

## **APPENDIX B**



# **BENCH SCALE TESTING MEMORANDUM**

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### **MEMORANDUM**

**San Luis Obispo County  
Bench Scale Testing  
Enhanced Coagulation**

**B&V Project 97260.300**

**April 2, 2001**

**To: Bruce Corwin  
Perri Standish-Lee**

**From: Jessica Edwards**

Bench scale testing was conducted on March 12<sup>th</sup> through March 15<sup>th</sup> 2001, at the County of San Luis Obispo, Lopez Water Treatment Plant. The results from the testing are expected to aid in discussions regarding coagulant addition in an effort to provide enhanced coagulation.

The best available technology (BAT) for meeting Stage 1 D/DBPR MCLs for TTHM and HAA5 is enhanced coagulation. The IESWTR rule requires total organic carbon (TOC) reduction. The source water TOC and alkalinity (CaCO<sub>3</sub>) concentrations are used to determine the percentage of required TOC removal. TOC removal can be achieved by addition of coagulants, filter/ coagulant aids, and pH adjustment.

Lake Lopez is the source water for the Lopez Water Treatment Plant. The water has an alkalinity range of 145 – 374 mg/L CaCO<sub>3</sub> and a TOC range of 4.0 – 5.5 mg/L. The required TOC removal is 25 percent.

#### **Bench Scale Procedure**

The bench scale tests were conducted using 2-Liter B<sup>2</sup>-Ker sample beakers and raw water from the Terminal Reservoir tap in the plant operator's laboratory. The samples were dosed with a coagulant (alum, ferric chloride, and JenChem 1679) and a coagulant aid (Cat-floc), if necessary, and subjected to rapid mix at 130 rpm for 1 minute. Following rapid mix, the samples were gently mixed at 45 rpm for 10 minutes, 30 rpm for 10 minutes, 25 rpm for 5 minutes and settled for 10 minutes. Samples for lab analysis were withdrawn from the sample ports. These samples were filtered through Whatman 40 filter paper to simulate granular media filtration.

A range of coagulant dosages was added to the raw water to help determine the optimum chemical dosages. Filtered turbidity measurements were used as a qualifying parameter for the optimum dosages. Three sets of coagulants and coagulants aids were tested.

- Ferric Chloride
- JenChem 1679 and Alum
- Alum and Cat-floc

Each set included six varying coagulant dosages in 10 mg/L increments. In experimental sets where a coagulant aid (Cat-floc) was used, the concentration was constant. Each sample was analyzed for the following parameters:

- final pH
- filtered turbidity

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Table 1 represents the final pH and filtered turbidity measurements for each sample

**Table 1. Preliminary Bench Scale Results**

<b>Ferric Chloride</b>						
Dose	0	10	20	30	40	50
Final pH	8.27	8.11	7.84	7.73	7.51	7.25
Filtered Turbidity	0.76	0.58	0.37	0.33	0.28	0.23

<b>JenChem 1679 and Alum</b>						
Dose JenChem	0	20	30	10	20	30
Dose Alum	0	0	0	10	10	15
Final pH	8.15	8.22	8.22	8.02	7.99	7.89
Filtered Turbidity	0.98	0.269	0.501	0.16	0.143	0.51

<b>Alum and Catfloc</b>						
Dose Alum	0	10	20	30	40	50
Dose Catfloc	0	1	1	1	1	1
Final pH	8.4	8.48	7.9	8	7.63	7.6
Filtered Turbidity	0.99	0.455	0.48	0.5	0.36	0.38

<b>Alum and Catfloc</b>	
Dose Alum	30 40
Dose Catfloc	3 3
Final pH	7.82 7.75
Filtered Turbidity	0.53 0.379

The same procedure was performed on two optimum dosages for each coagulant. Filtered samples were used for turbidity, pH, TOC and DBP (THM/HAA5) analyses. Table 2 represents the results from the optimum coagulant dosages.

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**Table 2. Optimum Coagulant Dose Results**

	40 mg/L Ferric	50 mg/L Ferric	40 mg/L Alum & 3 mg/L CatFloc	50 mg/L Alum & 3 mg/L CatFloc	10 mg/L JC 1679 & 10 mg/L Alum	20 mg/L JC 1679 & 10 mg/L Alum
Final pH	7.6	7.5	7.76	7.81	8.04	8.08
Filtered Turbidity, ntu	-	0.218	0.347	0.33	0.208	-
Adjusted pH	8.01	7.98	7.8	8.15	8.11	8.2
Cl <sub>2</sub> Residual, mg/L	1.43	1.25	1.07	1.17	1	1.2
Raw Water TOC, mg/L	4.6	4.6	4.6	4.6	4.6	4.6
Filtered TOC, mg/L	4.2	5	4.9	4	4.8	4.2
Percent Removal	8.7	-8.7	-6.5	13.0	-4.3	8.7
Total THM, ug/L	10.53	9.96	13.31	11.13	22.1	12.73
Total HAA5, ug/L	28.5	22.2	25.7	24.9	23.9	24

- Indicates insufficient sample

**Conclusions and Recommendations**

The initial jar test results indicate that the high pH of the raw water allows only a 9 percent to 13 percent TOC reduction. It is recommended that the pH of the raw water be lowered to an approximate pH value of 6.0 when alum is added, to achieve the effective pH range for turbidity removal and DBP precursor removal. Adjusting the pH during the jar test with sulfuric acid during rapid mix may be the best option. The effective pH range for ferric chloride lies between 3.5 to 9.0. Adjusting the pH after ferric chloride addition may also be necessary.