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STATE OF WASHINGTON

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Governor

DEPARTMENT OF ECOLOGY

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M E M O R A N D U M
November 8, 1979

To: David Wright, N.W. Region

From: Mike Morhous

Subject: Lynnwood Class II Inspection

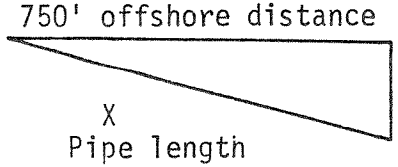
Introduction

The above-referenced Lynnwood Class II inspection was conducted on July 24 and 25, 1979. Those people in attendance at the July 24-25 inspection were David Wright; Ray Opsal, plant operator; Al Peppard, relief operator and maintenance man; and Darrel Anderson and Mike Morhous (DOE). Samples were collected at four locations in the receiving water and analyzed for fecal coliforms and nutrients. Due to the fact that the chief plant operator, Darrell Bruckshen, was on vacation, a follow-up inspection was subsequently conducted on August 22 and 23, 1979, during which a composite sample was split for BOD_5 analysis. BOD laboratory procedures were reviewed at this time (see Tables II and III for follow-up sample collection information).

The Lynnwood sewage treatment plant (STP) is a primary wastewater treatment facility that discharges to Puget Sound. The STP is comprised of a pre-chlorination system headworks, primary clarifier, and post-chlorination with no chlorine contact chamber. Disinfection contact time is provided in the outfall line. The STP also has a sludge incineration facility which consists of a centrifuge dewatering system and an incinerator with scrubbers in the stack to move fly ash. The plant has been experiencing difficulty for some time in meeting their NPDES permit limitations. The plant appears hydraulically overloaded based on the design criteria for the plant which is 2.2 MGD. The sludge thickener becomes anaerobic during the summer. This decreases its efficiency and is responsible for an obnoxious odor.

Because the STP does not have a chlorine contact chamber, a flow detention curve (Figure 1) was developed by DOE. The curve relates plant flow to detention time in the discharge line. Using this curve to determine the sample holding time prior to dechlorination should provide more realistic effluent fecal coliform data. It should be noted with regard to interim effluent limitations provided and DOE Order, Docket Number DE 77-380, that the sewage treatment plant is not required to test for or report fecal coliforms. Disinfection is controlled by a minimum effluent limit for total residual chlorine only. Again, the flow/detention time of the effluent (Figure 1) should be taken into account. This would enable the determination of the TRC concentration at the diffuser and not that concentration which exists immediately downstream from the chlorine feed.

FIGURE 1



100' below MLLW

$x = 757'$

dia = 3'

