

Work Plan: UMass Testing for UV Fouling Study

(Task 3.1.1a)



UMass Team travels to Pilot Site bringing:

- Three 2-liter glass-stoppered reagent bottles (one for each of samples 3 & 4, and one extra). These should be pre-cleaned and labeled
- One 2-liter glass stoppered reagent bottle filled with Elab II DI water for transfer as trip blank. This can be among the three bottles later used for pilot plant sampling
- Ten BOD bottles (two for each of the 4 locations two more for the trip blank; and two extras)
- Quench (sodium sulfite and ammonium chloride)
- Buret, reagents and labware (e.g., titration flask) for DPD titrimetric method
 - include one spare buret, in case of breakage
- pH meter, pH electrode and electrode holder, with buffers for calibration
 - include spare pH electrode in case of breakage
- pipets and other glassware for reagent addition on site
- Magnetic stirrer and several ten clean stir bars
- Two beakers (250 ml) for measuring pH
- extension cord and power strip
- Two large coolers
- Ten 1-liter flexible cubitainers for thermal mass
- Thermometer

Samples collected at 4 locations

1. Pilot influent (raw water)
2. Chlorinated Water (UV lamp off)
3. UV treated from pre-chlorine train
4. UV treated from non chlorinated train

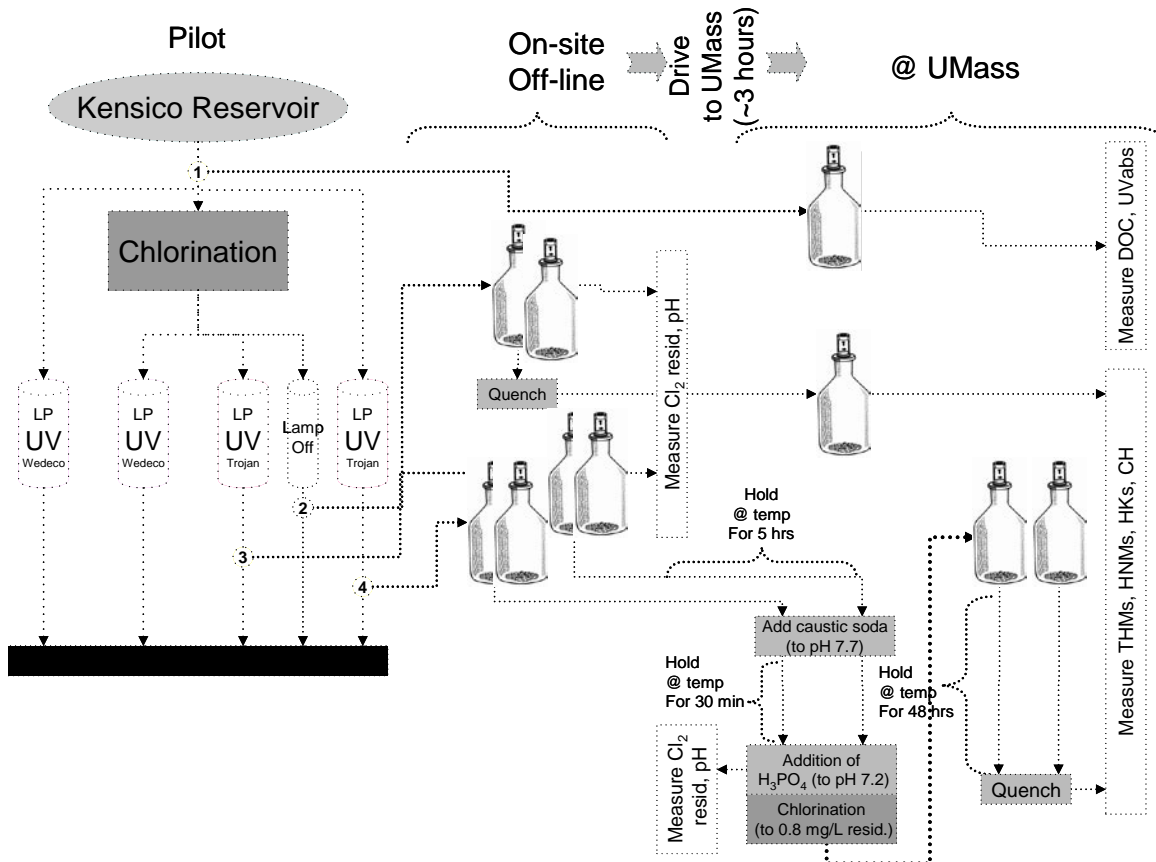
Treatment/analysis on-site for each sample

1. Raw Water: measure pH, no treatment
2. Chlorinated Water: measure pH, Cl₂ residual; quench
3. UV Treated, pre-Cl₂ water: measure pH and Cl₂ residual; no treatment
4. UV Treated, no pre-Cl₂ water: measure pH, no treatment

UMass treatment protocol

- Addition of caustic (follows 5-hr hold)
 - Use plant chemical, if available, otherwise use UMass chemical
 - Add to reach a pH of 7.7 (expected dose ~ 4 mg/L)
- Addition of phosphoric acid (follows 30 min hold)

