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STATE OF WASHINGTON
Dixie Ray
Governor

DEPARTMENT OF
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WA-45-1010

MEMORANDUM
December 31, 1980

To: Harold Porath

From: Sharon Chase

Subject: Leavenworth STP Class II Inspection

Introduction

On October 14 and 15, 1980 a Class II inspection was performed at the Leavenworth Sewage Treatment Plant (STP). A receiving water study in the Wenatchee River and a Class II inspection of the Cashmere STP were conducted at the same time. This memo is a report of the Leavenworth plant inspection. The results of the receiving water study will be reported in a later memorandum by Art Johnson.

Personnel involved in the inspection included Sharon Chase (Department of Ecology [DOE], Water and Wastewater Monitoring Section) Harold Porath (DOE, Central Regional Office) and Wes Maier (DOE, Headquarters). The plant operator, V. Ordonez was present during the inspection.

The Leavenworth STP is a secondary treatment plant with an oxidation ditch, a secondary clarifier, and a chlorine contact chamber. When the current upgrade of the plant is complete, it will have two oxidation ditches and two secondary clarifiers.

The plant's effluent is discharged to the Wenatchee River (water body segment number 21-45-01). DOE has five ambient water quality monitoring stations in the Wenatchee River, three above the Leavenworth and Cashmere STPs and one below both these effluents. "The Five-Year Water Quality Strategy" (1977) indicates that the Wenatchee River is presently meeting the state and federal water quality goals. More recently, the DOE released a memo entitled "Update of the 1986 Analysis of State Water Body Segments" (June 1980). Table 1 shows the water quality indices reported for the Wenatchee River and its tributaries. The indices were calculated using data from the two ambient monitoring stations previously mentioned.

The Wenatchee River is in good condition and under normal operating conditions, the Cashmere and Leavenworth treatment plants do not appear to have a significant adverse impact on the river.

Table 1. Water Quality Indices* for Wenatchee River.

	Temp.	Oxygen	pH	Bact.	Trophic	Aesth.	Sus. Solids	NH_3 Toxicity	Overall Index Rating
Wenatchee near Leavenworth 45A110	5.5	7.8	8.3	5.5	3.7	5.9	(7.9)+	0.0	3.3
Weantchee at Wenatchee 46A070	12.0	7.4	6.3	9.1	5.1	5.9	(10.9)+	0.7	7.7
Mean Values	9.8	7.5	7.0	7.9	4.6	5.9	(9.9)+	0.5	6.2

*0-20, good; 20-60, marginal; >60, unacceptable.

+( ) indicate that these numbers were not used in calculating the overall index rating.

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The National Pollution Discharge Elimination System (NPDES) waste discharge permit for the Leavenworth plant (number WA 0020907-4) places limits on effluent biochemical oxygen demand (BOD), suspended solids (TSS), pH, fecal coliforms, and flow. During this inspection, the plant was not meeting permit limitations for TSS.

General Description of Plant Conditions

Construction on the upgrade, in progress at the time of the inspection, accounted for much of the general disorder and lack of maintenance at the plant. The old sludge drying bed had been removed to make room for the new clarifiers and the new sludge drying bed was not ready for use. Sludge had therefore not been pumped out of the chlorine contact chamber or the secondary clarifier for some time.

Maintenance problems unrelated to the upgrade construction included problems with flow measuring equipment and oxidation ditch rotors.

When we arrived at the plant on October 14, only one of the rotors in the oxidation ditch was operating; the remaining rotor failed on the morning of the 15th. This problem apparently occurs fairly frequently. At this writing, the new ditch is on line and the old ditch is being cleaned and the rotors repaired. The old ditch is expected to be operating by spring.

The flow is measured by a three-inch Parshall flume immediately below the comminutor. The approach flow is not laminar, but the operator reported a flow that was in close agreement with the flow obtained with the Manning dipper (.28 and .27, respectively). Average flows for Leavenworth are substantially higher than the .15 MGD expected on the basis of population (100 gpd per capita). This result suggests infiltration and inflow, but increased population due to tourism, an important part of Leavenworth's economy year-round, may be partly responsible for the higher flows.

