



STATE OF
WASHINGTON

Dixy Lee Ray
Governor

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, Olympia, Washington 98504

206/753-2353

M E M O R A N D U M

September 28, 1979

To: Frank Monahan
From: Mike Morhous
Subject: Pennwalt Corporation, Tacoma, Class II Inspection

Introduction

The above-referenced Class II inspection was conducted on May 22-23, 1979 by Mike Morhous, DOE, Water and Wastewater Monitoring Section. Other persons in attendance were Frank Monahan, DOE, S.W. Regional Office; Deepak Raval, Pennwalt, Environmental Affairs Supervisor; and Frank Marvin, Pennwalt, Head Chemist.

The Pennwalt Corporation is an inorganic chemical (chlor-alkali) manufacturer which, by means of an electrolytic cell process, decomposes a prepared salt brine to produce chlorine gas, sodium hydroxide (caustic soda), and hydrogen gas. End products include liquid chlorine, caustic soda, and hydrochloric acid.

The plant has two influent sources of process water: (1) City of Tacoma domestic water supply; and (2) marine water from the Hylebos Waterway. The total effluent discharge consists primarily of three separate discharges: (1) Non-contact cooling water from the cell room; (2) non-contact cooling water from the hydrochloric acid plant and refrigeration system; and (3) barometric condenser water, which contributes approximately 60 percent of the total effluent flow. The total effluent is discharged to the Hylebos Waterway by gravity flow through a diffuser line which parallels the shoreline and is suspended from a shipping dock.

The Hylebos Waterway is included in Segment No. 05-10-01, Inner Commencement Bay to River Mile 1 on the Puyallup River. DOE's Five-Year Strategy Report indicates this segment is not meeting the state and federal water quality goal (fishable and swimmable) with respect to the dissolved oxygen and fecal coliform standards. However, it does not appear that Pennwalt's discharge is a contributing factor to this problem.

Findings and Conclusions

Both DOE and Pennwalt collected 24-hour composites during this Class II inspection for comparative purposes. All DOE composite samples were collected at the same sampling locations used by Pennwalt except for the total effluent composite. Due to a hookup problem with the negative pressure sampling line used by the plant, DOE total effluent composite was collected from inside the upstream end of the discharge line located at the collection box. It appeared the two effluent composites would be comparable in composition and DOE's lab results, in particular pH, turbidity, and specific conductivity, compared quite well (Table I).

Using the plant's flow values for the 24-hour composite period and the DOE and Pennwalt lab results from the split composites, both the total effluent flow and TSS net loadings exceeded the NPDES daily average limitations. The reported total effluent flow was 99.25 percent of the allowable daily maximum. Both DOE and Pennwalt TSS net loading results were within the respective daily maximum limitation with regard to DOE collected composites. However, Pennwalt's TSS net loading result from their own composite samples was slightly in excess of the daily maximum limitation. DOE and Pennwalt net loading results for lead were well within the daily average limitations. Refer to Table I for comparison of lab results for TSS and lead, together with plant flows and respective NPDES limitations.

In addition^o to the monitoring requirements and limitations for flow, total suspended solids, and lead, Pennwalt is required to monitor copper, iron, nickel, and zinc annually. The NPDES permit explains that the limits for these four metals are the net loading values reported at the time of application for the NPDES permit. Table II shows a comparison of concentration and loading results for these four metals as reported by DOE and Pennwalt, together with the respective limitations. Although both labs were using approved atomic absorption spectrophotometer (AAS) direct flame aspiration techniques and appeared competent in their respective procedures, a poor correlation of the separate lab results exists. No obvious procedural discrepancies were discovered during this inspection and both labs were using recognized and approved methods for extraction and analysis of the metals samples. This situation will be discussed further in the "Review of Lab Procedures" section of this memo.

In general, the metals results obtained from Pennwalt's composites are higher than the results from DOE's composites. This may be attributed to the fact that Pennwalt had not anticipated collecting metals samples and sample containers were not cleaned prior to collection.

Copper was the only metal experiencing difficulty in meeting effluent limitations. From the Pennwalt composites both copper loading values were in excess of both daily average and daily maximum limitations. From the DOE composites, DOE results showed compliance with the limitations. Pennwalt's results showed noncompliance with the daily average limitation and compliance with the daily maximum limitation.

