# The Confederated Tribes of Warm Springs

# Coagulation Control

## Standard Operating Procedure
## Dry Creek Water Treatment Plant

## Warm Springs Community Water System
**EPA PWS ID# 104101247**

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# Coagulant Control SOP

## Purpose of Coagulant Control

Nearly every process in a water treatment plant depends on proper coagulation. When coagulation is optimized, flocculation and sedimentation are better able to remove particles before they get to the filter. Coagulation also conditions particles so they can be effectively captured by the filter. Further, removing particles from the water dramatically improves the effectiveness of disinfection, to prevent pathogens getting into the distribution system.

This SOP is intended to serve as a functional, practical guide to the tasks that need to be done in order to optimize coagulant dosage. Coagulant control has two parts: the streaming current monitor (SCM) and jar testing. They perform separate but complementary roles.

The SCM indicates the overall charge of the water after coagulant addition. Since water particles are naturally negative, the positively-charged coagulant is used to reduce this negative charge as much as possible. As long as a charge remains, the particles will not be able to floc together and settle out, nor be properly removed by the filter. A negative charge read by the SCM indicates that too little coagulant is being added. A positive charge read by the SCM means that too much coagulant is added. The SCM provides a very responsive indication of the charge of the water, in reaction to changes in both water quality and coagulant dosage. An ideal SCM reading is 0.00 Streaming Current Units (SCUs).

Jar testing complements the SCM by serving as a gut check while the SCM is functioning properly, and as a back-up when the SCM is malfunctioning or broken. It is extremely important to continue jar testing weekly even when the SCM is working properly.

**Operation and Maintenance of the SCM and Turbidimeters**

The following tasks are necessary to perform on a regular basis to ensure the SCM is operating properly and that coagulant is being properly dosed.

**Hourly**

Check the SCM value and adjust the LMI pump stroke as needed to control coagulant dosage (see instructions for adjusting LMI pump dosage below)

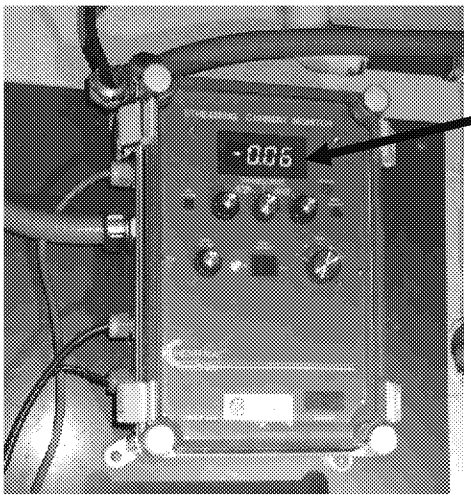


Fig 1. Streaming Current Monitor

Fig 2. LMI Pump

***SCM reading will respond to frequency adjustments in about 1 minute and 30 seconds. Adjust frequency again until SCM reading is close to 0.00.***

Record the SCM reading before pump adjustment, adjusted LMI pump information (pump stroke and speed), SCM reading after pump adjustment, and whether one or 2 raw water pumps are in operation (sample data sheet provided at the end of this document).

**Daily**

Briefly flush the hydrocyclone and the sand filter to remove built up sediment. Close valve once flow is clear of sediment.

