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Multiple Barrier Approach - Treatment Barriers

- Performance monitoring
 - Data analysis
 - Recordkeeping and referral
- Appropriate operational response

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Multiple Barrier Approach - Distribution System Barriers

- Ensuring the physical integrity of system components
- Maintaining adequate pressure
- Preserving water quality

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Multiple Barrier Approach - At the Tap... Consumer

- Public right-to-know
- Informed consumer is essential
 - Water quality
 - Compliance status
 - Risks to health
 - System's financial needs

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Surface Water Treatment Technique Requirements

- 99% (2-log) Removal of *Cryptosporidium*
 - (or address *Crypto.* in unfiltered source watershed control program)

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Surface Water Treatment Technique Requirements

- 99.9% (3-log) inactivation, or removal and inactivation of *Giardia lamblia*
- 99.99% (4-log) inactivation, or removal and inactivation of viruses

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Surface Water Treatment Technique Requirements

- Compliance measured by...
 - Turbidity limits for specific technologies
 - Microbial inactivation by disinfection

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Types of Filtration

- Conventional treatment
- Direct filtration
- Slow sand filtration
- Diatomaceous earth filtration
- Alternative filtration technologies
 - Membranes
 - Bags and cartridges

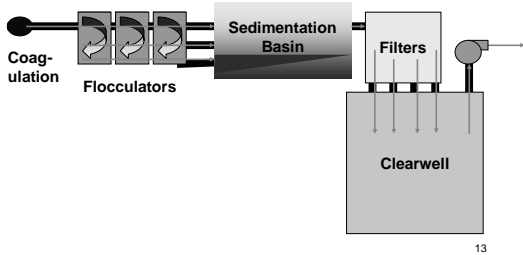
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Conventional Treatment

- *Conventional Filtration Treatment...*
 - means a series of processes including coagulation, flocculation, sedimentation, and filtration resulting in substantial particulate removal.

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Conventional Treatment



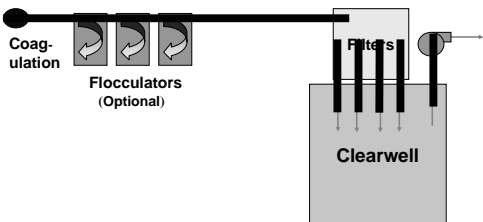
Direct Filtration

- *Direct Filtration...*

- means a series of processes including coagulation and filtration but excluding sedimentation resulting in substantial particulate removal.

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Direct Filtration



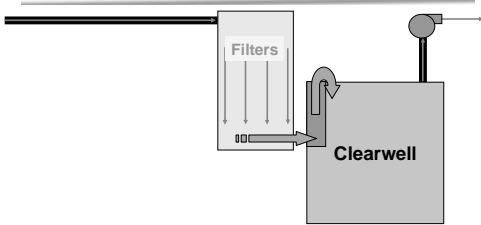
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Slow Sand Filtration

- Physical sieve and biological predation
 - Schmutzedecke
 - Colloids/clays pass through filter
 - Cleaning schmutzedecke and ripening period between filter runs

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Slow Sand Filtration



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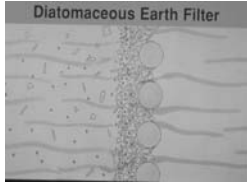
Slow Sand Filtration



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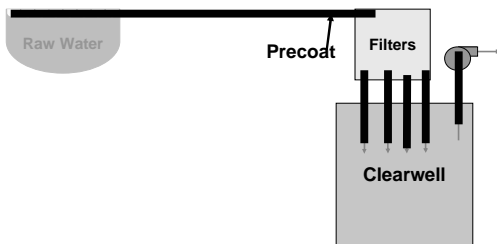
Diatomaceous Earth

- Physical sieve
 - Precoat development
 - Body feed with influent
 - Discard DE at end of run