In view of the generally low metals concentrations and the infrequent minimum sampling requirements, monthly-lead, annually-copper, iron, nickel, and zinc, it is suggested that an evaluation of previous data and the elimination of certain metal components resulting from the change over to metal anodes in the cells, be conducted. As a result of this evaluation, consideration should be given to the possibility of eliminating the monitoring requirements and effluent limitations for the metals.

Pennwalt's flow measuring devices consist of: (1) City of Tacoma water meters on the incoming freshwater; and (2) a strain gage on the total effluent line. The marine water influent is calculated by subtracting the freshwater influent flow from the total effluent flow. The strain gage is located inside the effluent line and consists of a circular diaphragm with a known surface area. The diaphragm measures the pressure exerted by the flow and transmits an electrical signal to a strip chart which measures percent of maximum flow with 100 percent equal to 20 MGD. The strain gage is set to operate properly when the effluent line is completely full. This creates erroneous readings at stages of low tide. Mr. Marvin explained that because the effluent is normally a constant flow, daily effluent flows are calculated from those tide stages where the strain gage is operating properly. The accuracy of this flow measuring device could not be checked because there was no available location to physically measure the total effluent flow. However, it would be possible to measure the marine influent flow from the two marine influent pumps and by combining the two influent flows, a comparison could be made with the calculated total effluent flow. Prior to installation of the strain gage, this was the procedure used to determine the total effluent flow.

Pennwalt has a continuous recording circular chart for monitoring total effluent temperature (°F) and pH. The temperature sensing probe is located inside the discharge line. The pH probe is located in the negative pressure (continuous flow) sampling line approximately one foot upstream from the sample collection reservoir. Probes are standardized monthly. This frequency is probably inadequate. Because of drift inherent in any recording system of this kind, weekly calibration should be strongly considered.

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A limited number of grab samples were collected from the sample reservoir for pH, temperature, and total residual chlorine measurements. The pH and temperature field measurements were also compared with the plant's circular chart for accuracy of the continuous recorder (see Table III). At the time of collection, these results showed Pennwalt to be in compliance with the respective NPDES limitations for all three parameters. The accuracy of the continuous recorder varied from 2 percent to 9 percent of the respective field temperature readings. The pH monitor was consistently low by approximately 0.3 standard units. No chlorine residual was detected in two grab samples collected on the afternoon of May 22, 1979. This compares with Pennwalt's result of 0.0 ppm obtained from a sample they collected on May 22, 1979 at 1400 hours.

Summary

1. Flow and net suspended solids discharged by Pennwalt during this inspection exceeded daily average permit limitations.
2. Pennwalt's continuous pH monitor was approximately 0.3 standard units low. Weekly calibration is suggested.
3. Comparison of analytical results, as well as collection and analytical procedures indicate that suspended solids and chlorine residual sampling and testing are adequate.
4. Net effluent copper loading exceeded both daily average and daily maximum permit limitations from Pennwalt's sample. This result may be an artifact of inadequate sampling procedure and should be assessed in view of the next item.
5. Trace metals results from spilt samples showed poor correlation. The reasons for these discrepancies are not obvious, although a number of possibilities are delineated in this memorandum. Prior to any extensive attempt to explain and eliminate discrepancies, it is our suggestion that the necessity for trace metals sampling and analysis be reassessed in light of process changes at Pennwalt.

Each of the above items (excepting #4) will probably require follow-up and possibly remedial action. If, Frank, you could send us a quick memo (say by November 30, 1979) briefly outlining the results of further discussions with Pennwalt, we would be much appreciative. Thanks.

Review of Sampling and Laboratory Procedures

Sampling and laboratory procedures were reviewed with Mr. Marvin, Head Chemist. Generally, procedures appeared to be in order with no major discrepancies. Refer to the attached "Laboratory Procedural Review" form.

Sampling Procedures

There were two basic problems with the composite sampling systems: (1) the large volumes collected - marine influent 29 gallons - total effluent 22 gallons; and (2) the fact that the sampling equipment is permanently installed. The composites are stirred with wooden paddles prior to sample removal. Particular care has to be taken to assure the composite sample is thoroughly mixed. If there is no other alternative for obtaining a completely mixed sample, then non-porous stirring paddle should be used and stored inside when not being used.