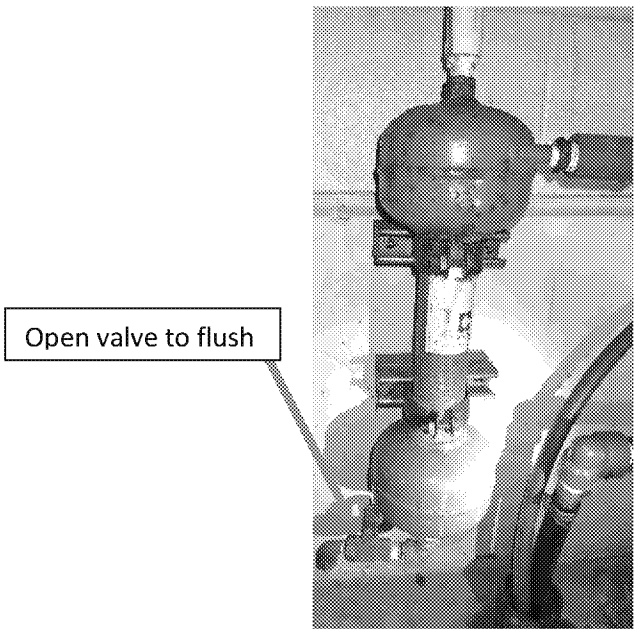


Fig 3. Hydrocyclone

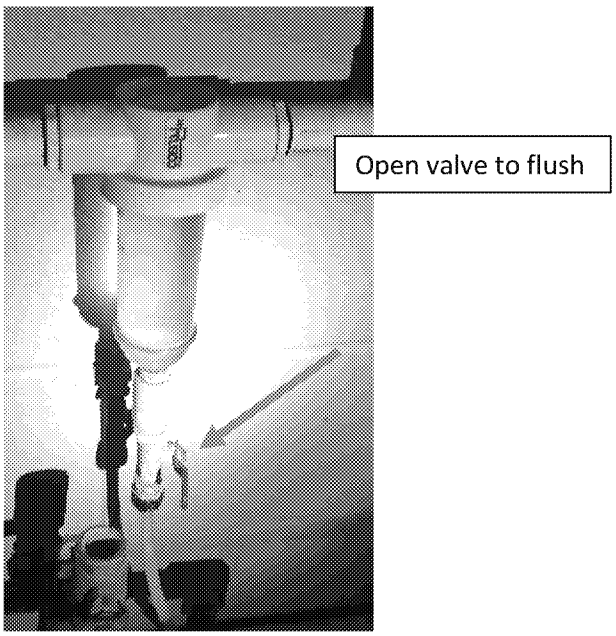


Fig 4. Sand Filter

Verify water supply to the SCM probe

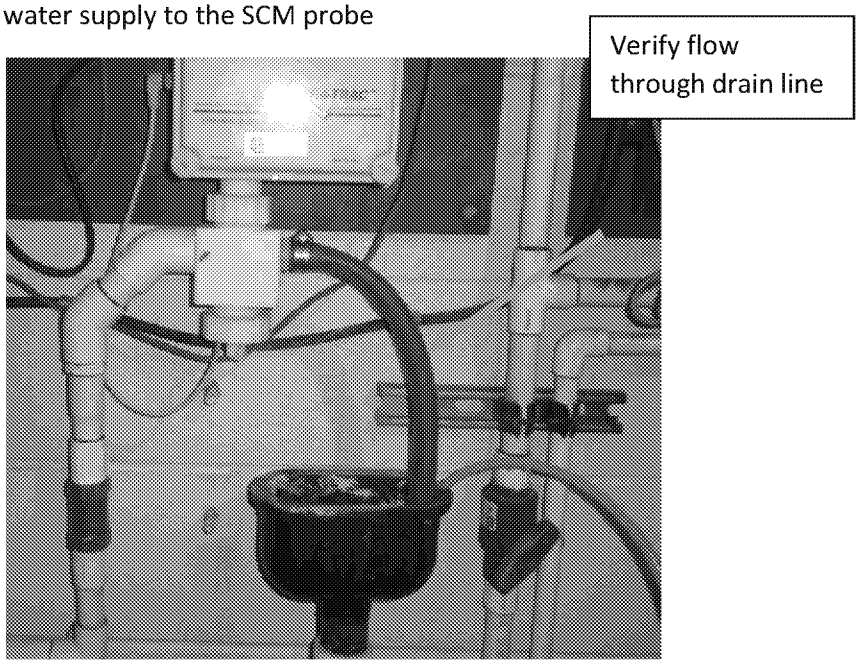


Fig 5. SCM Sample and Drain Line

Perform jar testing if the SCM is not functioning properly

**Weekly**

Clean the SCM probe and piston of organic slime build up using Comet Soft Scrub and bottle brushes (see instructions below)

Perform jar testing to ensure LMI pump coagulant dosage is correct, based on SCM readings

**Every 3 months**

Calibrate each turbidimeter (see User Manual, Hach 1720E Low Range Turbidimeter, Section 5.5)

**Yearly**

Replace bulbs in each turbidimeter (see User Manual, Hach 1720E Low Range Turbidimeter, Section 6.4.3)

**Every few years or as needed**

Replacement of the plastic tubing to and from the turbidimeters

Instructions on adjusting LMI pumping rate: (note: this section was modified from Section 8 of the Instruction Manual for the Series B9 and C9 Electronic Metering Pumps, produced by Novatech International.)

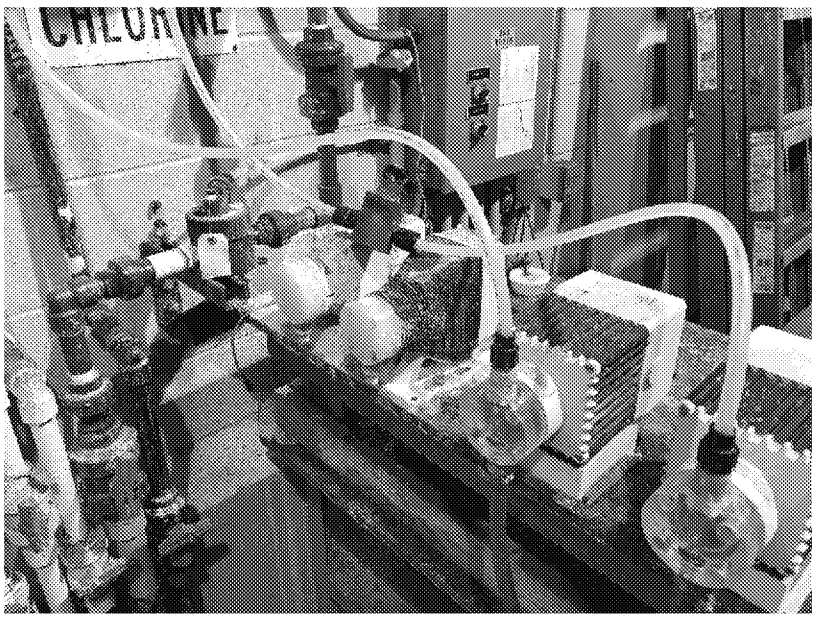

Fig 6. The chemical feed pumps. Verify which pump is supplying coagulant before making any adjustments. These pumps are located near the ACH feed barrels and the static mixer.

Fig. 7. Controls for the LMI Pump

1. Speed and stroke length can be changed while the pump is on or off.
2. To adjust the speed of the LMI pump, simply use the up or down arrows to change the speed. Ensure that the speed is displayed in numbers only. If the number for speed reads like H60, then that means the speed is in strokes per hour. To fix this, press the up arrow until the "H" disappears, so that stroke speeds are in strokes per minute. The current speed will be displayed on the liquid crystal display screen, just to the left of the arrows.
3. To adjust the stroke length of the LMI pump, simply rotate the knob until the pointer matches with the stroke length you want to set.
4. Since the SCM takes about 1.5 minutes to read flows from the initial mixer, it will take 1.5 minutes to respond to changes in coagulant dosage. Thus, just change either speed or stroke by a couple units at a time to see how the SCM responds. When fine-tuning, just change them by one unit at a time.
5. To calculate the flow rate from the LMI pump, divide the stroke number by 100, as well as the speed. Then multiply those numbers together, and multiply the result by 2.5. This will give you the flowrate from this pump in gallons per hour. For example, if speed was set to 50 and stroke

was set to 50, the actual flowrate would be: (50/100) * (50/100) = 0.25. 0.25 * 2.5 = 0.625 gallons per hour.

Instructions on cleaning the SCM Probe: (note: This section was modified from Section 5 of the Operations Manual for the SCM 2000 XRW, produced by ChemTrac Systems, Inc.)

