New WHO Guidelines for Potable Reuse: Impact on Reuse Opportunities

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Overview

- What is potable water reuse?
- Unplanned vs Planned **IPR** and **DPR**
- Microbial/Chemical Risks
- Waterborne disease risk and incidence
- DW Regulations
- IPR and DPR Technology
- Performance and Water Quality Monitoring
- WHO Guidelines-2017
- Management for DW Quality Assurance
- Perception vs Reality
- Conclusion

What is potable water reuse?

- All water is reused!
- Convert impaired water into safe drinking water
- Balance source composition vs necessary technology
- Simulate and accelerate natural purification processes
- Multiple barriers
- Tight design and management required

Reuse Categories

- Unplanned—traditional IPR
- Planned: IPR and DPR
- Difference: Environmental Passage
- Not necessarily beneficial after water has been highly treated
- Engineered Storage Buffer

Microbial/Chemical DPR Risks

- Microbial risks are preeminent in all DW and require the greatest assurance 7/24/365
- Microbial risks are acute and actuarial
- Trace chemical risks are less concern
- Trace chemical risks are usually more theoretical, and chronic, if they occur

US Waterborne Disease Risk

- 4 to 32 million?/year acute GI—projections
- >48 million/year foodborne-CDC
- DW -Downward trend & shift since 1980
- Distribution systems- not source water risks
- 2009-2012 CDC MMWRs
  65 outbreaks-40 legionellosis
- 1471 cases- Legionellosis -23 deaths
- 25 others: campylobacter, norovirus etc.

US Drinking Water Regulations and Health Advisories

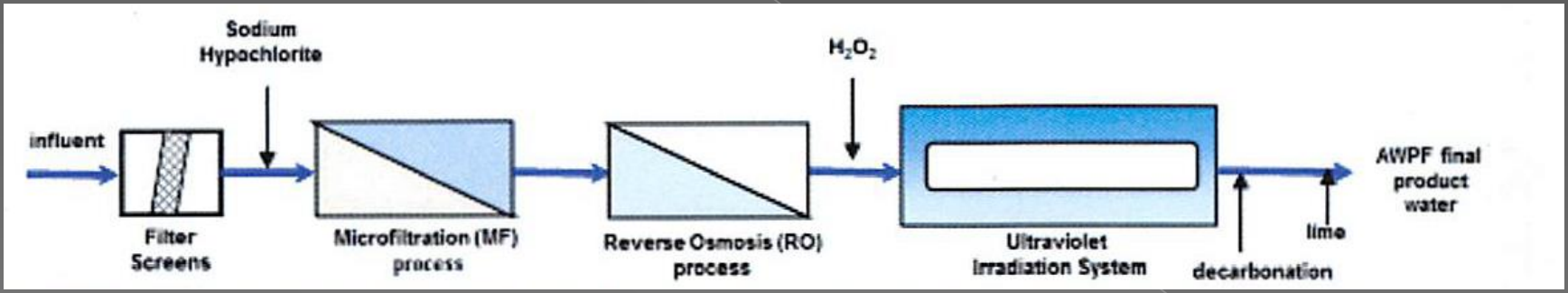
- ~90 chemicals MCLs + aesthetics
- ~500 Health advisories –benchmarks
- All microbes: via *E coli* and Filtration and Disinfection requirements-legionella?
- All radionuclides
- Many likely and many unlikely chemicals
- DBPs via TTHMs and HAAs
- Are special regulations needed for reuse? No! Perhaps a few supplements.

Chemicals: DPR Technology is very effective

- Inorganic ions
- SOCs and VOCs
- Pesticides and Pharmaceuticals
- Natural and synthetic hormones
- PFOS/PFOS and other PFCs
- Algal Toxins
- DBPs

Orange County Water District

one treatment train example



Technology: Merging WW and DW

- WW-Secondary or Tertiary Treatment
- Conventional treatment +
- Advanced DW Technology Options:
  Soil aquifer treatment
  Membranes -MF, UF, NF, RO
  MBR
  Cation and anion exchange
  Oxidation- Ozone, chlorine/chloramines
  Adv. Oxidation-OH radicals: UV/Peroxide-UV/Chlorine
  UV and combinations
  Biological Activated Carbon-ozone/GAC
  GAC
  Chlorine

Planned IPR and DPR examples

- IPR

LA CA-Montebello Forebay-1962 –SAT
Orange Co. CA-1976/2008 –FAT/AOP-GW
Upper Occuquan, Va- 1978- GAC-surface
El Paso, Tx-1985- GAC, Ozone-GW

- DPR

Windhoek, SA-1969/2002-Multiple+BAC +
Beaufort West, SA - 2010-FAT
Big Spring, Tx - 2013- FAT/Blend

Potential Log Removal Credits: WHO 2017 challenge tests

Sec. Waste Water	Bacteria	Viruses	Protozoa
Soil Aquifer Treatment	6	6	6
Membrane Bioreactor	5	5	6
MF/UF	6	4-6	6
Ozone/BAC	6	6	3
Reverse Osmosis	6	6	6
UV/AOP	6	6	6
Conventional DW	6	6	3-4

Log Reduction Targets, examples

- California

	Enteric viruses	Crypto	Giardia
Challenge conc.	100000	10000	100000
Log reduction	12	10	10

- Australia

	Campylobacter	Norovirus	Crypto
Wastewater def.	7000	8000	2000
Log reduction	8.1	9.5	8

WHO recommendations

	Campylobacter	Norovirus	Crypto
Wastewater def.	7000	20,000	2700
Log reduction	8.5	9.5	8.5

Use defaults absent system specific data

WHO Basis: Disability Adjusted Life Years/year (DALY) 0.000001
California Basis: 0.00001 risk of cases of any sort/year

Chemicals: WHO Guidelines for Drinking Water Quality
~ 100 + all rads + advisory values
+ site specific or generic to WW reuse

Process & Final Monitoring to assure consistent water quality

- *Tight control of WW treatment
  DO, ammonia, retention times, SS, Ct, flow
- *Real time, on line to the max!
- Turbidity
- pH and Ct
- Electrical conductivity/TDS/TOC
- UV transmission
- Pressure decay testing (membranes)–daily
- Fluorescence and UV absorbance
- Surrogate chemicals, e.g., sucralose, et al
- Consider NGS technology applications

WHO IPR/DPR Message

- IPR/DPR is drinking water: same principles apply
- At least as safe as good natural water
- Single set of DW regulations
- Potable reuse is feasible and sustainable
- Science and Technology are solid
- Microbial control always most critical
- Provides default challenges and Log Removal targets
- Chemicals: very low concentrations & site specific
- Scope from Source to treated WW to finished DW
- Source control & protection essential
- Rapid process and finished water monitoring
- Biological assays are interesting but premature

WHO IPR/DPR continued

- Management System-Water Safety Plans (HACCP)
- Multiple barriers: effective and essential
- Potential env. and engineered buffers, if desired
- Training and skills of operators is essential
- Numerous successful case studies

WHO IPR/DPR continued

- DPR are complex systems
- Close interaction between DW and WW entities
- Public engagement and education are essential
- Skeptical public : perceived risk from sewage source
- Public support is essential
- Success depends upon public agreement of need

Conclusions

- IPR and DPR drinking waters are Safe
- Modern advanced technologies work
- Tight design and management
- Real time monitoring
- Fail safe systems, if needed
- Better WQ than conventional systems
- Public Perception?

World Health Organization

- Potable Reuse:

Guidance for producing safe drinking water

- http://www.who.int/water_sanitation_health/publications/potable-reuse-guidelines/en/

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