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STATE OF WASHINGTON

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Governor

DEPARTMENT OF ECOLOGY

7272 Cleanwater Lane, Olympia, Washington 98504   206/753-2353

MEMORANDUM
July 17, 1979

To: Phil Williams

From: Bill Yake

Subject: Pasco Sewage Treatment Plant Class II Inspection

Introduction

A Class II sampling inspection was conducted at the Pasco Sewage Treatment Plant (STP) on May 30-31, 1979. Ray Morrow (Chief Plant Operator), Virgil Eldridge, Pete Reyland, and Don Hicks aided in various aspects of the inspection and were present during the review of laboratory techniques. DOE representatives were Phil Williams (Eastern Regional Office), and Bill Yake and Art Johnson (Water and Wastewater Monitoring).

The Pasco plant is a secondary (high rate trickling filter) treatment facility. Influent is degritted, comminuted, and passed to a rectangular primary clarifier. The clarified wastewater flows to a wet well where two fixed speed pumps pump both primary clarifier effluent and recirculating trickling filter effluent to the trickling filter. Overflow from the wet well passes to a circular final clarifier. Effluent is chlorinated, passed through a contact chamber, and discharged to the Columbia River (Surface Water Segment 26-02-00). The Pasco STP effluent is probably not materially affecting the status of this segment with respect to the "fishable, swimmable" goals of 1983.

The city and region are faced with deciding whether or not to allow additional discharges to the plant. Currently, a french fry processing concern is requesting access to the plant. This discharge would substantially increase organic loading to the plant. Thus, a major concern of this inspection was to determine, to the extent possible, whether NPDES permit limitations could be achieved with this additional load.

Findings and Conclusions

The Pasco wastewater treatment facility was meeting NPDES permit limitations for flow, pH, and fecal coliforms. Both carbonaceous and normal five-day BOD tests were performed on the effluent sample. Nitrification was inhibited in the carbonaceous BOD test through the use of methyline blue. The normal BOD test yielded an effluent BOD_5 of 30 mg/l which is equal to the NPDES monthly permit limitation. The carbonaceous BOD test result was 21 mg/l. Very little nitrification was occurring in the Pasco plant at the time of inspection, but it is possible that a sufficient number of nitrifying bacteria were present in the plant effluent to be responsible for the 30% discrepancy in values.

The question of plant compliance with the 30 mg/l limitation is a central issue. A Class II inspection on February 15, 1978 carried out by Claude Sappington reported an effluent BOD_5 of 42 mg/l. DMR's from February and March of 1979 report non-compliance with the BOD limitation. Plant personnel believe that non-compliance in the late-winter 1979 period was due to their inability to dispose of digested sludge in the usual manner. The sludge transport line was frozen and digested sludge had to be fed to the treatment system. Despite this, lower wastewater temperatures during the winter months have a marked adverse effect on trickling filter efficiency. This effect is estimated by Equation 1.

Equation 1 $$E_1 = E_{20}\Theta^{(T_1-20)}$$

E_1 = Filter efficiency at temperature T_1 (°C)

E_{20} = Filter efficiency at 20°C

Θ = Constant ranging from 1.035 to 1.047

Decreased winter efficiency is particularly prominent in trickling filter plants (such as Pasco) with high recirculation ratios. High recirculation allows the flow to the filter to approach ambient air temperatures. The recurrence of low treatment efficiencies during the winter is probably largely due to this phenomena.

There are two additional considerations which complicate analysis of BOD removal efficiencies at the Pasco plant:

1. Plant personnel have been neither dechlorinating nor reseeding the chlorinated effluent BOD tests which are reported on the DMR's. Although the 23% discrepancy between DOE and the STP effluent results is not unusual, the lack of proper sample preparation raises serious questions about the reliability of the STP's effluent BOD data.

2. The possiblity of nitrification in the five-day BOD test remains. It is conceivable that, at least during the summer, the plant is consistently achieving an effluent carbonaceous BOD of 30 mg/l or less. The specification of carbonaceous BOD in an NPDES permit is still open to debate, but at least two permits (Renton and Burlington) are being written or have been written in this manner.