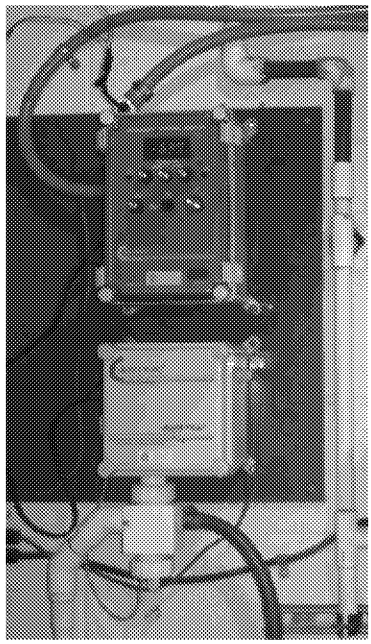

Fig. 8. ChemTrac display (top) and SCM (bottom). This is located in the same room as the raw water pumps, on the opposite wall.

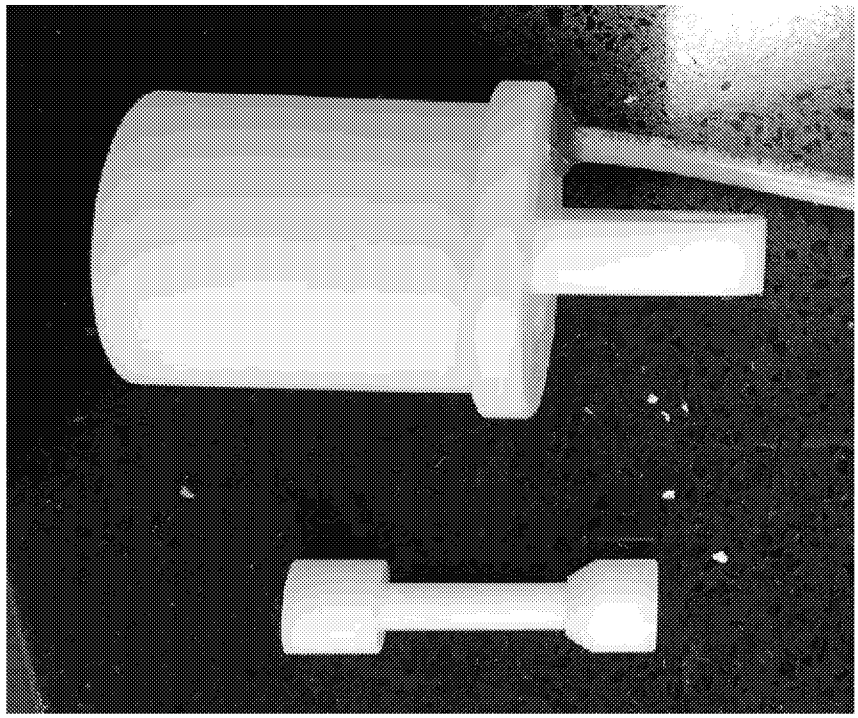

Fig. 9. Probe (top) and piston (bottom). Note the probe tab on the right side of this picture.

1. Disconnect the lead wire from the enclosure and remove the lower retaining slip nut from the probe.
2. Remove the probe by pulling on the tab. A small twist may be needed to loosen it.
3. Remove the piston using an appropriately sized flathead screwdriver.
4. Clean any debris from the cell housing.
5. To clean the probe wet ONLY the inside of the probe. DO NOT SUBMERGE OR SOAK THE PROBE. Sprinkle some Comet on the inside and scrub with a bottle brush. Rinse thoroughly with distilled water to remove any residue.
6. To clean the piston wet the outside of the piston. Sprinkle some Comet on the outside and scrub with a bottle brush. Rinse thoroughly with distilled water to remove any residue.
7. Screw clean piston into place. Do not over-tighten. Only slight torque is necessary.
8. Insert the clean probe back into the cell housing.
9. Slip the retaining nut over the probe lead wire and tighten onto probe. Finger tight is acceptable. Take care to ensure that the nut is not cross threaded.
10. Connect lead wire to the enclosure.
11. After cleaning the probe, the SCM readings may take several minutes to stabilize. The SCM may also be more sensitive to changes in coagulant feed or raw water. After the readings stabilize, adjust the LMI pump as needed to reduce the SCM reading to 0.00 SCUs.

A rough approximation of ACH dosing by the chemical feed pump can be estimated by using the table on the next page. This can be used to select the starting point for jar testing.

| | | Approximate ACH Dosage in mg/L based on Stroke and Speed - 1 Pump in Operation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Stroke Length (from 5-50) | | | | | | | | | |
| | | **5** | 10 | **15** | 20 | **25** | 30 | **35** | 40 | **45** | 50 |
| Speed (from 5-50 strokes per minute) | 5 | **0.06** | 0.13 | **0.19** | 0.26 | **0.32** | 0.38 | **0.45** | 0.51 | **0.58** | 0.64 |
| | 10 | **0.13** | 0.26 | **0.38** | 0.51 | **0.64** | 0.77 | **0.89** | 1.02 | **1.15** | 1.28 |
| | 15 | **0.19** | 0.38 | **0.58** | 0.77 | **0.96** | 1.15 | **1.34** | 1.53 | **1.73** | 1.92 |
| | 20 | **0.26** | 0.51 | **0.77** | 1.02 | **1.28** | 1.53 | **1.79** | 2.04 | **2.30** | 2.56 |
| | 25 | **0.32** | 0.64 | **0.96** | 1.28 | **1.60** | 1.92 | **2.24** | 2.56 | **2.88** | 3.19 |
| | 30 | **0.38** | 0.77 | **1.15** | 1.53 | **1.92** | 2.30 | **2.68** | 3.07 | **3.45** | 3.83 |
| | 35 | **0.45** | 0.89 | **1.34** | 1.79 | **2.24** | 2.68 | **3.13** | 3.58 | **4.03** | 4.47 |
| | 40 | **0.51** | 1.02 | **1.53** | 2.04 | **2.56** | 3.07 | **3.58** | 4.09 | **4.60** | 5.11 |
| | 45 | **0.58** | 1.15 | **1.73** | 2.30 | **2.88** | 3.45 | **4.03** | 4.60 | **5.18** | 5.75 |
| | 50 | **0.64** | 1.28 | **1.92** | 2.56 | **3.19** | 3.83 | **4.47** | 5.11 | **5.75** | 6.39 |