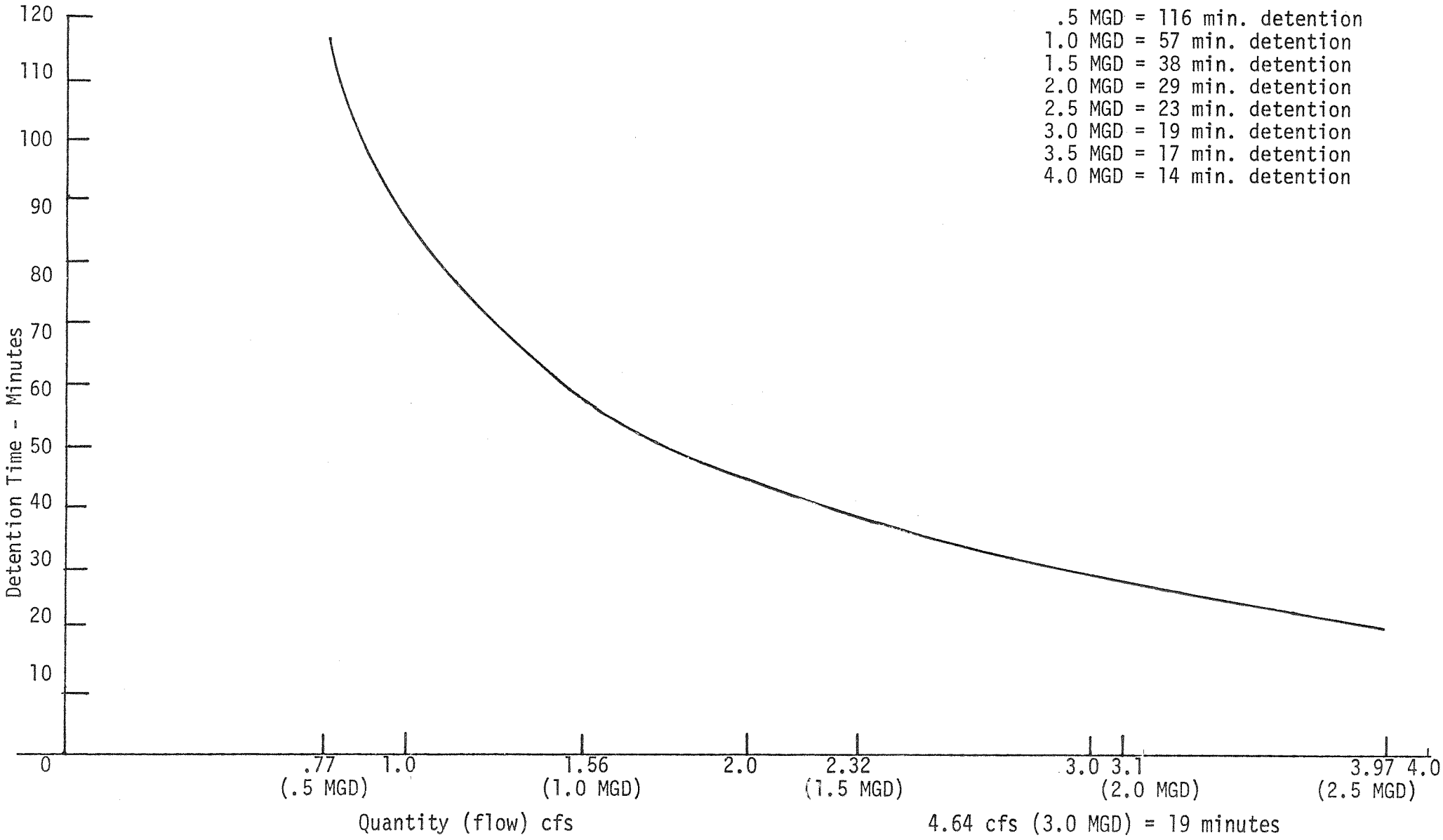
$X(3/2)^2 \pi = V\ ft^3$

$V = 5351$ cu ft

Detention Time Curve for Chlorinated Effluent in discharge pipe, Lynnwood STP

$$\frac{\text{Volume } (ft^3)}{\text{Quantity (cfs)}} = \text{time (sec)}$$

.5 MGD = 116 min. detention
1.0 MGD = 57 min. detention
1.5 MGD = 38 min. detention
2.0 MGD = 29 min. detention
2.5 MGD = 23 min. detention
3.0 MGD = 19 min. detention
3.5 MGD = 17 min. detention
4.0 MGD = 14 min. detention



Findings and Conclusions

Class II Inspection

At the time of the initial inspection, the STP was meeting all limitations that were successfully analyzed. BOD_5 samples were not analyzed. The hydraulic loading was 4 percent above design specifications (see Table I). The second set of composite samples collected on August 7 and 8 showed the plant was not meeting BOD_5 effluent limitations, although total suspended solids results were in compliance. Flow data for the composite period was unavailable. The flow meter was down for repairs.

On August 22 and 23 a third trip was made to the Lynnwood STP to split the unchlorinated composite sample collected by Lynnwood. The results showed the STP was meeting its BOD_5 and total suspended solids limitations. The hydraulic loading was 6 percent above design specifications.

The plant measures total flow with a Sparling (propeller) flow meter installed at the outfall end of the clarifier discharge pipe. The flow meter could not be checked for accuracy because there were no locations available to accurately measure the instantaneous flow.

Samples from Receiving Water

Several samples were obtained in the vicinity of the plume. These were analyzed for fecal coliforms and nutrients to provide an indication of effluent impact on the receiving water.

At the time of the receiving water study the wind was blowing from the southwest. The effluent plume was visible, and a number of seagulls were observed sitting on the upwelling and drifting with the wind toward shore. Four samples were collected. Station 1 was located upwind from the upwelling. Station 2 was located in the plume upwelling, while stations 3 and 4 were successively downwind from the plume. Station 4 was about 50 feet offshore. The results of these samples are shown in Table V.