In an attempt to predict the effect of the additional organic loading from the potato processor on effluent BOD concentrations, several calculations were made. Table 1 gives the anticipated characteristics of this additional load. Table 2 presents the design and operational data used in calculations. Column 1 (Design Data) is for comparative purposes only. Table 3 compares the efficiency documented during the May 30-31 inspection with four predicted efficiencies. Substantial discrepancies are obvious. Predicting the efficiency of trickling filters is notoriously difficult and available predictive models are, in general, inadequate. However, each equation predicts an effluent deterioration with the increased organic load. The NRC equation, which most closely replicates the present efficiency of the plant, predicts a 5 mg BOD/l increase.

Based on present information (marginal compliance with the 30 mg/l permit limitation) and the projected loss of efficiency, it would appear that adding organic loading to the Pasco plant will result in frequent permit violations.

An analysis of carbonaceous effluent BOD may modify this conclusion. If the plant can show consistent (year-around) treatment to 25 mg BOD/l, additional organic loading may be feasible. Operation and maintenance at the plant appeared to be very good. This, coupled with the fixed return rate on the filter pumps, which provides no operational flexibility, makes substantial effluent improvement unlikely.

If effluent quality cannot be improved at the existing plant, the only additional options appear to be replacement of the rock media with an artificial media with a greater surface area/volume ratio or the addition of treatment units (a second filter, an aeration basin, etc.).

The plant discharges to the Columbia River (Waterway Segment 26-02-00). This segment is meeting fishable-swimmable criteria except for total dissolved gases. The impact of the Pasco effluent on the Columbia River is probably (by itself) rather minor.

During the course of the inspection, we observed the sludge disposal site. Sludge is pumped from the anaerobic digestors to the bottom of a large abandoned gravel pit west of the plant. The bottom of this pit appears to be not far above the level of the Columbia River and therefore probably not far above the water table. The sludge is pumped to the pit wet, increasing the potential for migration of bacteria, nutrients, and other pollutants to the groundwater. This arrangement generates some concern. You noted in our telephone conversation of June 18, 1979 that there is a new solid waste facility close at hand with excellent facilities for accepting sludges. I think we are in agreement that serious consideration should be given to using these facilities as an alternative to the present disposal method.

Table 1. Characteristics of Potato Process Flow

Parameter	Quantity
Maximum Flow	50 gpm
Average Flow	30-35 gpm
BOD Load	514 lbs/day
BOD Concentration	1500 mg/l
Suspended Solids Load	306 lbs/day
Suspended Solids Concentration	850 mg/l
pH	5-7
Temperature	25°C

Table 2. Parameters and Design Information Used in Calculations

Symbol	Parameter	Units	Design Data[1]	During Class II Inspection[2]	After Potato Process Flow Added[3]
r	Filter Radias	feet	60	60	60
A	Surface Area	$feet^2$	11,310	11,310	11,310
		acre	0.26	0.26	0.26
D	Filter Depth	feet	8	8	8
	Filter Volume	$feet^3$	90,480	90,480	90,480
V		acre-feet	2.08	2.08	2.08
	Hydraulic Loading	$gpm/feet^2$	.651	.651	.651
		mgad	40.8	40.8	40.8
W	Filter BOD Loading	lbs/day	4,207	2,807	3,220
	BOD Loading/Volume	$lbs/1000\ ft^3/day$	46.5	31	35.6
R	Recirculation Ratio		4.05	4.45	4.30
Q_i	Plant Flow	mgd	2.1	1.945	2.00
		gpm	1,460	1,350	1,385
Q_r	Recirculation Flow	mgd	8.5	8.66	8.6
		gpm	5,900	6,010	5,970
Q_{i+r}	Flow to Filter	mgd	10.6	10.6	10.6
		gpm	7,360	7,360	7,360
L_q	Raw Influent BOD	mg/l		286	291
L_i	Primary Eff. BOD	mg/l		173	193
L_e	Final Effluent BOD	mg/l		30	--

[1]Pasco STP operating manual.

[2]May 30-31, 1979.