| | | Approximate ACH Dosage in mg/L based on Stroke and Speed - 2 Pumps in Operation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Stroke Length (from 5-50) | | | | | | | | | |
| | | **5** | 10 | **15** | 20 | **25** | 30 | **35** | 40 | **45** | 50 |
| Speed (from 5-50 strokes per minute) | 5 | **0.03** | 0.06 | **0.09** | 0.12 | **0.15** | 0.18 | **0.21** | 0.24 | **0.27** | 0.30 |
| | 10 | **0.06** | 0.12 | **0.18** | 0.24 | **0.30** | 0.36 | **0.42** | 0.48 | **0.54** | 0.60 |
| | 15 | **0.09** | 0.18 | **0.27** | 0.36 | **0.45** | 0.54 | **0.63** | 0.72 | **0.81** | 0.90 |
| | 20 | **0.12** | 0.24 | **0.36** | 0.48 | **0.60** | 0.72 | **0.84** | 0.96 | **1.08** | 1.20 |
| | 25 | **0.15** | 0.30 | **0.45** | 0.60 | **0.75** | 0.90 | **1.05** | 1.20 | **1.35** | 1.50 |
| | 30 | **0.18** | 0.36 | **0.54** | 0.72 | **0.90** | 1.08 | **1.26** | 1.44 | **1.62** | 1.80 |
| | 35 | **0.21** | 0.42 | **0.63** | 0.84 | **1.05** | 1.26 | **1.47** | 1.68 | **1.89** | 2.10 |
| | 40 | **0.24** | 0.48 | **0.72** | 0.96 | **1.20** | 1.44 | **1.68** | 1.92 | **2.16** | 2.40 |
| | 45 | **0.27** | 0.54 | **0.81** | 1.08 | **1.35** | 1.62 | **1.89** | 2.16 | **2.43** | 2.70 |
| | 50 | **0.30** | 0.60 | **0.90** | 1.20 | **1.50** | 1.80 | **2.10** | 2.40 | **2.70** | 2.99 |

| | | Approximate ACH Dosage in mg/L based on Stroke and Speed - 1 Pump in Operation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Stroke Length (from 5-50) | | | | | | | | | |
| | | **5** | 10 | **15** | 20 | **25** | 30 | **35** | 40 | **45** | 50 |
| Speed (from 55-100 strokes per minute) | 55 | **0.76** | 1.53 | **2.29** | 3.06 | **3.82** | 4.58 | **5.35** | 6.11 | **6.88** | 7.64 |
| | 60 | **0.83** | 1.67 | **2.50** | 3.33 | **4.17** | 5.00 | **5.83** | 6.67 | **7.50** | 8.33 |
| | 65 | **0.90** | 1.81 | **2.71** | 3.61 | **4.51** | 5.42 | **6.32** | 7.22 | **8.13** | 9.03 |
| | 70 | **0.97** | 1.94 | **2.92** | 3.89 | **4.86** | 5.83 | **6.81** | 7.78 | **8.75** | 9.72 |
| | 75 | **1.04** | 2.08 | **3.13** | 4.17 | **5.21** | 6.25 | **7.29** | 8.33 | **9.38** | 10.42 |
| | 80 | **1.11** | 2.22 | **3.33** | 4.44 | **5.56** | 6.67 | **7.78** | 8.89 | **10.00** | 11.11 |
| | 85 | **1.18** | 2.36 | **3.54** | 4.72 | **5.90** | 7.08 | **8.26** | 9.44 | **10.63** | 11.81 |
| | 90 | **1.25** | 2.50 | **3.75** | 5.00 | **6.25** | 7.50 | **8.75** | 10.00 | **11.25** | 12.50 |
| | 95 | **1.32** | 2.64 | **3.96** | 5.28 | **6.60** | 7.92 | **9.24** | 10.56 | **11.88** | 13.19 |
| | 100 | **1.39** | 2.78 | **4.17** | 5.56 | **6.94** | 8.33 | **9.72** | 11.11 | **12.50** | 13.89 |

| | | Approximate ACH Dosage in mg/L based on Stroke and Speed - 2 Pumps in Operation | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Stroke Length (from 5-50) | | | | | | | | | |
| | | **5** | 10 | **15** | 20 | **25** | 30 | **35** | 40 | **45** | 50 |
| Speed (from 55-100 strokes per minute) | 55 | **0.36** | 0.72 | **1.07** | 1.43 | **1.79** | 2.15 | **2.51** | 2.86 | **3.22** | 3.58 |
| | 60 | **0.39** | 0.78 | **1.17** | 1.56 | **1.95** | 2.34 | **2.73** | 3.13 | **3.52** | 3.91 |
| | 65 | **0.42** | 0.85 | **1.27** | 1.69 | **2.12** | 2.54 | **2.96** | 3.39 | **3.81** | 4.23 |
| | 70 | **0.46** | 0.91 | **1.37** | 1.82 | **2.28** | 2.73 | **3.19** | 3.65 | **4.10** | 4.56 |
| | 75 | **0.49** | 0.98 | **1.46** | 1.95 | **2.44** | 2.93 | **3.42** | 3.91 | **4.39** | 4.88 |
| | 80 | **0.52** | 1.04 | **1.56** | 2.08 | **2.60** | 3.13 | **3.65** | 4.17 | **4.69** | 5.21 |
| | 85 | **0.55** | 1.11 | **1.66** | 2.21 | **2.77** | 3.32 | **3.87** | 4.43 | **4.98** | 5.53 |
| | 90 | **0.59** | 1.17 | **1.76** | 2.34 | **2.93** | 3.52 | **4.10** | 4.69 | **5.27** | 5.86 |
| | 95 | **0.62** | 1.24 | **1.86** | 2.47 | **3.09** | 3.71 | **4.33** | 4.95 | **5.57** | 6.18 |
| | 100 | **0.65** | 1.30 | **1.95** | 2.60 | **3.26** | 3.91 | **4.56** | 5.21 | **5.86** | 6.51 |

**Purpose of Jar Testing**

The purpose of jar testing is to determine what dosage of coagulant works best for a given set of water conditions. In cases where the SCM isn't working, jar testing is needed once per day to find the optimal dosage of coagulant. Even when the SCM is operational, jar testing about once a week is still good practice to ensure proper dosage rates are used. Jar testing can help improve the operation of the plant dramatically, by ensuring more solids are removed through flocculation and sedimentation. This relieves some of the burden on the filters, and increases filter run time. Further, determining the right dosage of coagulant can help save money for the plant.