Table V. Laboratory results from DOE receiving water (Puget Sound) study - surface samples collected in vicinity of outfall discharge upwelling.

	Station #1	Station #2	Station #3	Station #4
Time	1200	1205	1210	1215
Fecal coliform (col./100 ml)	<5	<5	<5	<5
NO_3-N (mg/l) Filtered	.11	.18	.13	.12
NO_2-N (mg/l) Filtered	<.01	<.01	<.01	<.01
NH_3-N (mg/l) Unfiltered	<.01	.25	.01	.01
O-PO_4-P (mg/l) Filtered	.05	.13	.07	.06
Tot. Phos.-P (mg/l) Unfiltered	.09	.19	.10	.10

"<" is "less than" and ">" is "greater than"

At the time these samples were obtained, the discharge effluent from the treatment plant appeared to be having a minimal effect on Puget Sound waters in the vicinity of the discharge outfall. Although increased nutrient levels were detected at the plume, dilution rapidly brought these concentrations to near background (station 1). All fecal coliform samples yielded values less than 5 colonies per 100 ml.

Based on NH_3-N and T-PO_4-P results, initial dilution at the surface (station 2) was approximately 90:1. The fecal coliform results (<5/100 mls) are in keeping with this finding. Effluent fecal coliform samples were dechlorinated after the times indicated in Figure 1. Values of 180 to 780/100 mls were obtained. Based on a 90:1 dilution, these effluent coliform concentrations would result in values of approximately 2 to 10 additional colonies/100 mls at the most concentrated point of the surfacing plume.

Summary

1. The Lynnwood plant is exceeding design flow, based on flow data generated by the treatment plant's in-line flow meter.

2. Based on COD and BOD_5 data, the plant is removing little or no organic matter from the waste stream.

Laboratory procedures were reviewed with Ray Opsal and Darrell Bruckshen.

Composite Sampling

The STP uses one Manning S-3000 automatic sampler. They sample the influent one day and the final (unchlorinated) effluent the following day. They do this weekly. The influent sample is collected above prechlorination injection. The unchlorinated sampler is placed on the launder ring of the clarifier which makes it very difficult to pick up a total clarifier discharge.

BOD's are analyzed on the day that composites are collected. Suspended solids samples are stored in the refrigerator and are run each weekend by Ray Opsal. Darrell Bruckshen conducts the BOD_5 analyses. It was noted during the inspection that the composite samples were not chilled during the composite period.

Recommendations

Recommendations were provided as follows:

1. Change the location of the unchlorinated effluent sampling site to the manhole used by DOE during the Class II inspection in order to composite the total clarifier effluent.

2. Clean the composite samplers a minimum of once a week, provided the effluent sample is collected on the first day and the influent is sampled on the second day.

3. In view of the fact that solids sample is poured from the composite jug into a 300 ml D.O. bottle, it was recommended that a larger, wide-mouth container be acquired to provide a larger, more representative sample volume and to preclude possible settling of solids during the transfer of sample from the composite jug to the holding container.

4. Composite samples should be iced during the composite sampling period.

BOD_5 Analysis

The lab uses the Water Pollution Control Federation, Simplified Laboratory Procedure for Wastewater Examination, 1976 edition. DOE's BOD manual was given to the operator, Darrell Bruckshen, for guidance in conducting future tests.

Two major discrepancies were noted during review of BOD_5 procedures:

1. In preparing the dilution water, 1 ml of each nutrient reagent was mixed per gallon (rather than per liter) of distilled water.

2. Phosphate buffer solution used in the BOD test was in fact the phosphate buffer solution prepared for use in the fecal coliform analysis.

These are two separate phosphate buffers and the phosphate buffer used in the fecal coliform analysis does not provide the nutrients necessary for the BOD_5 analysis. It was recommended that the dilution water be prepared in accordance with *Standard Methods*; one ml of each nutrient per liter of distilled water. It was also recommended that dilution water blanks be set up each time the test is run. In addition, it was also recommended that accuracy checks of the incubator be conducted using a water bath and thermometer placed on the same shelf as the bottles. Along with this, a log should be maintained of incubator temperatures together with the results of the accuracy checks on the incubator itself.