- Use plant chemical, if available, otherwise use UMass chemical
- Add to reach a pH of 7.2 (expected dose ~ 2 mg/L)
- Addition of sodium hypochlorite
 - Use UMass stock
 - Add to reach a chlorine residual of 0.8 mg/L (expected dose ~ 0.5 mg/L for sample #3; and 1.5 mg/L for sample #4)



Sequence

1. Fill all cubitainers with raw Kensico water for thermal mass, and possible use as back-up RW sample. Place cubitainers in coolers.
2. Measure raw water temperature and temperature of water at sampling locations #3 and #4
3. Collect small samples from all 3 locations (note that #2 and #3 are the same location) and measure pH
4. Transfer trip blank water to two BOD bottles
5. Collect first 8 samples (at locations #1, 3, and 4: start 5 hour hold time
 - a. Sample summary:

- i. Location #1: Two BOD bottles (1° samples) only
 - ii. Location #3: Two BOD bottles (1° samples) & one 2-liter bottle (2° sample)
 - iii. Location #4: Two BOD bottles (1° samples) & one 2-liter bottle (2° sample)
- b. Pre-rinse each bottle with the sample being collected. BOD bottles must contain a stir bar
- c. Bottles can be filled to overflow. The five 1° samples must be sealed headspace-free (BOD bottles). Secondary samples can have small amounts of headspace.
6. Turn off Trojan LP lamp on chlorination train, and collect remaining 2 samples (location #2; 1° samples) from the reactor effluent.
 - a. Use BOD bottles with a stir bar in each
 - b. Add quench to bottle, then carefully fill bottle with sample. Fill to top headspace free, but do not allow these bottles to overflow
7. Chlorine Residual Analysis: Immediately take 2° bottle for sample location #2 and #3, and pour off a portion for the DPD titration.
8. Place all samples in Cooler, surrounded by cubitainers filled with ambient temperature raw water.
9. **Drive back to UMass**. Check temperature periodically throughout the day.
10. Once back at UMass, pour off a small volume of the 2° samples from locations #3 and #4 and use this to check required caustic and phosphate sequential doses to reach desired pHs (7.7, then 7.2)
11. Using the 2° sample from location #4, check necessary booster doses to reach desired residual (0.8 mg/L). Some guidance might be available from actual operations doses.
 - a. This may require addition of several different doses to parallel subsamples and measuring residual chlorine at some fixed time (e.g., 5 minutes)
12. After about 4.8 hours, add the requisite amount of NaOH to 2° samples for locations #3 & 4 to bring them up to the target pH.
13. After 5 hours, add caustic to the six 1° samples (two from #3, #4 and trip blank) using the headspace-free syringe method (below), and start timer for 30 minute hold
 - a. place bottle on stir plate and begin stirring
 - b. open bottle being careful not to disturb surface
 - c. quickly add required volume of NaOH stock¹ (50-500 µL) with syringe needle extending into the main body of the bottle.
 - d. Replace stopper, being careful not to introduce any air bubbles
14. After about 20 min hold, add the requisite phosphoric acid dose to 2° set of samples #3 & #4, measure pH and chlorine residual.
15. Using the measured chlorine residual on the 2° sample for location #3; calculate booster dose needed to reach desired level (target is 0.8 mg/L).
16. Add the chlorine doses to the set of 2° samples for #3 and #4. Check residual.

¹ Concentration of NaOH stock solution is selected so that volume added to each 300 mL BOD bottle is in the range of 50-500 µL

17. Make adjustment to chlorine dose based on results from 2^o samples, and after the 30 minute hold time, add this dose to the 1^o set of #3 and #4 samples and trip blank. Keep these headspace-free.
18. Immediately place samples in a constant temperature chamber pre-set at the temperature of the Kensico UV pilot water. Start the 48-hr clock at this time.
19. Measure TOC, DOC and UV absorbance of sample #1.
20. At the end of the 48 hour period incubation period, open both experimental bottles (1^o set) from locations #3 & #4 and trip blank,
 - a. Pour off duplicate samples for each of the following analyses: THMs, Halonitromethanes, halo ketones, and chloral hydrate. These should each be quenched as needed.
 - b. Pour off samples for analysis of chlorine residual and pH
21. Conduct DBP analysis on sample exposed to chlorine (#2, #3, and #4) and trip blank.

Schedule (tentative):

1 st Run	18 Sept 06
2 nd Run	14 Nov 06
3 rd Run	9 Jan 07
4 th Run	6 Mar 07
5 th Run	1 May 07
6 th Run	10 Jul 07

This pilot sampling task is to be done once every two months for a 1 year period. The first run date was selected as the earliest date that can be scheduled following execution of the subcontract. The subsequent 5 runs are scheduled to coincide with the monthly compliance sampling, so that raw water from Kensico for the laboratory chloramine testing work can be collected during the same trip. These dates are subject to change in accordance with the final compliance sampling schedule.