One round of jar testing should take less than an hour to complete. It will take less time the more often you do it. Be sure to set aside about an hour for the first round you do.

**Overview of chemical and equipment needs**

To conduct jar testing you will need:

- A gang stirrer
- 6 square 2000 ml beakers (these are preferable to round beakers due to improved mixing, and the sampling port which makes sampling easier)
- 1 5 gallon bucket about 4/5 full of source water
- A small beaker with ACH coagulant
- Distilled water, both for mixing the coagulant and rinsing out the turbidimeter vials after testing is done
- One container with lid for mixing the 1% coagulant solution
- A turbidity analyzer with vials
- Pipettes/Syringes for dosing neat coagulant into distilled water, as well as a separate pipette or syringe for dosing the 1% solution into the raw water
- A data sheet to record data and observations (sample sheet is at the end of this SOP)
- A program to run the jar tester, so you don't have to manually adjust speeds and set timers during the process. A separate SOP has been developed to walk you through programming the suggested steps (fast mix, slow mix and sedimentation). Once this has been programmed into gang stirrer, the gang stirrer can be set to run the program very easily. The program on the SOP is as follows:
    - 100 RPM for 1 minute (flash mix/coagulation)
    - 35 RPM for 10 minutes (slow mix/flocculation)
    - 0 RPM for 10 minutes (sedimentation)
    - An alarm will sound at the end of the last 10 minutes to indicate it is time to take samples

Fig 10. Turbidity analyzer with vial inserted and example NTU reading. This is located in the laboratory.

**Jar Testing Steps**

1. Set up the lab with all the necessary pieces of equipment and chemicals, including raw water and coagulant.

2. Next, stir up the raw water in the bucket to ensure the sand and other particles are thoroughly mixed in. Take a turbidity sample from the raw water bucket and record it on the data sheet.

3. Now, fill each of the 6 square beakers to the 2000 ml line as close as possible with raw water. You can use a pipette to fine tune it once you're close.

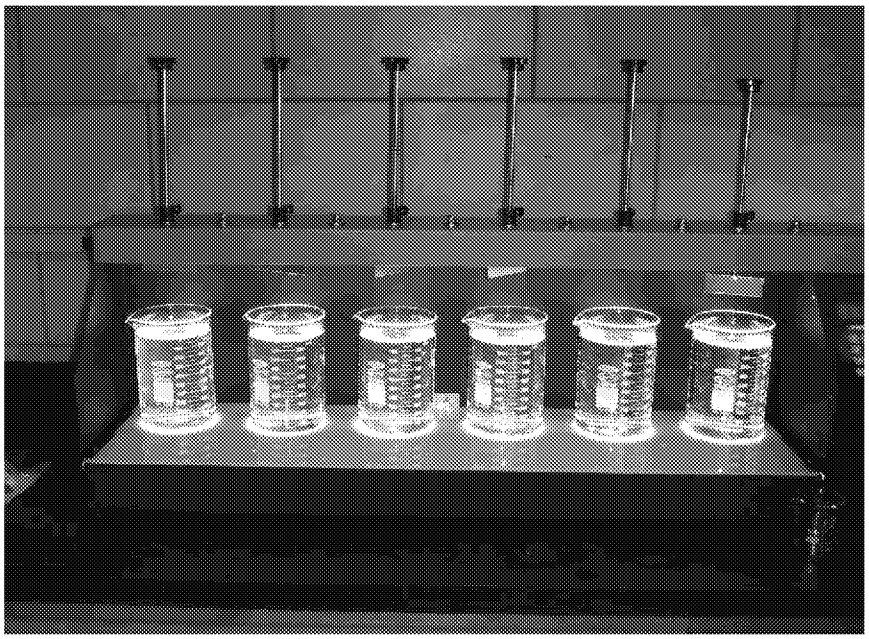

Fig. 11. Beakers with raw water. Round 1000 ml beakers were used here; however, square 2000 ml beakers (not shown) are preferred for jar testing due to improved mixing. The siphon tube is also helpful for sample collection.

4. Decide on how much you want to dose in the different beakers. You want to have a couple doses that are lower than the current feed rate, and a couple doses that are higher. For example, if the chemical feed pump is supplying 15 mg/L, you could try adding a dose of 5 mg/L, 10 mg/L, 15 mg/L, 20 mg/L and 25 mg/L to five different jars. Be sure to leave one jar as a control or blank, meaning you don't add any coagulant to it. Write down the dosages you want to add to each beaker on your data sheet. You can also write them on slips of paper and put them in front of each beaker, so you can keep track of which is which.
   Note: for your first set of jar tests, it may be worthwhile to only use 1 or 2 beakers until you get the hang of it, and then adding others as needed. Having a helper for this process makes a big difference.

5. Next, determine how much 1% ACH solution you need to make. This concentration of coagulant will add 5 mg/L for every 1 ml you add into the raw water beakers (see table below).

**Table 1. Dosing the Raw Water Beakers**

| If you want to have this concentration of ACH (in mg/L)… | Then you should add this much of a 1% coagulant solution (in ml)… | To this much raw water |
|---|---|---|
| 5 | 1 | 2000 ml (square beakers) |
| 10 | 2 | |
| 15 | 3 | |
| 20 | 4 | |
| 25 | 5 | |
| 30 | 6 | |

So, to reach a concentration of 10 mg/L ACH in a beaker, you would simply add 2 ml of the 1% coagulant solution. If we continue our example of dosing 5 mg/L, 10 mg/L, 15 mg/L, 20 mg/L and 25 mg/L, we would need a total of 15 ml of 1% ACH (simply add the concentrations in mg/L and divide by 5: (5+10+15+20+25) = 75. 75/5 = 15 ml of 1% coagulant solution). To be safe, we would make 50 ml of the 1% coagulant solution, in case we want to do another jar test. Next, follow the guidelines in the below table to determine how much coagulant you need to add to distilled water to make the 1% coagulant solution:

**Table 2. Making the 1% Coagulant Solution**

| If you want to make this amount of 1% coagulant solution (in ml)… | Then you should add this amount of coagulant (in ml)… | To this amount of distilled water (in ml) |
|---|---|---|
| **50** | **0.37** | **49.5** |
| 100 | 0.75 | 99 |
| **150** | **1.12** | **148.5** |
| 200 | 1.49 | 198 |

Mix the ACH with water in a small container, preferably with a lid. You'll draw from this container when you dose the coagulant into the larger beakers with the raw water. Once this mixture has been made, secure the container with a lid and shake for 30 seconds to a minute.