In conjunction with the BOD test, dissolved oxygen is measured using the Winkler Azide modification technique. Sodium thiosulfate is used as the titrant. The STP purchases the manufactured sodium thiosulfate at .025 normal from Chem West of Seattle. However, the STP does not check the

normality of the sodium thiosulfate. It was recommended that the normality of the sodium thiosulfate be checked at least once every two weeks. This will provide the lab man with the actual normality of the sodium thiosulfate and give him the option of making appropriate adjustments when calculating the DO concentrations or adjusting the thio to the appropriate normality.

Total Suspended Solids

Again, the lab was using the Water Pollution Control Federation manual. The lab uses the Gooch Crucible filtering apparatus and Whatman GF/A, 2.1 cm diameter, filter papers. Since the inspection, the lab has reordered and are presently using Reeve Angel 934AH filter papers recommended by *Standard Methods*. The basic procedures and techniques used by the lab appeared adequate except that only 20 mls of sample was being filtered from each composite sample. A minimum of 50 mls should be filtered in order to obtain representative results. Because of the small amount of sample being filtered, the average filtering time was between one-half a minute to a minute. It was explained that as a check for optimum volume of sample to be filtered during this analysis, the following guidelines should be used: An optimum sample volume should reduce the initial filtration rate by approximately 50 to 60 percent at the end of the sample filtering period. Sample volume should be adjusted accordingly. This may necessitate filtering a portion of the sample prior to the analysis to determine the sample volume required. In no case should the total volume filtered be less than 50 mls. Duplicate or triplicate filtrations may become necessary when the filterable sample volume is less than 50 mls.

It was recommended that the sample measuring container be rinsed following sample filtration and the resulting rinse water be filtered. It was also recommended that the filtration funnel Gooch Crucible be washed down following sample filtration and the washdown water filtered. Finally, it was also recommended after drying and weighing the filter that the drying cycle be repeated until a constant filter weight is obtained or until weight loss is less than .5 mg as prescribed in *Standard Methods*, 14th Edition.

The laboratory measures pH using the Hellige color comparitor with Bromthymol Blue-D indicator solution. The lab also uses a Hellige DPD colormetric test kit for measuring total chlorine residual.

At the time of this inspection, the STP was not analyzing for fecal coliforms. Because there is no chlorine contact chamber, in the past they consistently were getting "too numerous to count" results. The flow/detention curve (see Figure 1) developed by DOE for the effluent line was explained and discussed with Darrell. Detention times were given him with regard to various flows at the time samples were collected. It was explained that by implementing the sample holding time

prior to dechlorination, he should be able to obtain valid coliform results. A copy of DOE's fecal coliform manual edition 1977 was given to him and it was recommended that he begin running fecal coliform analyses.

MM:cp

Attachments

Class II Field Review and Sample Collection

24-hour Composite Sampler Installations

Sampler	Date and Time Installed	Location
1. Influent	7/24/79 @ 1015	Headworks below comminutor and bar screen
sample aliquot: 250 mls/30 min.		
2. Unchlorinated Eff.	7/24/79 @ 1035	Clarifier outfall line (manhole)
sample aliquot: 250 mls/30 min.		
3. Chlorinated Eff.	7/24/79 @ 1100	Chlorinated effluent below weir
sample aliquot: 250 mls/30 min.		
4.		
sample aliquot:		
5.		
sample aliquot:		

Field Data

Parameter(s)	Date and Time	Sample Location
pH, Temp., sp. cond.	7/24/79 @ 1130	Same as comp. sampler #1
pH, Temp., sp. cond.	@ 1115	Same as comp. sampler #2
pH, Temp., sp. cond.	@ 1100	Same as comp. sampler #3
Total residual chlorine	7/25/79 @ 1030	Same as comp. sampler #3
Total residual chlorine	@ 1155	Same as comp. sampler #3

Grab Samples

Lab Analysis	Date and Time	Sample Location
Trace metals	7/25/79	Dewatered sludge
Trace metals	7/25/79	Reclaimed sludge ash
Fecal coliform	7/25/79 @ 1015	Same as comp. sampler #3
Fecal coliform	@ 1019	Same as comp. sampler #3
Fecal coliform	@ 1155	Same as comp. sampler #3

Table I. The following table is a comparison of laboratory results from 24-hour composite(s) collected July 24-25, 1979 together with NPDES permit effluent limitations. Additional results pertinent to this inspection have also been included.