Procedure at the Plant

On October 14, we placed compositors at the influent and effluent and took grab samples at the same locations and at the oxidation ditch and secondary clarifier. We recorded temperature, pH, and conductivity for each location (see Table 2).

Table 2 Field Parameters

	pH	Temperature	Conductivity
Influent			
10/14/80	7.7	15.8	362
10/15/80	7.6	16.0	370
Oxidation Ditch			
10/14/80	7.0	15.0	345
10/15/80	7.2	14.9	335
Secondary Clarifier			
10/14/80	7.1	13.6	369
10/15/80	7.2	14.9	340
Chlorinated Effluent			
10/14/80	6.8	14.0	350
10/15/80	7.1	--	350

Table 3 summarizes the sample collection schedule, locations, and constituents analyzed. We did not obtain a 24-hour influent composite due to a loose battery wire.

On October 15, the influent sampler was set at 250 ml/15 min. and a 5-hour composite taken. The plant has no automatic sampling equipment so we split our effluent sample with the operator and split a grab sample from the influent. The 5-hour composite was not split.

The lab procedural survey was conducted on October 15, 1980. Wes Maier gave the operator additional instruction on proper procedures.

Compliance with NPDES Permit

The Leavenworth plant was not in full compliance with its NPDES permit at the time of this inspection. The violations fell into two categories. (1) failure to meet effluent limitations; and (2) use of improper laboratory techniques or equipment. Table 4 compares DOE laboratory results with the NPDES permit limitations. A summary of all field and lab data can be found in Table 5.

Table 3. Summary of sample collection schedule, locations, and constituents analyzed.

Composite Sampler	Aliquot	Date & Time Installed	Location	Field Data Collected
Influent	*250 ml/15 min.	10/15/80	Influent channel below comminutor	pH, Temperature, Conductivity
Effluent	250 ml/30 min.	10/14/80	Effluent channel at end of chlorine contact chamber	pH, Temperature, Conductivity
Grab Samples		**Date & Time**	**Location**	**Field Data Collected**
Fecal coliform		10/15/80	Chlorine contact chamber effluent	Chlorine residual
Fecal coliform		10/15/80	Chlorine contact chamber effluent	Chlorine residual
Field Parameters		10/14/80 10/15/80	Secondary clarifier and oxidation ditch	pH, Temperature, Conductivity

*Compositor initially installed 10/14/80 with sample aliquot set at 250 ml/30 min. The compositor did not sample because of a loose battery wire. On 10/15/80 the compositor was re-set at 250 ml/15 min and a 5-hr. composite sample obtained.

Table 4. Comparison of laboratory results from composite samples with NPDES permit effluent limitations.

	DOE Laboratory				Leavenworth STP Lab. Split		
	Influent Grab	Influent Comp.	Eff. Comp.	Eff. Grab	Inf. Grab	Eff. Grab	NPDES Permit
BOD_5 (mg/l)	210	180	26		165*	69*	60
(lbs/day)			58			161	150
TSS (mg/l)	180	180	100		132	54	60
(lbs/day)			255			126	150
Fecal Coliform	---	--		<3		0	700
(col/100 mls)				<2			
Chl. Resid.	---	--		4.5			...
(mg/l)				5.0			
pH	7.6	7.7	7.7				6.5-8.5
Flow (MGD)		.27				.28	.7

*Operator ran a 6-day BOD
"<" = less than

Table 5 Summary of field and laboratory data

	Influent		Effluent	Split Samples		NPDES
	Grab	Composite	Composite	Inf. Grab	Eff. Comp.	Permit
Flow (MGD)		.27				.7
BOD_5 (mg/l)	210	180	26	165	69	60
(lbs/day)			58			150
COD	280	470	160			
Fecal Coli.			<3		0	700
(col/100 mls)			<2			
Cl_2 Resid.			4.5			
			5.0			
Temperature	16.0		--			
Conductivity	370	420	350			
pH		7.7	6.8			
	7.6	7.2	7.1			6.5-8.5
TS	390	540	310			
TNVS	140	210	170			
TSS (mg/l)	180	180	60	132	57	60
(lbs/day)			155			150
TNVSS	34	45	28			
Turb. (NTU)	86	63	39			
NO_3-N		0.25	<0.25			
NO_2-N		0.28	0.25			
NH_3-N		14	11			
O-PO_4-P		5.3	5.0			
T-PO_4-P		8.3	6.3			