Sample cleaning procedures appeared adequate except that no acid rinsing is conducted with regard to the collection of metals samples. The sample containers and lines, if possible, should be acid rinsed prior to the collection of metals samples.

Total Suspended Solids - TSS

Procedures were reviewed and appeared to be in order. The following recommendations were made with regard to minor discrepancies observed.

1. When reordering filter papers, it is recommended that either the Reeve Angel 934AH or Gelman A/E filter papers be ordered.
2. After filters have been prewashed, filters should be dried and stored in accordance with the procedures provided in *Standard Methods*, 14th Edition, pg. 94.
3. Provide a rinse-down of sample measuring container, after filtration of the sample, and filtering the resulting rinse water.

Total Residual Chlorine - TRC

Grab samples are collected four times per day for the measurement of TRC. This incorporates two methods: (1) DPD colorimetric test kit; and (2) the iodometric method II - back titration procedure provided in *Standard Methods*, 14th Edition. Both procedures are acceptable.

Trace Metals

Trace metals analysis is accomplished using an atomic absorption spectrophotometer (AAS) with direct flame aspiration. As previously mentioned, the comparison of DOE and Pennwalt metals results did not correlate particularly well. There was no obvious reason why this occurred. However, variations in the two approved methods used were noticed which may provide a possible explanation.

Pennwalt uses the *Standard Methods*, 14th Edition MIBK/APDC extraction procedure and DOE used the sample extraction procedure provided in EPA's *Manual of Methods for Chemical Analysis of Water and Wastes*, 1974. These two methods have the following variations in reagents and extraction procedures:

1. Solvent - S.M. uses methyl isobutyl ketone - MIBK as a solvent which is stored separately from the chelating agent. EPA uses chloroform as a solvent.
2. Chelating Agent - S.M. uses ammonium pyrrolidine dithiocarbamate - APDC. EPA uses the acid form of APDC, pyrrolidine dithiocarbamic acid - PDCA, which is prepared directly in the chloroform. This solution has the advantage of being very stable and can be stored in a brown bottle in the refrigerator for months.
3. Extraction Procedures - S.M. conducts a single extraction of the sample. Prior to extraction, the sample pH is adjusted to within a 2.2-to-2.8 range. The extract, MIBK/chelated metals solution is aspirated directly into AA spectrophotometer. EPA conducts multiple extractions (4) of a single sample, adjusting the pH between extractions to 2.3, 4.5, and 5.5.

In addition, EPA incorporates a digestion process of the resulting combined extracts to eliminate the organic solvent chloroform which cannot be aspirated in AAS.

The ability of a laboratory to analyze reproducible metals results is directly related to the adherence of strict analytical procedures. This is particularly true when sample extraction procedures are used in conjunction with the analysis. It is the concensus of this section that each of the following factors contributed, in varying degrees, to the poor correlation of metals results from the split composite samples:

1. Two separate laboratories conducting the analyses;
2. Use of different chelating agents and solvents during extraction;
3. Number of extractions conducted; and
4. Sample pH prior to each extraction.

If the DOE, S.W. Regional Office believes this situation warrants further investigation, additional samples can be split and analyzed upon request.

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It should be noted that no recommendations were made to Pennwalt indicating a preference of one method over the other. However, a copy of EPA's metals analysis, including sample extraction, was mailed to Mr. Marvin for his own information and review with respect to their own methodology.

MM:cp

Attachments

Class II Field Review and Sample Collection

24-hour Composite Sampler Installations

Sampler	Date and Time Installed	Location
1. Saltwater Influent sample aliquot: 250 mls/30 min.	5/22/79 @ 1145	^{1/} Collected from a 4-inch line off the marine water influent main line
2. Freshwater Influent (manual composite) sample aliquot: 5/22/79 400 mls @ 1130 400 mls @ 1400 400 mls @ 1455 400 mls @ 1515		^{1/} Water faucet inside laboratory 5/23/79 400 mls @ 0850 400 mls @ 0925 400 mls @ 1020 400 mls @ 1045 400 mls @ 1130
3. Final Effluent sample aliquot: 250 mls/30 min.	5/22/79 @ 1105	Inside the upstream end of the discharge line at the collection box outfall