	DOE			Lynnwood STP		
	Influent	Unchlor. Effluent	Chlor. Effluent	Influent	Unchlor. Effluent	NPDES[5] (Monthly Average)
BOD_5 (mg/l)	data rejected - contaminated dilution water					200
lbs/day						4,000
TSS (mg/l)	220	72	78	180	70	175
lbs/day		1,380	1,490		1,340	3,500
Plant Flow (MGD)					2.29	
COD (mg/l)	400	330	350			
Fecal Coliform Colonies/100 ml						
@ 1015			Est. 780[1]			
@ 1019		3502	350[2]			
@ 1153			180[3]			
pH (S.U.)	7.5*	7.1*	7.0*			
	7.2	7.1	7.0			
Temp. (°C)	19.0*	19.0*	19.0*			
Sp. Cond. (μmhos/cm)	478*	490*	490*			
	469	416	419			
Tot. Res. Chl.* (mg/l)						1.0 min.
@ 1030			3.0			
@ 1155			1.25[4]			
NH_3-N (mg/l) Unfiltered	19.0	21.0	21.0			
NO_2-N (mg/l) Filtered	<.01	.29	.27			
NO_3-N (mg/l) Filtered	<.01	.14	<.01			
O-PO_4-P (mg/l) Filtered	.41	.41	.43			
Tot. Phos.-P (mg/l) Unfiltered	9.5	9.5	9.6			
Total Solids (mg/l)	490	400	410			
TNVS (mg/l)	200	180	180			
TSS (mg/l)	220	72	78	180	70	175
TNVSS (mg/l)	24	4	2			

* = Field Analysis "<" is "less than" and ">" is "greater than"

[1] Sample held 20 min. per Figure 1 before dechlorination.

[2] Sample held 15 min. to determine minimum disinfection at peak flow - Figure 1.

[3] Held 19 min. per Figure 1 before dechlorination.

[4] Held 19 min. before measuring TRC.

[5] As per interim limits, DOE Order, Docket No. DE 77-380.

Table II. Follow-up Sample Collection. The following table is a comparison of laboratory results from 24-hour composite(s) collected August 22-23, 1979 together with NPDES permit effluent limitations. Additional results pertinent to this inspection have also been included.

		DOE		
	Influent	Unchlorinated Effluent	Chlorinated Effluent	NPDES (Monthly Average)
BOD_5 (mg/l)	200	200	210	200
pH (S.U.)	7.8	7.6	7.1	6.0-9.0
TSS (mg/l)	210	100	63	175
Turbidity	90	84	78	
Sp. Cond. (μmhos/cm)	485	498	492	
COD (mg/l)	390	340	340	
NH_3-N (mg/l) Unfiltered	18	21	20	
NO_2-N (mg/l) Filtered	<0.2	<0.2	<0.3	
NO_3-N (mg/l) Filtered	<0.2	<0.2	<0.2	
O-PO_4-P (mg/l) Filtered	6.2	7.0	6.8	
Total Phos.-P (mg/l) Unfiltered	8.9	9.9	9.3	
Total Solids (mg/l)	440	390	380	
TNVS (mg/l)	200	200	200	
TNVSS (mg/l)	80	26	10	

*Field Analysis "<" is "less than" and ">" is "greater than"

No total flow value, Sparling flow meter was down for repair.

Table III. Follow-up Sample Collection. The following table is a comparison of laboratory results from 24-hour composite(s) collected August 22-23, 1979 together with NPDES permit effluent limitations.

	DOE Unchlorinated Effluent	Lynnwood STP Unchlorinated Effluent	NPDES[1/] (Monthly Average)
BOD_5 (mg/l)	130	170	200
lbs/day	2540	3320	4000
TSS (mg/l)	110	108	175
lbs/day	2150	2110	3500
Total Plant Flow MGD		2.34	

* Field Analysis "<" is "less than" and ">" is "greater than"

[1/] As per interim limitations, DOE Order, Docket No. DE 77-380.