6. At this point, you can lower the paddles into the raw water beakers, and turn on the gang-stirrer. Press 2 on the keypad to select **RUN SEQUENTIAL**. The jar tester will start rotating at 100

rpm. This will simulate the coagulation step in the static mixer currently in use. Using a pipette, add the desired coagulant dosage to each beaker. In this example, we would dose as follows:

a. Jar 1 – 0 mg/l (control)
b. Jar 2 – 5 mg/l (1 ml of 1% coagulant solution)
c. Jar 3 – 10 mg/l (2 ml of 1% coagulant solution)
d. Jar 4 – 15 mg/l (3 ml of 1% coagulant solution)
e. Jar 5 – 20 mg/l (4 ml of 1% coagulant solution)
f. Jar 6 – 25 mg/l (5 ml of 1% coagulant solution)

Try to add the coagulant as quickly as possible to each jar, so each jar has about the same amount of time for the coagulant to disperse.

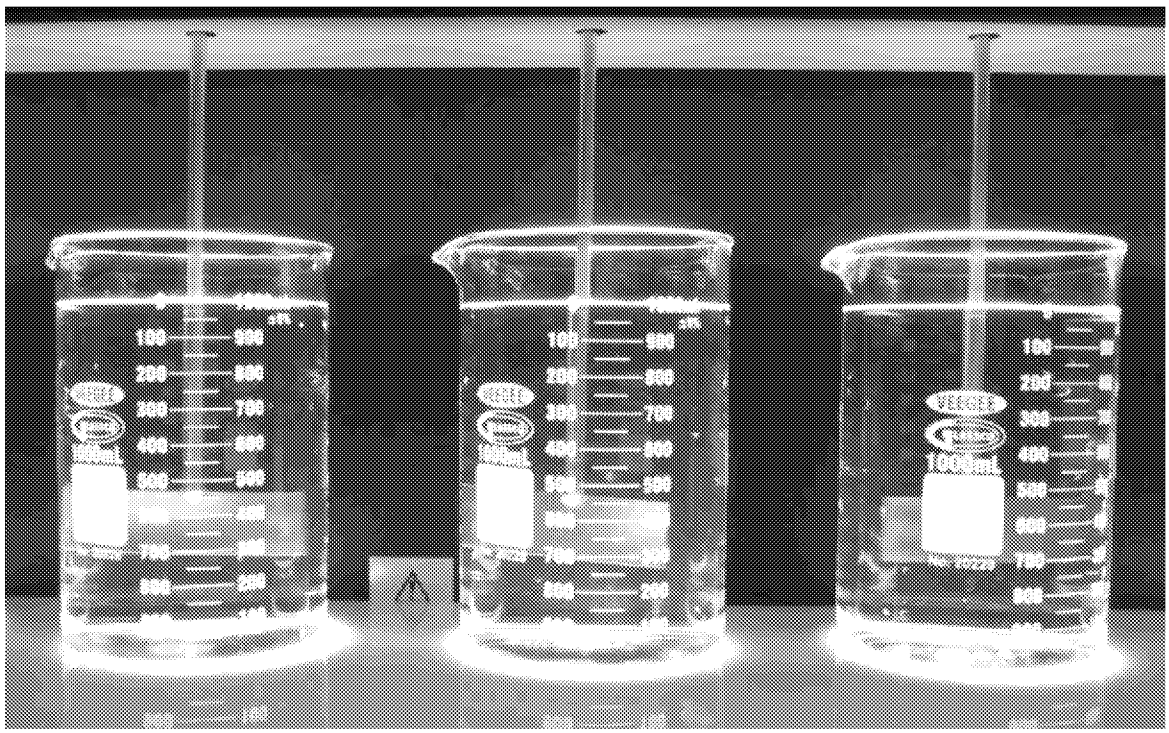

Fig. 12. Initial mixing of jar test

7. After the minute is up, the jar tester will continue to the next step of the program and rotate at 35 rpm for 10 minutes. This will simulate the flocculation step. While the gang stirrer is running, observe each beaker and note which jar forms flocs first, and write this on your data sheet. Also note how the floc particles are forming. Some will be a little larger and fluffy, and others will be more compact. Floc particles which are more compact are more desirable, as they are easier to remove. Note any observations on your data sheet. The background light switch is to the right of the right-most beaker, and is helpful in illuminating flocs.