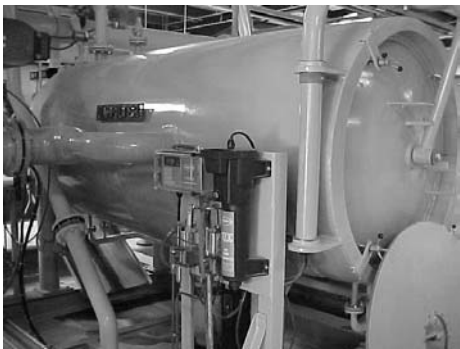


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Diatomaceous Earth Filtration



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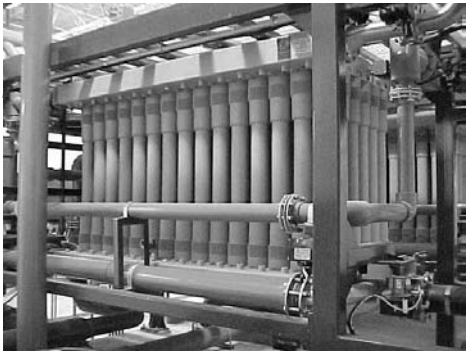


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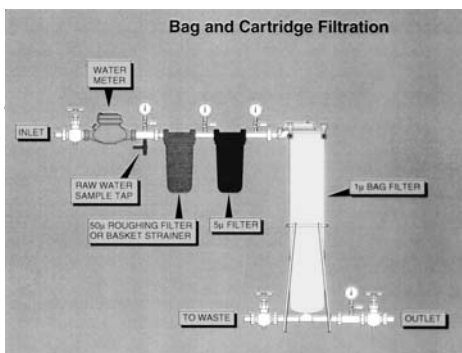
Alternative Filtration Technologies

- Membrane filters
 - Microfiltration, Ultrafiltration, Nanofiltration, Reverse Osmosis
- Cartridge filters, bag filters
- Others
- All: physical sieve

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Microbial Inactivation

- Surface water treatment technique:
 - Inactivation, or removal and inactivation
- Capable performance defined...
 - SWTR Guidance (research)
 - Demonstration Studies

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What is Microbial Inactivation?

- Render the organism unable to cause disease
- Does not mean sterilization
- Targets pathogens
 - Non-pathogenic organisms may still be present

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Factors Affecting Microbial Inactivation

- Organism disinfectant resistance
- Disinfectant concentration
- Contact time
- Competing/shielding of other particles
- Water temperature and pH

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Types of Disinfectants

- Chlorine
- Chloramines
- Chlorine Dioxide
- Ozone
- UV Light

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Quantifying Microbial Inactivation

- Log Inactivation
 - Log_{10}
 - Specific to organism and disinfectant
- CT concept
- CT calc

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Maintaining Water Quality - Distribution Systems

- Challenges to maintain...
 - Adequate minimum pressure and flow
 - Water quality
- Solution...
 - Operational and physical tools

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Maintaining Water Quality - Distribution System Tools

- Disinfectant residual
 - Minimize microbial regrowth
 - Protection from (limited) contamination
- Maximum Residual Disinfectant Levels (MRDL's)
- Disinfection byproduct MCLs

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Maintaining Water Quality - Distribution System Tools

- Cross connection control programs
- Monitoring
 - Identify problem areas
 - Identify deterioration events
 - Document adequate treatment

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Multiple Barriers - Public Education and Involvement

- Public Notification Rule
- Consumer Confidence Reports
- Public participation opportunities
 - Capital investment
 - Source water protection

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Sanitary Surveys – Eight Essential Elements

1. Source
2. Treatment
3. Distribution system
4. Finished water storage
5. Pumps/pump facilities and controls
6. Monitoring/reporting/data verification
7. Water system management/operations
8. Operator compliance with State rules

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Sanitary Surveys - Surface Water or GWUDI

- No less than every 3 years for community systems
- No less than every 5 years for noncommunity systems

- *Regardless of population served*

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