"<" = "less than"

Memo to Harold Poath
Leavenworth STP Class II Inspection
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The plant was in violation of its limitation on suspended solids according to the DOE laboratory results. The results from the BOD test were inconclusive. The agreement between DOE and Leavenworth effluent BOD results was very poor and errors in procedure at both labs make both the results suspect. The BOD's at the Leavenworth lab were allowed to run 6 days instead of 5 and the DOE effluent sample was neither dechlorinated nor re-seeded. With the Cl_2 residual in the 4-5 ppm range, the failure to dechlorinate and re-seed severely reduces confidence in the results.

In view of the fact that the plant upgrade will soon be completed the violations of effluent TSS limitations and inconclusive results on BOD are not the greatest concern. Also, with all aeration down and solids accumulating in the clarifier and contact chamber, violations are not surprising. Presumably, the new plant will meet its permit limitations when it comes on line. The violations which came to light as a result of the lab procedural survey are more serious because, except for providing some much needed new equipment, the upgrade cannot be expected to correct these problems automatically. The following section outlines these violations.

Laboratory Procedural Survey

The laboratory procedural survey was conducted on October 14, 1980. For compliance with the testing equipment portion of the NPDES permit, the changes in procedure required are as follows:

Sample Collection and Handling - Since the plant has no automatic sampling equipment, a grab composite has been used. Samples of 200 mls every two hours for 8 hours were taken. It is recommended that samples be taken every hour. The eight-hour composite should be a flow composite (i.e., a sample volume proportional to the flow - see Figure 1). The operator reported stirring the composite before withdrawing the sample for testing. The sample should be mixed more thoroughly (vigorously shaken). The samples were being stored prior to analysis at 14°C; the recommended temperature is 4°C.

BOD

Seed Material - The operator reported keeping seed material for a week and storing it on top of the refrigerator at approximately 14°C. The maximum recommended storage time for seed is 72 hours (3 days). It should be held in the BOD incubator at 20°C. The operator also reported stirring the seed before pipetting it into the BOD bottles. The proper procedure is to allow the sample to settle for 24 hours using the supernatant for the seed. If the sample is not allowed to settle, the organic material in the seed will add BOD. Seed material should be obtained from the secondary clarifier rather than the oxidation ditch.