Field Data^{2/}

Parameter(s)*	Date and Time	Sample Location
pH, temp., T. Res. Chl.	5/22/79 @ 1429	Final Eff.-Plant's automatic compositing system (sample reservoir) located on a negative pressure (continuous flow) line off the total eff. line.
pH, temp., T. Res. Chl.	5/22/79 @ 1532	
pH, temp., T. Res. Chl.	5/23/79 @ 1059	

Grab Samples

Lab Analysis	Date and Time	Sample Location
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^{1/} Same sample location used by Pennwalt

^{2/} See Table III for results

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

Parameter	Pennwalt Composites						DOE Composites						NPDES Limitations
	Marine Influent		Freshwater Influent ^{1/}		Total Effluent		Marine Influent		Freshwater Influent		Total Effluent		
	DOE	PENN.	DOE	PENN.	DOE	PENN.	DOE	PENN.	DOE	PENN.	DOE	PENN.	
pH S.U.	7.9				8.2		7.9		7.3		8.2		
Turb. NTU	4				2		4		2		3		
Sp. Cond. μ mhos/cm	39,000				37,600		38,700		421		37,100		
Flow MGD		8.162		1.258		9.420							D.A.-8.444 D.M.-9.491
TSS mg/l lbs/day	35 [†] 2,432	7.3 507		2.7 28.3	8 640	9.9 792	3 208	4.9 340	<1 <10.4	1.3 13.6	5 400	6.5 520	
Net Loading lbs/day						256.7					181.6 \pm 5.2	166.4	D.A.-128 D.M.-256
Pb mg/l lbs/day	.0144 1.0	.0014 .10		.0126 .13	.013 1.04	.0057 .47	.0024 .17	.0014 .10	.0027 .03	.0038 .04	.0048 .38	.0029 .23	
Net Loading lbs/day						.24					.18	.09	D.A.-1.0 D.M.-2.0

^{1/}Pennwalt's freshwater influent composite was not split with DOE.

"<" is "Less Than" and ">" is "Greater Than".

D.A. = Daily Average.

D.M. = Daily Maximum.

[†] = Possible laboratory error.

Table II. The following table is a comparison of laboratory results from 24-hour composite(s) together with NPDES permit effluent limitations.

Parameter	Pennwalt Composites						DOE Composites						NPDES ^{2/} Limitations
	Marine Influent		Freshwater Influent ^{1/}		Total Effluent		Marine Influent		Freshwater Influent		Total Effluent		
	DOE	PENN.	DOE	PENN.	DOE	PENN.	DOE	PENN.	DOE	PENN.	DOE	PENN.	
Fe mg/l	.844	.40		.30	.663	.30	.069	.10	.073	.10	.25	.30	D.A. (33.2) D.M. (79.2)
lbs/day	58.6	27.8		3.14	53 (N.L.)	24 (N.L.)	4.8	6.9	.77	1.05	20 (15.20)	24 (17.10)	
Net Loading lbs/day						N.L.					14.43	16.05	
Ni mg/l	.0025	.154 [†]		.077	.018	N.D. [†]	<.001	.077	.0027	.154 [†]	<.001	N.D.	D.A. (2.09) D.M. (4.68)
lbs/day	.17	10.7		.81	1.44 (1.27)	0.0 (N.L.)	<.07	5.3	.03	1.61	<.08 (.044 ±.034)	0.0 (N.L.)	
Net Loading lbs/day						N.L.					N.L.	N.L.	
Cu mg/l	.0114	N.D. [†]		.025	.0318	.050	.0042	.025	.0054	N.D. [†]	.0036	.025	D.A. (.12) D.M. (.51)
lbs/day	.79	0		.26	2.54 (1.75)	4.0 (4.0)	.29	1.74	.06	0.0	.29 (0.0)	2.0 (.26)	
Net Loading lbs/day						3.74					N.L.	.26	
Zn mg/l	<.01	.015		2.813	.42	.592	<.01	.030	.54	.732	<.01	.015	D.A. <u>3/</u> D.M.
lbs/day	<.69	1.04		29.49	33.6 (33.25 ±.34)	47.4 (46.36)	<.69	2.08	5.7	7.67	<.80 (N.L.)	1.20 (N.L.)	
Net Loading lbs/day						16.87					N.L.	N.L.	