Table IV. Trace Metals Analysis of Sludge Samples

	Dewatered Sludge	DOE Dewatered Sludge Ash
Copper (mg/kg) dry wt.	200	280
Zinc (mg/kg) dry wt.	600	790
Nickel (mg/kg) dry wt.	19	90
Chromium (mg/kg) dry wt.	43	65
Cadmium (mg/kg) dry. wt.	18	13
Lead (mg/kg) dry wt.	170	230

* Field Analysis
"<" is "less than" and ">" is "greater than"

LABORATORY PROCEDURAL SURVEY

Discharger: Lynnwood STP 775-1971

NPDES Permit Number: _____

Date: 7/24/79

Industrial/Municipal Representatives Present: Ray Opsal, Al Peppard,

Darrel will be back from vacation 20th of August.

Agency Representatives Present: Mike Morhous

I. COMPOSITE SAMPLES

A. Collection and Handling

1. Are samples collected via automatic or manual compositing method? automated, Model? Manning S 3000

a. If automatic, are samplers portable portable or permanently installed _____?

Comments/~~problems~~ Plant has one sampler only

2. What is the frequency of collecting composite samples? _____

Once a week; influent on Tuesday and effluent on Wednesday.

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

a. Influent? In manhole above prechlorination injection point ~~(above comminutor and bar screen)~~

b. Final Effluent? Laying hose intake in clarifier trough.

c. Other (specify)? _____

4. What is the time span for compositing period? 24 hours

Sample aliquot? 200 mls per 30 minutes

5. Is composite sample flow or time proportional? time

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

7. Are composites refrigerated during collection? No

8. How long are samples held prior to analyses? BOD_5 is set up the same morning samples are picked. Solids sample is refrigerated until it is run on the weekend.

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

   a. Refrigeration? TSS - Yes; BOD set up right away

   b. Frozen? _____

   c. Other (specify)? _____

10. What is the approximate sample temperature at the time of analysis? Solids - room temp.; BOD_5 - ambient temp.

11. Are compositor bottles and sampling lines cleaned periodically? _____

   a. Frequency? after every 3rd or 4th use

   b. Method? _____

12. Does compositor have a flushing cycle? Yes

   a. Before drawing sample? X

   b. After drawing sample? X

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

Recommendations:

3b - Change location to manhole just downstream from clarifier outfall.

11a - Clean a minimum of once a week provided effluent is sampled first day and influent is sampled second day.

13 - Solids sample is held in 300 ml DO bottle; should obtain larger wide mouth container.

7 - Should be iced - 8/23 has started using ice.

II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

A. Technique

1. What analysis technique is utilized in determining BOD_5?

a. Standard Methods? _____ Edition? _____

b. EPA? _____

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

d. Other (specify)? WPCF Simplified Lab Proceedure for Wastewater Examination, 1976

B. Seed Material N/A

1. Is seed material used in determining BOD? _____

2. Where is seed material obtained? _____

_____

3. How long is a batch of seed kept? _____

and under what conditions? (temperature, dark) _____

_____

4. How is seed material prepared for use in the BOD test? _____

_____

Recommendations:

_____

_____

_____

_____

_____

_____

_____

C. Reagent Water

1. Reagent water utilized in preparing diultion water is:

   a. Distilled? commercially distilled water

   b. Deionized? _____

   c. Tap _____, chlorinated _____ non-chlorinated _____

   d. Other (specify)? _____

2. Is reagent water aged prior to use? Yes

   How long? min. 1 day; max 3 wks, under what conditions? room temperature in the light

Recommendations:

C.2. - should be stored in the dark

D. Dilution Water

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

   a. 1 mls of each nutrient buffer per 1 gallon ~~ml/l~~ of reagent water

*2. When is phosphate buffer added (in relation to setting up BOD test)? at initial preparation of dilution water

3. How often is dilution water prepared? once a week
   Maximum age of dilution water at the time test is set up.
   Uses D.W. the day it's prepared and stores overnight in incubator for BOD test the following day.

4. Under what conditions is dilution water kept? 20°C in the dark

*Uses commercially prepared nutrients; however, was using phosphate buffer for coliform test instead of phos. buffer for BOD test. Chem West buffer solution coliform AB-324-G

5. What is temperature of dilution water at time of setup? _____
Approximately 20°C

Recommendations:

D.1. - Prepare dilution water in accordance with Standard Methods (1 ml of each reagent per liter of distilled water).