[3]May 30-31 data plus Table 1 data.

Table 3

	Actual[1]	Media Design Criteria[2]	Eckenfelder[3]	NRC[4]	Galler and Gotass[5]
% BOD Removal Present[6]	82.7%	65-80%	86.1%	83.8%	97.3%
Effluent BOD (mg/l) Present[6]	30	35-61	24	28	7.6
% BOD Removal Future[7]		65-80%	86.1%	82.8%	97.3%
Effluent BOD (mg/l) Future[7]		39-68	27	33	7.8

1) Data derived from Class II inspection.
2) Criteria for sewage works design, DOE p. 107.
3) Eckenfelder & O'Connor, 1961. *Biological Waste Treatment*, p. 227-234
   Using Figure 6-16, p. 230
4) Metcalf & Eddy, 1972. *Wastewater Engineering*. p. 537

$$1-(L_e/L_o) = 1/(1 + 0.0085 \sqrt{W/VF})$$

$$\text{Where } F = (1 + R)/(1 + R/10)^2$$

5) WPCF, 1977. *MOP #8, Wastewater Treatment Plant Design*. p. 298

$$L_e = [K(Q_i L_q + Q_r L_e)^{1.19}]/(Q_i + Q_r)^{0.78} (1 + D)^{0.67} (r)^{0.25}$$

$$\text{where } K = \frac{0.487}{Q_i^{0.28} T^{0.15}}$$

6) Based on "During Class II Inspection" Column (Table #2)
7) Based on "After Potato Process Flow Added" Column (Table #2)

Prior to the follow-up inspection to be conducted in mid-August 1979, Pasco STP should address the following recommendations:

1. Dechlorinate and reseed effluent BOD tests if chlorinated effluent samples continue to be collected. An alternative would be collection of samples prior to chlorination.

2. Address other laboratory procedures recommendations.

3. If you feel it is warranted, begin nitrification-inhibited BOD tests run simultaneously with normal BOD tests to assess the effect of nitrification in the five-day BOD test.

4. Reassess present sludge disposal practices.

Review of Laboratory Procedures and Techniques

In general, laboratory procedures at the Pasco STP were good and results from split samples compared reasonably well. There were, however, some substantial deviations from accepted analytical practices which could raise doubts about the accuracy of BOD values reported on the DMR's. There were also several less critical departures from standard analytical practices. Recommendations are noted below, which should bring practices at the lab into line with accepted procedures.

BOD_5:

1. If chlorinated effluent samples continue to be collected and analyzed the samples should be dechlorinated and reseeded in the manner specified in *Laboratory Test Procedures for Biochemical Oxygen Demand of Water and Wastewater*, DOE, 1977. An alternative would be collection and analysis of effluent before chlorination.

2. Scrub collection jars clean weekly to prevent wall growth.

3. Clean out sample collection lines weekly using reverse flow with high pressure city water. The occasional addition of chlorine to this water will prevent wall growth in the lines.

4. Allow samples to warm to about room temperature (20°C) before dilutions are made.

5. Maintain a log of incubator temperatures and settings.

6. If dilution water blank depletions exceed 0.3 mg/l, note this on the DMR, and:

a. Check purity of reagents and make up new reagent mixtures as necessary.

b. Add phosphate buffer immediately prior to setting up sample dilutions.

c. Filter air prior to aeration of dilution water.

d. Seed dilution water lightly (seed capability to generating a 0.1 mgO_2/l drop) and allow incubation at room temperature for 10 to 20 days.

Total Suspended Solids:

1. Convert to an accepted filter (Reeves Angel 934AH or Gelman A/E) after present supply of Whitman GF/A filters is exhausted.

2. During the inspection the drying oven was operating at 70°C. This oven should be maintained at 103°C to 105°C. In addition, maintenance of a log recording settings and resulting oven temperatures would be useful.

3. Filter at least 50 ml of sample. With influent samples, this may require either:

   a. Multiple aliquots through multiple filters; or

   b. Change from gooch crucibles to a larger diameter filtering apparatus.

Total Residual Chlorine:

Method correct, use of DPD methodology.