^{1/} Pennwalt's freshwater influent composite was not split with DOE.

^{2/} In accordance with S4. of Pennwalt's NPDES permit, the following are the loading values Pennwalt reported at the time of application for a NPDES permit.

^{3/} At the time of application, zinc was not monitored by Pennwalt.

() Indicates a net loading value derived from marine influent and total effluent loading data only. At the time of application, Pennwalt did not incorporate freshwater influent loading data in their net loading calculations.

N.D. = None Detected. N.L. = Net Loss. "<" is "Less Than" and ">" is "Greater Than".
D.A. = Daily Average. D.M. = Daily Maximum.

[†] = Result questionable, possible laboratory error.

Table III. Total effluent field data together with respective instantaneous readings from Pennwalt's continuous reader.

Parameter	Date and Time	DOE Field Analysis	Pennwalt Continuous Recorder Reading	NPDES Limitations
Temperature	5/22/79 @ 1429	24.1°C (75.4°F)	77°F	
pH S.U.	5/22/79 @ 1429	8.2	7.75	6.0 to 9.0
Total Res. Chl. ppm	5/22/79 @ 1429	N.D.		Daily Max.-1.0
Temperature	5/22/79 @ 1532	24.0°C (75.2°F)	77°F	
pH S.U.	5/22/79 @ 1532	8.1	7.75	6.0 to 9.0
Total Res. Chl. ppm	5/22/79 @ 1532	N.D.		Daily Max.-1.0
Temperature	5/23/79 @ 1059	22.0°C (71.6°F)	78°F	
pH S.U.	5/23/79 @ 1059	8.2	7.9	6.0 to 9.0
Total Res. Chl.	5/23/79 @ 1059	Trace, <.1 ppm		Daily Max.-1.0

"<" is "Less Than" and ">" is "Greater Than".

N.D. = None Detected.

LABORATORY PROCEDURAL SURVEY

Discharger: Pennwalt Corporation, Tacoma

NPDES Permit Number: WA-000311-5

Date: May 23, 1979

Industrial/Municipal Representatives Present: _____

Frank Marvin, Head Chemist

Agency Representatives Present: Mike Morhous

I. COMPOSITE SAMPLES

A. Collection and Handling

1. *Samples collected via automatic method? Marine Inf. & T. Eff., Model? Pressurized lines w/timers and valves

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

Comments/problems Can not flush or acid rinse sampling lines.

*Freshwater inf. sample collected via manual compositing method.

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

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

a. Influent? Fresh & Saltwater - yes

b. Final Effluent? Yes

c. Other (specify)? _____

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

Saltwater Inf.	Sample aliquot? <u>29 gallons</u>	per <u>24 hours</u>
Total Effluent	Sample aliquot <u>22 gallons</u>	per <u>24 hours</u>

5. Is composite sample flow or time proportional? time

6. Is final effluent composite collected from a chlorinated or non-chlorinated source? chlorinated - has no bearing on the composite analyses
7. Are composites refrigerated during collection? No
8. How long are samples held prior to analyses? less than 1 day
9. Under what condition are samples held prior to analyses?
- Refrigeration? _____
 - Frozen? _____
 - Other (specify)? at room temperature in laboratory
10. What is the approximate sample temperature at the time of analysis? room temperature
11. Are compositor bottles and sampling lines cleaned periodically? containers - yes; lines - no.
- Frequency? prior to each collection of TSS & Metals sample
 - Method? brushes & rinses container, using sodium hypochlorite when needed
12. Does compositor have a flushing cycle? No
- Before drawing sample? _____
 - After drawing sample? _____
13. Is composite sample thoroughly mixed immediately prior to withdrawing sample? Composite samples are mixed with a wooden paddle before withdrawing sample

Recommendations:

- 4.a. Large composite volumes are collected because the composite of smaller volumes resulted in plugged sampling lines.
13. May experience difficulty in obtaining a completely mixed sample from such large composite volumes with existing mixing technique.
- 11.b. Should be acid rinsing sample containers (and lines, if possible) prior to collection of metals samples.