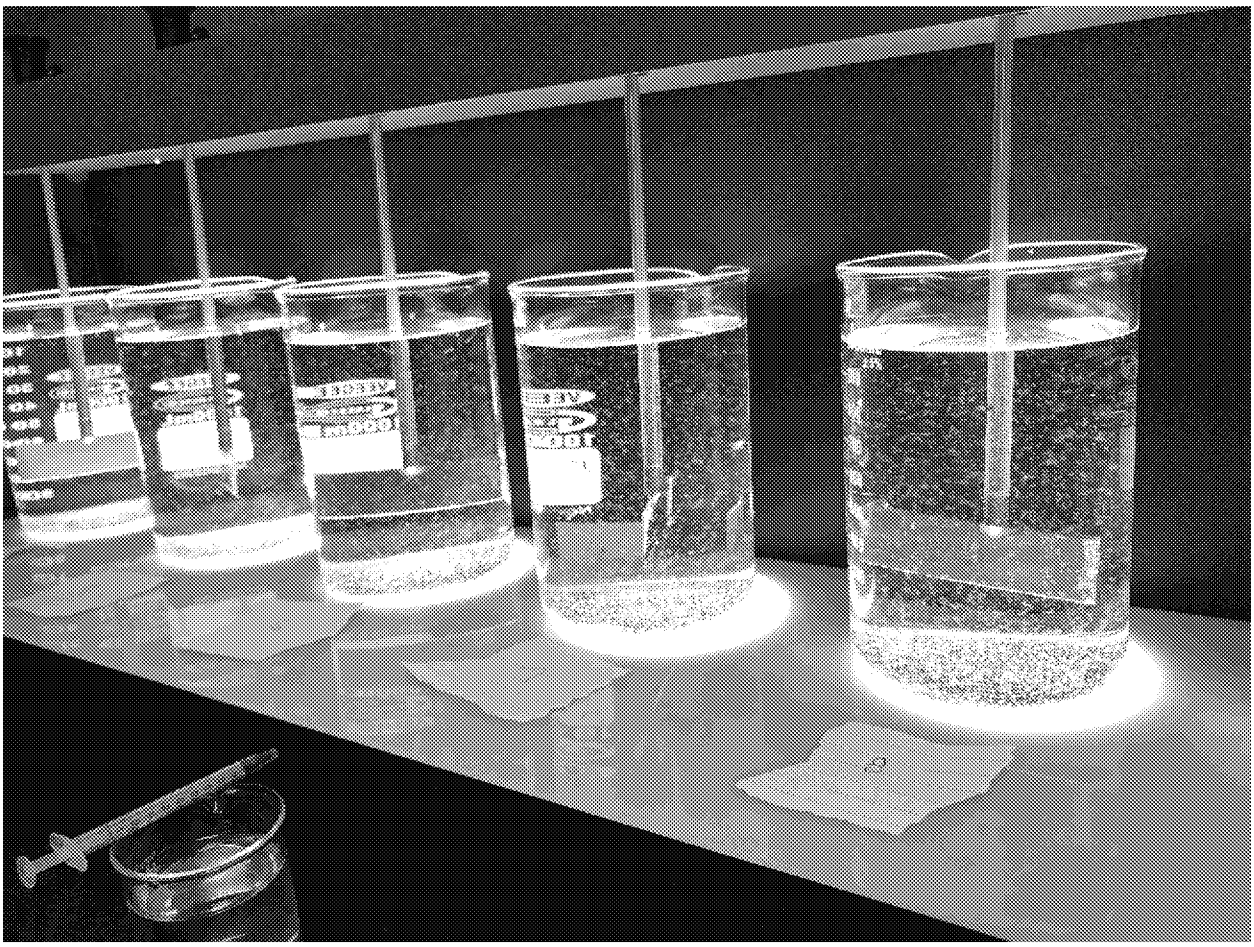

Fig. 13. Jars during the flocculation stage. Note slips of paper noting the coagulant dosage for each beaker.

8. Once the 10 minutes have passed, the paddles will stop stirring so the particles have a chance to simply settle out, as they would in the sedimentation basin. You can leave the paddles in the beakers. Continue observing and making notes on your data sheet as needed.
9. At the end of the 10 minutes, the alarm should sound, signaling the end of the sedimentation step. Drain the siphon tube for each beaker so you collect a fresh sample. Start collecting turbidity samples from the beakers. Use the tube from each beaker to sample enough water to fill the turbidity vials to the appropriate line. Make sure to collect the samples, check the turbidity and write down the result quickly, so that each jar is sampled right after the other. Leaving too much time between samples will affect the results, as beakers that have not been sampled until much later will have more particles that settle out, giving the appearance that the dosage in that beaker is preferable.
10. Now, analyze your results. Based on the final turbidity of the beakers, which coagulant dosage is best? Based on the floc formation, which coagulant dosage is best? If two dosages give similar results (for instance, 7 mg/l and 10 mg/l both give about the same turbidity readings), it may be worth it to conduct a second round of jar testing. In that case, you could dose the jars as such:
    a. Jar 1 – 0 mg/l (control)
    b. Jar 2 – 7 mg/l

c. Jar 3 – 8 mg/l
d. Jar 4 – 9 mg/l
e. Jar 5 – 10 mg/l
f. Jar 6 – 11 mg/l

Another table with additional concentration dosages is presented here for reference. Any dosage of 1% coagulant solution (in ml) can be determined by dividing the desired concentration of ACH in the raw water (in mg/L) by 5.

**Table 3. Additional Dosages for the Raw Water Beakers**

| If you want to have this concentration of ACH (in mg/L)… | Then you should add this much of a 1% coagulant solution (in ml)… | To this much raw water |
|---|---|---|
| 6 | 1.2 | 2000 ml (square beakers) |
| 7 | 1.4 | |
| 8 | 1.6 | |
| 9 | 1.8 | |
| 10 | 2 | |
| 11 | 2.2 | |

11. Select an optimum coagulant dosage and compare with that currently being dosed by the chemical feed pump, as guided by the SCM. If it's a slight difference, adjust the chemical feed pump as necessary. Use the table provided under the SCM section as a guide, taking into consideration whether one raw water pump is running or both. If there is constantly a wide variation between the optimal dosage found through jar testing, and that found by using the SCM, that may point to an issue in the SCM, jar testing methodology, or both. In those cases, reaching out to appropriate IHS personnel may be appropriate.

## Programming the Jar Tester

Note: parts of this SOP were modified from the PB-900 Programmable JarTester Instruction Manual, developed by Phipps&Bird.

Jar testing involves testing the effectiveness of a coagulant over different mixing speeds, each for different lengths of time. Running a jar test can involve a lot of tasks, and manually adjusting the timing and mixing speed of the gang stirrer can interrupt the work flow.

This is a guide to program the jar tester so it automatically runs through a sequence of mixing speeds and times with the push of just a couple buttons, and eliminates the need to adjust mixing speeds and set separate timers.

We are going to set up the gang stirrer to run this series of mixes:

100 RPM for 1 minute (flash mix/coagulation)

35 RPM for 10 minutes (slow mix/flocculation)

0 RPM for 10 minutes (sedimentation)

We will program one alarm into this program, at the end of the sedimentation step. If you want to add more alarms in the future, you should have a clear sense of how to do that if desired in the future by the end of this SOP.