D.1,2 - Use phosphate buffer solution prescribed for BOD_5 test, Standard Methods

E. Test Procedure

1. How often are BOD's being set up? Once a week. Inf. - Wed. a.m.; Eff. - Thurs. a.m
What is maximum holding time of sample subsequent to end of composite period? no holding tim

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

3. Does sample to be tested contain residual chlorine? No
If yes, is sample

a. Dechlorinated? _____

How? _____

b. Reseeded? _____

How? _____

4. Is pH of sample between 6.5 and 8.0? Yes

If no, is sample pH adjusted and sample reseeded? _____

5. How is pH measured? Hellige color comparator w/bromthymol Blue-D indicator solution

a. Frequency of calibration? none required

b. Buffers used? none required

6. Is final effluent sample toxic? No

7. Is the five (5) day DO depletion of the dilution water (blank) determined? Yes. once a mo., normal range? 0 - .2 mg/l

8. What is the range of initial (zero day) DO in dilution water blank? 8.5 to 9.9 mg/l

9. How much seed is used in preparing the seeded dilution water? N/A

10. Is five (5) day DO depletion of seeded blank determined? N/A
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? N/A

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

    a. Seeded dilution water? N/A

       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? Yes

    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?

    Reported as "no value"

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

    a. Seeded dilution water? N/A

    b. Sample dilutions?

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

17. How is incubator temperature regulated? thermostat

18. Is the incubator temperature gage 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 _____ Winkler X Other _____

    a. If by probe:

        1. What method of calibration is in use?

        2. What is the frequency of calibration?

    b. If by Winkler:

        1. Is sodium thiosulfate or PAO used as titrant? .025N

        2. How is standardization of titrant accomplished?

           Uses commercial sod. thio. Chem West - Seattle

        3. What is the frequency of standardization?

           does not standardize

Recommendations:

7. - Set up dilution water blanks each time test is run.

14. - Report BOD values as either "less than" or "greater than" values when experiencing invalid DO depletions

17.-19. - Check accuracy of thermostat by placing a water bath and thermometer on same shelf as bottles and maintain a log of incubator temps. and results of accuracy checks on incubator temperature.

20.b. - Standardization of sodium thiosulfate should be conducted.

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-scf) x D.F.

c. For unseeded sample:

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

3. Industry/Municipality Final Calculations

$$\frac{\text{Int. D.O. - Final D.O. x 100}}{\text{\% of Sample used}}$$

Recommend using 2.c. formula

Recommendations:

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

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

a. Standard Methods? _____ Edition _____

b. EPA? _____

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

d. Other (specify)? WPCF Simplified Lab. Proced. for Wastewater Examination, 1976

B. Test Procedure

1. What type of filter paper is utilized:

a. Reeve Angel 934 AH? _____

b. Gelman A/E? _____

c. Other (specify)? GF/A has reordered Reeve Angel 934AH

d. Size? 2.1 cm (Gooch)

2. What type of filtering apparatus is used? Gooch

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

4. How are filters stored prior to use? Aren't stored; prewashed, dried, and used.

5. What is the average and minimum volume filtered? 20 mls

6. How is sample volume selected?

   a. Ease of filtration? _____

   b. Ease of calculation? _____

   c. Grams per unit surface area? _____

   d. Other (specify)? Read somewhere that was sample volume to filter

7. What is the average filtering time (assume sample is from final effluent)? 1/2 to 1 minute

   Filtration rate doesn't change appreciably

8. How does analyst proceed with the test when the filter clogs at partial filtration? Has never happened; explained starting over with prewashed, dried and weighed crucible and filter.

9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? No

10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting ~~washwater~~ rinsewater filtered with the sample? No, recommended

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

    No. Recommended

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. Recommended

14. Is a filter aid such as cellite used? No

a. If yes, explain: _____

Recommendations:

Increase sample volume using filtration rate as a guide. If a minimum of 50 mls still can't be run, duplicate or triplicate sample volumes are necessary.

Uses a double pan Voland 100 balance.

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

2. Industry/Municipality Calculations

$$\frac{A_{(mg)} - B_{(mg)} \times 1000}{Volume\ (ml)}$$

Recommendations:

SPLIT SAMPLE RESULTS:

Origin of Sample _____

Collection Date _____

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