II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

N/A DOES NOT ANALYZE BOD₅

A. Technique

1. What analysis technique is utilized in determining BOD₅?

a. Standard Methods? _____ Edition? _____

b. EPA? _____

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

d. Other (specify)? _____

B. Seed Material

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 dilution water is:

a. Distilled? _____

b. Deionized? _____

c. Tap _____, chlorinated _____ non-chlorinated _____

d. Other (specify)? _____

2. Is reagent water aged prior to use? _____

How long? _____, under what conditions? _____

Recommendations:

D. Dilution Water

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

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

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

3. How often is dilution water prepared? _____
Maximum age of dilution water at the time test is set up.

4. Under what conditions is dilution water kept? _____

5. What is temperature of dilution water at time of setup? _____

Recommendations:

E. Test Procedure

1. How often are BOD's being set up? _____

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

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

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

a. Dechlorinated? _____

How? _____

b. Reseeded? _____

How? _____

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

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

5. How is pH measured? _____

a. Frequency of calibration? _____

b. Buffers used? _____

6. Is final effluent sample toxic? _____

7. Is the five (5) day DO depletion of the dilution water (blank) determined? _____, 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. Is five (5) day DO depletion of seeded blank determined? _____
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? _____
12. Does BOD calculation account for five (5) day DO depletion of
- a. Seeded dilution water? _____
How? _____
- b. Dilution water blank? _____
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 BOD₅ 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? _____

15. Is liter dilution method or bottle dilution method utilized in preparation of
- a. Seeded dilution water? _____
- b. Sample dilutions? _____
16. Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? _____

17. How is incubator temperature regulated? _____

18. Is the incubator temperature gage checked for accuracy? _____
a. If yes, how? _____
b. Frequency? _____
19. Is a log of recorded incubator temperatures maintained? _____
a. If yes, how often is the incubator temperature monitored/
checked? _____
20. By what method are dissolved oxygen concentrations determined?
Probe _____ Winkler _____ 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? _____
2. How is standardization of titrant accomplished? _____

3. What is the frequency of standardization? _____

Recommendations:

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:

$$(\text{seed reagent depletion-dilution water blank depletion}) \times \text{D.F.}$$

b. For seeded sample:

$$(\text{sample dilution depletion-dilution water blank depletion-scf}) \times \text{D.F.}$$

c. For unseeded sample:

$$(\text{sample dilution depletion-dilution water blank depletion}) \times \text{D.F.}$$

3. Industry/Municipality Final Calculations

Recommendations:

III. TOTAL SUSPENDED SOLIDS CHECKLIST

A. Technique

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

- a. Standard Methods? Yes Edition 14th
- 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)? Whatman GF/C
- d. Size? 2.4 cm

2. What type of filtering apparatus is used? Gooch Crucible

3. Are filter papers prewashed prior to analysis? Yes

- a. If yes, are filters then dried for a minimum of one hour no - 1/2 hr. at 103°C-105°C Yes ?
- b. Are filters allowed to cool in a dessicator prior to weighing? No. Filters were stored in oven and cooled in open room prior to weighing and filtering.

4. How are filters stored prior to use? in drying room
5. What is the average and minimum volume filtered? 1 liter of sample is filtered from all composites
6. How is sample volume selected?
- Ease of filtration? _____
 - Ease of calculation? _____
 - Grams per unit surface area? _____
 - Other (specify)? per sensitivity of balance (weighs to .1 mg) and the small TSS concentrations in the samples
7. What is the average filtering time (assume sample is from final effluent)? Approximately 20 minutes and less
8. How does analyst proceed with the test when the filter clogs at partial filtration? Would start over with a new, prewashed and dried filter (the lab does not have this problem)
9. If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? N/A
10. Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample? No
11. Is filter funnel washed down following sample filtration? Yes
12. Following filtration, is filter dried 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? This procedure was used on a routine basis until it was determined that obtaining a constant weight was no problem. Now uses this procedure as a periodic quality assurance check.

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

a. If yes, explain: N/A

Recommendations:

B.1. When reordering filter papers, it is recommended that either the
Reeve Angel 934AH or Gelman A/E filter papers be ordered.

B.3. Drying filters for one hour in oven at specified temperature (see Standard
Methods, 14th Edition, pg. 94), then cool and store in dessicator until
ready to weigh and use.

B.10. Providing a rinsedown of sample measuring container, after filtration
of sample, and filtering the resulting rinse water.

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

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

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

Uses the same calculation as A., above