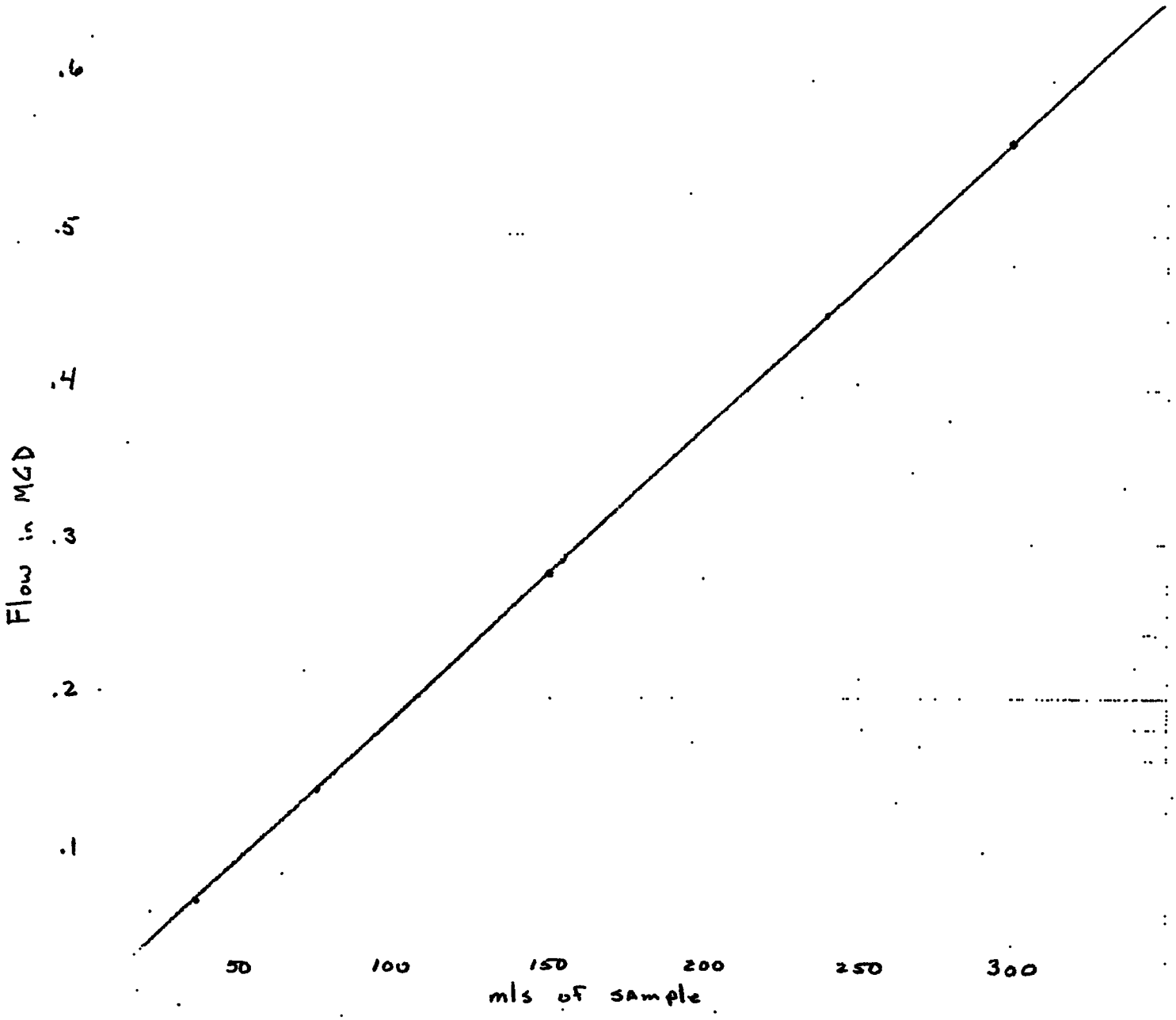

Figure 1. Sample graph for calculation of flow proportional composite. Based on maximum flow of .56 MGD.

Memo to Harold Porath
Leavenworth STP Class II Inspect.
December 31, 1980

Reagent and Dilution Water - The operator is currently buying bottled distilled water for use in preparing reagent and dilution water. A still is included in the equipment expected with the plant upgrade.

The reagent water was being aged on a lab counter in the light. The operator was told to age it in the dark

The operator reported preparing five gallons of dilution water at a time. This water would then be used over the course of a month. The dilution water should be made fresh for each BOD test.

Test Procedure - The BOD test should be run once a week as required by the plant's NPDI permit. The chlorine residual of the effluent sample should be checked and an appropriate amount of thiosulfate added (see Standard Methods). The pH meter should be calibrated more frequently than once a week; at least once a day.

The operator knew the proper temperature and incubation time for the test but beyond that, she lacked sufficient knowledge to complete the test. She did not determine the 5-day dissolved oxygen depletion of the dilution water blank. The BOD of the seed was not determined and the dilution factor was not taken into account in the calculations.

The correct procedure was explained to the operator and Wes Maier set up the test with her and further explained how to complete the test. Despite this detailed instruction, the operator let the BOD run 6 days. It is clear that the operator will need to study the correct methods carefully. The DOE manual for BOD was left with the operator.

TSS - The operator understood the correct technique for the suspended solids test. Sample drying was the major problem noted. The temperature of the oven was 75°C on the day of the lab survey. The operator knew that the correct temperature for drying the filters was 103°C to 105°C. However, the thermometer used to register temperature in the oven only went up to 100°C.

The operator reportedly had no difficulty filtering 50 mls of sample. The correct procedure of running duplicate or triplicate sample volumes if less than 50 mls can be filtered was explained. The correct formula for calculating TSS was being used. A new thermometer must be obtained for the drying oven.

Memo to Marc Porath
Leavenworth STP Class II Inspection
December 31, 1980

Fecal Coliform - A review of lab techniques for this test was not conducted because the operator had no idea how to run the test and the lab did not contain the proper equipment. The Chelan/Douglas County Health Department had been running the fecal test for the plant. The health department ran the test once a month by the MPN method. The operator is not at all familiar with the fecal coliform test. She will need to review all procedures from sterilization of glassware and sterile sample collection technique to correct dilution and counting. Some experimentation will be necessary to find the correct dilutions to get valid results. A copy of the DOE manual for the fecal coliform test was left with the operator.

A more accurate thermometer will be needed for the water bath incubator. The one in use is accurate to 1°C. The temperature for the incubation of fecal coliforms is critical. A thermometer with .1°C increments is necessary.

Recommendations

In light of the current upgrade, which we hope will correct the effluent violations, our recommendations relate primarily to the operator's test procedures.

It is clear from the lab procedural survey that the operator does not know how to properly perform the fecal coliform or the BOD tests. The operator will, therefore, need training in laboratory procedures. Wes Maier can provide some assistance, but the operator must conscientiously apply herself to learning the procedures and not rely too heavily on Wes Maier. We suggest that the operator review the proper procedures in Standard Methods and/or the DOE procedure manuals, copies of which were supplied to her, and then ask Wes to clarify any test procedures or calculations that are still unclear. If possible, the operator should take some laboratory technique classes.

Because of the operator's insufficient knowledge of laboratory procedures, we do not feel that the values reported on the DMR's for BOD's are reliable. The DMR's also indicate that tests were not being done as frequently as the permit required. The fecal coliform test was done monthly by the Chelan/Douglas Public Health Department, while the permit requires weekly testing. BOD and TSS are also required weekly. We ask that BOD and TSS be run on the same day from the same composite sample, so that the results can be compared. The operator should be reminded that the frequency of the testing, the proper reporting of results, and the use of proper procedures are all as much a part of permit requirements as meeting effluent limitations.

The regional office should pay close attention to the DMR's and follow up on any violations in testing or reporting or any numbers that appear unreliable.

SC:cp

Attachments

Department of Ecology, 1977. Five year [illegible] Wash. State Dept. of Ecology, Water Qual Mgmt Div [illegible] pp.

Singleton, I.R., 1980 Update of the 1980 analysis of state waterway segments: Water Quality Index (WQI) Analysis; Trend Analysis Memorandum to John Bernhardt, Water & Wastewater Monitoring Section, DOE, 44 pp.

Discharger: Leavenworth STP

NPDES Permit Number: WA 002011-4

Date: Oct. 15 19[illegible]

Industrial/Municipal Representatives Present: V. [illegible] Hatch

Agency Representatives Present: Steve Chase, Wes [illegible], Harold Porath

I. COMPOSITE SAMPLES

A. Collection and Handling

1. Are samples collected via automatic or manual compositing method? ______ Model? ______

   a. If automatic, are samples portable ______ or permanently installed ______?

   Comments/problems: new plant will not have composite samplers

2. What is the frequency of collecting composite samples?

   every 2 hrs (8-hrs – 6 samples)

3. Are composites collected at a location where homogeneous conditions exist?

   a. Influent? before comminutor (new plant after comminutor)

   b. Final effluent? at 'V' notch weir after chlorination chamber

   c. Other (specify)? ______

4. What is the time span for compositing period? 8 hrs approx.

   Sample aliquot? 200 [illegible] mls per 2 hrs ~~minutes~~

5. Is composite sample flow or time proportional? time

6. Is final effluent composite collected from a chlorinated or non-chlorinated source? Chlorinated

7. Are composites refrigerated during collection? YES / NO
Kept in top of refrigerator. Bottom of refrigerator used for [illegible]

8. How long are samples held prior to analyses? 6 1/2 hrs

9. Under what condition are samples held prior to analyses?

   a. Refrigeration? ✓

   b. Frozen? _____

   c. Other (specify)? _____

10. What is the approximate sample temperature at the time of analysis? 20 °C.

11. Are compositor bottles and sampling lines cleaned periodically? N/A

   a. Frequency? _____

   b. Method? _____

12. Does compositor have a flushing cycle? N/A

   a. Before drawing sample? _____

   b. After drawing sample? _____

13. Is composite sample thoroughly mixed immediately prior to withdrawing sample? Stirred

Recommendations:

- through mixing of sample
- flow composite rather than time composite (see tip of Report)
- Store samples at lower temp. using ice chest (or other avail. method)

II. BIOCHEMICAL OXYGEN DEMAND CHECK SHEET

A. Technique

1. What analysis technique is utilized in determining BOD_5?

a. Standard Methods? ✓ Which? 14th edition

b. EPA? _____

c. A.S.T.M.? _____

d. Other (specify)? 1974 wastewater plant operators manual

B. Seed Material

1. Is seed material used in determining BOD? yes

2. Where is seed material obtained? oxidation ditch overflow wet well

3. How long is a batch of seed kept? one week

and under what conditions? (temperature, dark) in top of refrig. (1°C)

4. How is seed material prepared for use in the BOD test? 5 hrs sample & pipettes to BOD bottle

Recommendations:

- use standard methods as a reference in preference to plant operators manual.
- obtain seed from the secondary clarifier
- don't store seed for more than 12 hrs
- Store seed in BOD incubator
- Allow seed to settle use supernatant for seeding.

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? ✓ currently buying distilled water [illegible] will provide a still for [illegible] production

   b. Deionized? ______

   c. Tap ______, chlorinated ______ non-chlorinated ______

   d. Other (specify)? ______

2. Is reagent water aged prior to use? yes

   How long? couple of days, under what conditions? on shelf in the lab (in light)

Recommendations:

store reagent water in the dark

D. Dilution Water

1. Are the four (4) nutrient buffers added to the reagent water? yes

   a. ______ mls of each nutrient buffer per ______ mls of reagent water

2. When is phosphate buffer added (in relation to setting up BOD test)? ______

5 gallons at a time 3. How often is dilution water prepared? once a month
Maximum age of dilution water at the time test is set up. ______

4. Under what conditions is dilution water kept? on shelf

5. What is [illegible] of dilution water at time of setup? 20°C [illegible]

Recommendations:

make a [illegible] [illegible] dilution water [illegible] [illegible]

E. Test Procedure

1. How often are BOD's being set up? 1 or 2 times a month

What is maximum holding time of sample subsequent to end of composite period? 6 hrs

2. If sample to be tested has been previously frozen, is it reseeded? N/A How?

3. Does sample to be tested contain residual chlorine? Yes
If yes, is sample

a. Dechlorinated? NO - used to add set amt of thio

How? explained correct procedure. (take TCR add sufficient thio to counteract Cl_2)

b. Reseeded?

How?

4. Is pH of sample between 6.5 and 8.5? Yes

If no, is sample pH adjusted and sample reseeded?

5. How is pH measured? Corning model 5

a. Frequency of calibration? once a week

b. Buffers used? 7 + 10

6. Is final effluent sample toxic? No

7. Is the five (5) day DO depletion of the dilution water (blank) determined? NO, normal range? ____

8. What is the range of initial (zero day) DO in dilution water blank? ____

9. How much seed is used in preparing the seeded dilution water? 10 ml's

operator confused about this portion of test

10. Is five (5) day DO depletion of seeded blank determined? NO
If yes, is five (5) day DO depletion of seeded blank approximately 0.5 mg/l greater than that of the dilution water blank? ____

11. Is BOD of seed determined? NO

12. Does BOD calculation account for five (5) day DO depletion of

a. Seeded dilution water? NO

How? ____

b. Dilution water blank? NO

How? ____

13. In calculating the five (5) day DO depletion of the sample dilution, is the initial (zero day) DO obtained from

a. Sample dilution? ____

b. Dilution water blank? ____

14. How is the BOD_5 calculated for a given sample dilution which has resulted in a five (5) day DO depletion of less than 2.0 ppm or has a residual (final) DO of less than 1.0 ppm? ____

proper reporting procedure explained

15. Is liter dilution method or bottle dilution method utilized in preparation of

a. Seeded dilution water? liter

b. Sample dilutions? liter

16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? dark, 20°C. yes

17. How is incubator temperature measured? [illegible]

18. Is the incubator temperature checked for accuracy? NO

a. If yes, how?

b. Frequency?

19. Is a log of recorded incubator temperatures maintained? NO

a. If yes, how often is the incubator temperature monitored/checked?

20. By what method are dissolved oxygen concentrations determined?

Probe X Winkler Other

a. If by probe

1. What method of calibration is in use? manufacturers

2. What is the frequency of calibration? weekly

b. If by Winkler

1. Is sodium thiosulfate or PAO used as titrant?

2. How is standardization of titrant accomplished?

3. What is the frequency of standardization?

Recommendations:

- review procedures for BOD test & calculations
- calibrate pH meter at least daily
- check temp in incubator w/ thermometer on shelf in waterbath. Keep a log of temps in incubator (adjust as necessary)

F. Calculating Final Biochemical Oxygen Demand Values Washington State Department of Ecology

1. Correction Factors

a. Dilution factor:

$$= \frac{\text{total dilution volume (ml)}}{\text{volume of sample diluted (ml)}}$$

b. Seed correction:

$$= \frac{(\text{BOD of Seed})(\text{ml of seed in 1 liter dilution water})}{1000}$$

c. F factor = a minor correction for the amount of seed in the seeded reagent versus the amount of seed in the sample dilution:

$$F = \frac{[\text{total dilution volume (ml)}] - [\text{volume of sample diluted ml}}{\text{total dilution volume, ml}}$$

2. Final BOD Calculations

a. For seed reagent:

(seed reagent depletion-dilution water blank depletion) x D.F.

b. For seeded sample:

(sample dilution depletion-dilution water blank depletion-seed) x D.F.

c. For unseeded sample:

(sample dilution depletion-dilution water blank depletion) x D.F.

3. Industry/Municipality Final Calculations

operators method ??

10mls of sample 10mls of seed

Calculation - didn't take dilution into account

- No correction for DO of seed, for dilutions, NO DO blank calc.

initial DO - final DO = BOD ???

- operator confused

Recommendations: [illegible]

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

1. What analysis technique is utilized in determining total suspended solids?

a. Standard Methods? ✓ Edition 14th edition

b. EPA? _____

c. A.S.T.M.? _____

d. Other (specify)? _____

B. Test Procedure

1. What type of filter paper is utilized:

a. Reeve Angel 934 AH? _____

b. Gelman A/E? _____

c. Other (specify): Schleicher + Schnell

d. Size? 47mm

2. What type of filtering apparatus is used? Gelman

3. Are filter papers prewashed prior to analysis? yes

a. If yes, are filters then dried for a minimum of one hour yes at 103°C-105°C yes ?

b. Are filters allowed to cool in a dessicator prior to weighing? yes (15 min)

Temp in oven 175°

therm. only good to 100 C

4. How are filters stored prior to use? _____

5. What is the average and minimum volume filtered? 50 ml/s

6. How is test volume selected?

   a. Ease of filtration? _____

   b. Ease of calculation? _____

   c. Grams per unit surface area? _____

   d. Other (specify)? _____

7. What is the average filtering time (assume sample is from final effluent)? up to 1 hr

8. How does analyst proceed with the test when the filter clogs at partial filtration? Starts over

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? NO (procedure explained)

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? YES

11. Is filter funnel washed down following sample filtration? YES

12. Following filtration, is filter dryed for one (1) hour, cooled in a desscator, and then reweighed? YES

13. Subsequent to initial reweighing of the filter, is the drying cycle repeated until a constant filter weight is obtained or until weight loss is less than 0.5 mg? NO

4. Is [illegible] NO

a. If y , explain: _____

Recommendations:

- 4 Hrs to take max 5, if up to 1 hr is needed. Operator should be running duplicates in triplicate if much smaller value.

C. Calculating Total Suspended Solids Values Washington State Department of Ecology

A. $mg/l\ TSS = \frac{A-B}{C} \times 10^6$

1. Where: A = Final weight of filter and residue (grams)

B = initial weight of filter (grams)

C = Milliliters of sample filtered

Calculation OK

2. Industry/Municipality Calculations

Recommendations:

SPLIT SAMPLE RESULTS:

Origin of Sample _____

Collection Date _____

BOD		TSS		EPA BOD Standard	
DOE	IND./MUN.	DOE	IND./MUN.	DOE	IND./MUN