Fecal Coliform

1. When individual filter counts are less than 20 colonies, add the number of colonies on all three filters (15, 20, and 25 ml samples) and multiply by 100/60 to yield results in "colonies per 100 mls".

BY:cp

Attachments

Class II Field Review and Sample Collection

24-hour Composite Sampler Installations

Sampler	Date and Time Installed	Location
1. Influent	5/30/79 0830	Channel downstream from comminutors originally through step grates in center of channel, moved to wire mesh closure at site of channel at 1500 due to clogging
sample aliquot: 230 ml/30 min		
2. Primary Clarifier Eff.	5/30/79 0910	Through step grates at primary clarifier outfall
sample aliquot: 230 ml/30 min		
3. Chlorinated Effluent	5/30/79 0845	Through step grates between contact chamber and Parshall flume.
sample aliquot: 230 ml/30 min		
4.		
sample aliquot:		

Field Data

Parameter(s)	Date and Time	Sample Location
pH, Sp. Conductivity, Temp.	5/30/79 - 0830	Influent
pH, Sp. Conductivity, Temp.	5/30/79 - 0910	Primary Effluent
pH, Sp. Conductivity, Temp.	5/30/79 - 0845	Chlorinated Effluent
Total Chlorine Residual	5/30/79 - 0930	Chlorinated Effluent
Total Chlorine Residual	5/30/79 - 1110	Chlorinated Effluent

Grab Samples

Lab Analysis	Date and Time	Sample Location
Fecal Coliform	5/30/79 - 0930	Chlorinated Effluent
Fecal Coliform	5/30/79 - 1110	Chlorinated Effluent
Trace Metals	5/30/79 - 1030	Secondary Digestor

Flow Measuring Device

Type: Parshall Flume

Dimensions: 18" throat (actually 17-1/2")

a. Meets standards criteria? Yes Explain:

b. Accuracy check:

	Actual Instantaneous Flow	Recorder Reading (Totalizer)	Recorder Accuracy (% of Instan. Flow)	Percent Error
1.	2.18 MGD*	2.16 MGD	99.1%	0.9%
2.				
3.				

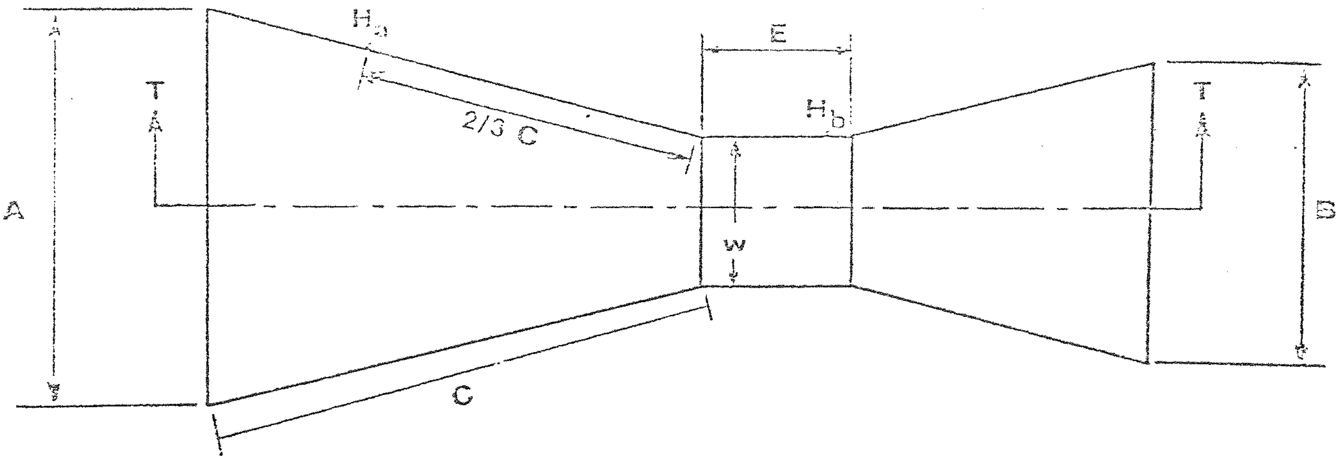
*Corrected for 17-1/2" throat

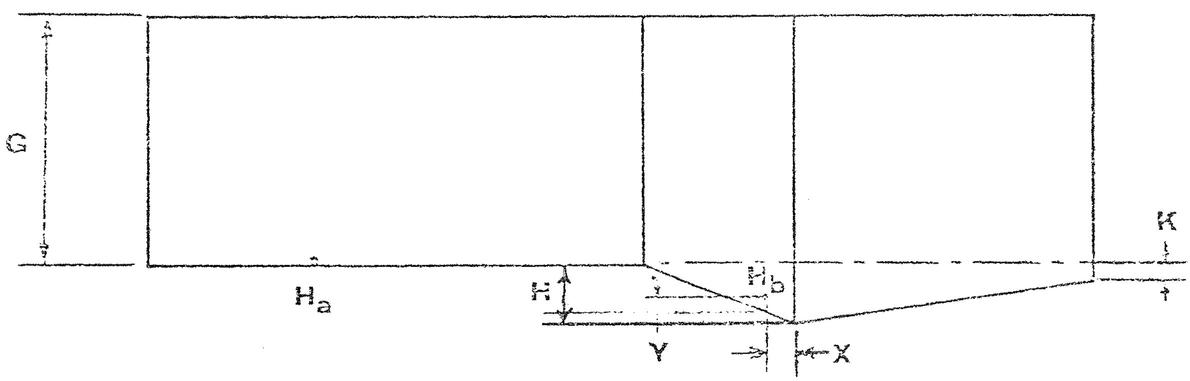
X Is within acceptable 15% error limitation.

___ Is in need of calibration.

PARSHALL FLUME: Pasco STP

Dimensions & Flow





Code	Spec's	Measured
A	40 3/8"	40 1/2"
B	30"	30 1/4"
C	57"	56 1/2"
2/3 C		
E	24"	24"
G		
H		
K		
W	18"	17 5/8"
X		
Y		

Time	H_a	H_b	Theoretical Flow	Recorded Flow
1600	8 3/8"		2.18 MGD	2.16 MGD

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.

	DOE Results			Pasco STP Results		NPDES
	Influent	Primary Effluent	Final Chlorinated Effluent	Influent	Final Chlorinated Effluent	(Monthly average)
BOD_5 mg/l	270	170	30	251	22	30
lbs/day	4350	2807	487	4070	357	525
TSS mg/l	166	120	16	138	12	30
lbs/day	2690	1950	260	2240	195	525
Total Plant Flow MGD			1.945		1.945	2.1
COD (mg/l)	360	250	79			200
Fecal Coliforms (No./100 ml)			82[1] 64[2]			
pH (S.U.)	7.1* 7.4** 7.3	7.4* 7.35** 7.4	7.4* 7.6** 7.7			6.5-8.5
Temperature	19.9*	20.1*	19.1*			
Spec. Cond. (μmhos/cm)	730* 600** 578	605* 630** 584	580* 595** 547			
Turbidity (JTU's)	40	62	11			
NH_3-N (mg/l)	19.6	25.4	18.1			
NO_2-N (mg/l)	<0.2	<0.2	0.3			
NO_3-N (mg/l)	0.2	<0.1	0.1			
O-PO_4-P (mg/l)	5.4	6.8	7.0			
T-PO_4-P (mg/l)	8.0	8.2	7.1			
Total Solids (mg/l)	510	440	340			
TNVS (mg/l)	270	250	250			
TSS (mg/l)	170	120	16			
TNVSS (mg/l)	8	12	<1			

* Field Analysis-grab "<" is "less than" and ">" is "greater than"
** Field Analysis-composite

Analytical Results - DOE Laboratory

	Digested Sludge-Total Metals mg/kg Dry Weight	Digested Sludge-Soluble Metals mg/l
Zn	1450*	4.0
Cu	270*	0.06
Ni	17*	0.22
Cr	18*	0.17
Cd	10*	0.27
Pb	315*	0.20

*These levels are normal for secondary municipal sludges.