Publication No. 83-e32

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MEMORANDUM
January 17, 1983

To: Fred Fenske

From: Dale Norton D.N.

Subject: Sound Refining Company Class II Inspection, June 30 - July 1, 1981

INTRODUCTION

On June 30 - July 1, 1981, a combination source/receiving environment monitoring survey was conducted at the Sound Refining Company in Tacoma, Washington. This study was the fourth in a series of specific source-oriented surveys conducted cooperatively by the Washington State Department of Ecology (WDOE) and Region X, U.S. Environmental Protection Agency (USEPA). The focus of these surveys is to identify and quantify priority pollutants in wastewaters from specific sources, as well as in adjacent surface waters and sediments in and near Commencement Bay.

Participants in the source survey included Dan Tangarone, Jim Hileman, and Carolyn Gangmark (USEPA, Region X), Bill Yake and Dale Norton (WDOE, Water Quality Investigations Section). Sound Refining was represented by Ray Burke and Rick Strait. The receiving environment study was conducted by Art Johnson and Shirley Prescott (WDOE, Water Quality Investigations Section), the findings of which are reported in a separate document (Johnson and Prescott, 1982).

SETTING

The Sound Refining Company is located along the north shore of Hylebos Waterway in the Tacoma industrial area. Crude oil processing at Sound Refining consists of: (1) atmospheric fractionation to produce full-range naphtha, kerosene, diesel, gas, oil, and residual fuel; and (2) vacuum fractionation to produce vacuum gas oils and asphalt (USEPA, 1980f).

The study area is depicted in Figure 1. Wastewaters discharged from Sound Refining are of two general types: treated wastewaters from the refining process and general drainage from the plant site. Storm water drainage from bermed areas around the oil storage tanks, as well as

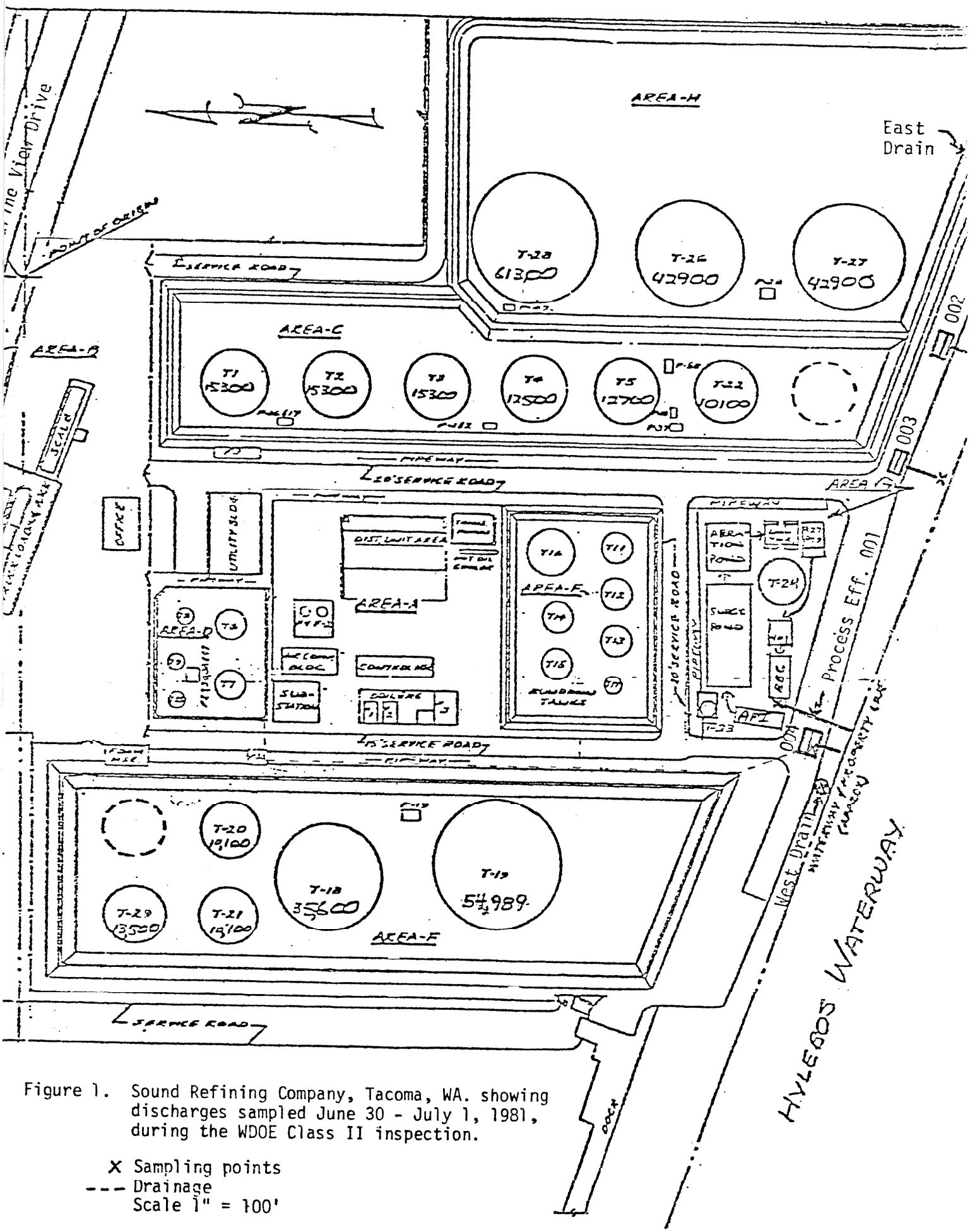

Figure 1. Sound Refining Company, Tacoma, WA. showing discharges sampled June 30 - July 1, 1981, during the WDOE Class II inspection.

X Sampling points
--- Drainage
Scale 1" = 100'

steam condensate, is collected, passed through straw bails, and discharged to Hylebos Waterway via drains 004, 003, 002, and the east drain (Figure 1). Water discharged through the west drain originates from a natural spring located north of the refinery.

The treatment train for the main process effluent (discharge 001) consists of an API oil/water separator, flow equalization basin, an aeration basin, and a rotating biological contactor (RBC). The effluent is finally passed through a straw bail before it is discharged to Hylebos Waterway. Oil separated from the waste stream in the treatment process is placed in a storage tank and eventually returned to the plant for recovery.

SAMPLING DESIGN

Details regarding the location, timing, and types of samples collected during the Sound Refining Class II inspection are presented in Table 1. Samples for conventional pollutants and metals analyses on discharges 004 and the main process effluent were collected over a 24-hour period using acid washed Manning composite samplers. Samples for conventional pollutants and metals analyses on the west drain, east drain, and drain 003 were collected as grab composites over a 2.5-hour period. