Overview of Water Recycling
Public Health Criteria in Ca
WERF Project No. SWIM10C15
Workshop #1
Public Health Standards
for Onsite Water Systems

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State Water Resources Control Board
Division of Drinking Water

- July 2014, Governor moved drinking water from California Department of Public Health
- Primary role is the regulation of Public Water Systems
- Recycled water is other important role
- Field Operations Branch (North & South)
  - 24 District field offices statewide
- Technical Programs Branch
  - Recycled Water Unit
Division of Drinking Water

- Sets standards for municipal wastewater reuse to protect public health
  - "Water Recycling Criteria" in Title 22 of California Code of Regulations

- These regulations specify treatment and use requirements for various recycled water uses
  - Landscape Irrigation
  - Agricultural Irrigation
  - Cooling towers & other industrial uses
  - Dual plumbed (toilet flushing & residential)
Public Health Role

- Technical Operations Branch Recycled Water Unit provides technical assistance and review of new technologies.

- District offices provide comments and recommendations to Regional Water Quality Control Boards for protection of public health on specific projects.

- Incorporated in the permits issued by the SWRCB or RWQCBs.

- RWQCBs have permitting and ongoing oversight authority for Recycled Water.
Regulations Address...

- Level of Treatment
- Alternative Technology
- Reliability Features
- Use Area Controls
- Dual Plumbing
- Cross Connections
- Monitoring
- Engineering Report
Treatment Reliability...

- Multiple units
  - (Redundancy)
- Alarms
- Power
- Emergency storage
- Operation
Chlorine CT Requirements

California criteria based upon the Pomona Virus Study (PVS)

CT of 450 mg-min/L - 90 minutes of contact time minimum

Alarms & Instrumentation – flow & chlorine residual (to make sure enough is added to overcome chlorine demand)

Reliability features

- Meters & Sensors – liquid chlorine dose applied
- Tablet chlorinator is simpler at small scale
- Liquid or tablet replacement
Potential Chlorination Shortfalls

Particles can interfere with chlorine disinfection, illustrating need for high quality filtered water

Studies show high levels of infectious protozoa in chlorinated effluents (not a surprise)

EPA gives no credit for crypto kill with chlorine and giardia kill requires a high level of free chlorine to be cost-effective

Older studies remain relevant on the pitfalls of chlorination. 1974 dissertation by Roger Sung (UC Davis) as one example.

Most organics studies by Sung “react with chlorine to form chloro-organic compounds” titrating as chlorine residual “yet were found to have little or no bactericidal potential

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Units</th>
<th>50th percentile</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giardia</td>
<td>Cysts/100L</td>
<td>1092</td>
<td>7188</td>
</tr>
<tr>
<td>Crypto</td>
<td>Oocysts/100L</td>
<td>17</td>
<td>210</td>
</tr>
</tbody>
</table>

Slifko et al, 2004
Where Does UV Fit In?

California requires:

- 100 mJ/cm² following media filtration
- 80 mJ/cm² following micro/ultra membrane filtration
- 50 mJ/cm² following RO membrane filtration

Numerous studies show 5-log inactivation of virus at recycled water UV dose values

With the exception of adenovirus

Alarms - Instrumentation UV dose readout

Reliability features

- Cleaning system
- Sensors
- Lamp replacement
UV Dose Requirements

- **German Guideline**—*DVGW W294 (2003)*—specify UV reactor validation protocols. It defines measured flow rate, UV intensity, and lamp status for UV Dose of 40 mJ/cm².

- USEPA established UV Dose requirements to obtain log credits for *Crypto, Giardia*, and Virus as part of LT2 rule. Through the validation a Factor (2-3) is multiplied to the Dose.

<table>
<thead>
<tr>
<th>Log Inactivation Credit</th>
<th>UV Dose Required (mJ/cm²)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Crypto</td>
</tr>
<tr>
<td>0.5</td>
<td>1.6</td>
</tr>
<tr>
<td>1.0</td>
<td>2.5</td>
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<td>1.5</td>
<td>3.9</td>
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</tr>
<tr>
<td>3.5</td>
<td>15</td>
</tr>
<tr>
<td>4.0</td>
<td>22</td>
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</tbody>
</table>

Source: USEPA, Long Term 2 Enhanced Surface Water Treatment Rule
ANSI/NSF Standard 55 for Disinfection, Class A - UV Dose of 40 mJ/cm²

- “Class A systems (40 mJ/cm²) are designed to disinfect and/or remove microorganisms, including bacteria and viruses, from contaminated water to a safe level. Class A systems may claim to disinfect water that may be contaminated with pathogenic bacteria, viruses, Cryptosporidium or Giardia.”

Examples from NSF International website:

- Greenway Water Tech (2.9-16.1 gpm)
- LUMINOR Environmental (5.4-13 gpm)
- Puretec Pty Ltd. (7.9-13 gpm)
- UV Pure Technologies Inc (14.6-30 gpm)
- Viqua “UVMAX” (10-30 gpm)

There are other ANSI certification bodies
Additional State Agencies

- California Building Standards Commission
  - Uniform statewide plumbing standards
  - Greywater use (Chapter 16) Indoor plumbing
  - 1604.10.2 “Minimum Water Quality. On-site treated nonpotable gray water supplied to toilets or urinals or for other uses in which it is sprayed or exposed shall be disinfected.”
  - 1604.10.6 Disinfection. “... on-site treated nonpotable gray water shall be disinfected as needed...”
G-13 What should the criteria address? (Water quality, monitoring, treatment performance, reporting, and operational standards)

- “Yes, plus maybe cross-connection control. The emphasis should be on treatment, treatment performance, and operation. (RH)”

- Treatment
  - Filtration
  - Disinfection

- Treatment performance
  - Monitoring
  - Control

- and Operation
  - Training?
  - Oversight – WHO?
Never mind that the re-use of what is known as kitchen gray water -- untreated waste water -- is illegal in Ca.

Unable to get a permit from the city or Marin County, Nix forged ahead, using methods employed in the state of Oregon, where kitchen gray water use is legal.

"I may get red-tagged, I may get fined -- that's OK with me," Nix said. "There are many people doing this because it's the right thing to do."

Studies have shown that wastewater from kitchen sinks may contain concentrations of fecal coliform similar to what's found in a toilet, said a spokesman for the Ca Water Resources Control Board, who noted that Oregon require kitchen gray water undergo treatment first.
Question WQC-1 - What are the important water quality parameters to consider for each of the end uses under consideration (i.e. drip/submerged irrigation, spray irrigation, toilet flushing)?

- Toilet flushing has high potential exposure hazard/risk
- Aerosols?
- Viruses - Other?

- Operational surrogates parameters?
  - online process monitoring and control
  - chlorine, turbidity, UV dose
  - calibration & maintenance of instrumentation
G-5. What can be learned from Title 22 Recycled Water regulations in Ca?

- “The criteria could be adapted to on-site systems. We have had discussions in California about waiving the need for a daily coliform sample where membrane filtration is included. (RH)”
  - At this point, any “discussions” are informal & not the position of DDW
  - Would still need a way to determine that the membrane is working (turbidimeter?)

- “Highly reliable treatment with treatment performance monitoring can greatly reduce the need for water quality monitoring. (RH)”
  - Is weekly coliform sampling sufficient?
“The median effluent turbidity for the MBR facilities was 0.2 NTU but 10% of the facilities sampled produced effluents with turbidity above 0.7 NTU (Fig. 1D), indicating that some of these facilities may be operating with breached membranes.”

“adenoviruses were detected in effluents of all nine MBR facilities sampled. The presence of Giardia cysts in filtrate samples of two of nine MBR facilities sampled demonstrated the need for an appropriate disinfection process at these facilities.”

Two Important CA Public Health Standards

- Goal is implied in Title 22, §60301.230. Disinfected tertiary recycled water, which requires a 450 CT, “or (2) A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater.”

- Does graywater need 5-log treatment?

- §60301.320. Filtered wastewater. “(b) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:
  - (1) 0.2 NTU more than 5 percent of the time within a 24-hour period; and
  - (2) 0.5 NTU at any time.”
ADDITIONAL INFORMATION

- Recycled Water website:
  - http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Recycled_Water.shtml

- DDW Recycled Water staff
  - Randy Barnard, RW Specialist
    - Randy.barnard@waterboards.ca.gov
  - Brian Bernados, RW and Treatment Technology Specialist
    - Brian.bernados@waterboards.ca.gov

- Or your local DDW district office