1. Turn the power switch to on. The **MAIN** selection window will appear. This will have four options:

   1) Run Continuous
   2) Run Sequential
   3) Run Single Memory
   4) Program Memories

2. Select **PROGRAM MEMORIES** by hitting **4** on the keypad. The **CHOOSE MEMORY** screen will appear:

| | | |
|---|---|---|
| Choose Memory | | M1 |
| RPM: | 000 | |
| Time: | 00:00 | mm:ss |
| Alarm: | 00 | minutes |

3. Press **ENTER** and **EDITING VALUES IN M1** will appear:

| | | |
|---|---|---|
| Editing Values in M1 | | |
| RPM: | 000 | |
| Time: | 00:00 | mm:ss |
| Alarm: | 00 | minutes |

4. A blinking cursor will appear besides **RPM**. Hit **100** on the keypad and hit **ENTER** to set the **RPM** setting. The cursor will then move to the next field, **TIME**.

| Editing Values in M1 | | |
|---|---|---|
| RPM: | 100 | |
| Time: | 00:00 | mm:ss |
| Alarm: | 00 | minutes |

5. Press **100** and **ENTER** to accept run time.

| Editing Values in M1 | | |
|---|---|---|
| RPM: | 100 | |
| Time: | 1:00 | mm:ss |
| Alarm: | 00 | minutes |

6. The cursor will move to the **ALARM** field. If the value for **ALARM** is not **0**, hit **0** and **ENTER** to set it. Otherwise, press **BACK** to go to the **CHOOSE MEMORY** screen.
7. Press **UP** and **ENTER**. The **EDITING VALUES IN M2** screen will appear. Press **35** and **ENTER** to change the **RPM** setting.

| Editing Values in M2 | | |
|---|---|---|
| RPM: | 035 | |
| Time: | 00:00 | mm:ss |
| Alarm: | 00 | minutes |

8. The cursor will move to **TIME**. Hit **1000** on the keypad and **ENTER** to set the **TIME**.

| Editing Values in M2 | | |
|---|---|---|
| RPM: | 035 | |
| Time: | 10:00 | mm:ss |
| Alarm: | 00 | minutes |

9. The cursor will move to the **ALARM** field. If the value for **ALARM** is not **0**, hit **0** and **ENTER** to set it. Otherwise, press **BACK** to go to the **CHOOSE MEMORY** screen.
10. Press **UP** twice and **ENTER**. The **EDITING VALUES IN M3** screen will appear.
11. Press **0** and **ENTER** to accept the **RPM** setting.

| Editing Values in M3 | | |
|---|---|---|
| RPM: | 000 | |
| Time: | 00:00 | mm:ss |
| Alarm: | 00 | minutes |

12. Press **1000** and **ENTER** to accept the time.

| | | |
|---|---|---|
| Editing Values in M3 | | |
| RPM: | 000 | |
| Time: | 10:00 | mm:ss |
| Alarm: | 00 | minutes |

13. Press **10** and **ENTER** to set the **ALARM** frequency.

| | | |
|---|---|---|
| Editing Values in M3 | | |
| RPM: | 000 | |
| Time: | 10:00 | mm:ss |
| Alarm: | 10 | minutes |

14. Press **BACK** to go to the **CHOOSE MEMORY** screen.
15. Press **DOWN** to go to the **EDITING VALUES IN M4** screen. Ensure all parameters are set to **0**; if not, follow the steps above to set them to **0**.

| | | |
|---|---|---|
| Editing Values in M4 | | |
| RPM: | 000 | |
| Time: | 00:00 | mm:ss |
| Alarm: | 00 | minutes |

16. Press **BACK** twice to go to the **MAIN** selection window. You have finished programming the jar tester. You can turn off the jar tester and unplug it, and the programmed memories you just assigned will be available whenever it is turned on in the future.

When you are ready to begin (ie, raw water is in each beaker, the paddles have been lowered into the beakers, and coagulant is ready to dose), turn **ON** the jar testing setup. Press **2** to select **RUN SEQUENTIAL**. This will run the program stored in M1 (the fast mix), then the program stored in M2 (the slow mix) and finally the program stored in M3 (sedimentation/no mixing). M4, as it has all its parameters zeroed out, will not contribute to the sequential program.

Once you have experience jar testing and want to change the program to more accurately match conditions in the plant, you can use this as a reference to do so, or you can use the PB-900 Programmable JarTester Instruction Manual, available from the Phipps & Bird website, and attached here for reference.

**Jar Testing Data Collection - to be done weekly if SCM is working, or daily if SCM is not working**

| | |
|---|---|
| PWS ID# | 104101247 |
| Plant Name | Warm Springs Water Treatment Plant |
| Operator | |
| Date | |
| Time | |

Initial Turbidity (NTU)

| | Jar 1 | Jar 2 | Jar 3 | Jar 4 | Jar 5 | Jar 6 |
|---|---|---|---|---|---|---|
| ACH Dosage (mg/L) | | | | | | |
| Final Turbidity (NTU) | | | | | | |
| First to form floc | | | | | | |
| Observations (ex, small pinhole floc, large fluffy floc, etc) | | | | | | |

Initial Turbidity (NTU)

| | Jar 1 | Jar 2 | Jar 3 | Jar 4 | Jar 5 | Jar 6 |
|---|---|---|---|---|---|---|
| ACH Dosage (mg/L) | | | | | | |
| Final Turbidity (NTU) | | | | | | |
| First to form floc | | | | | | |
| Observations (ex, small pinhole floc, large fluffy floc, etc) | | | | | | |

**SCM Data Reporting - to be done hourly while plant is on**

PWS ID# 104101247

Plant Name Warm Springs Water Treatment Plant

| | | | | Changed Pump Parameters | | | |
|---|---|---|---|---|---|---|---|
| Date | Time | Operator | SCM Reading before adjusting LMI Pump | Stroke | Speed (strokes per minute) | SCM Reading after adjusting LMI Pump | # Raw Water Pumps |
| | | | | | | | |
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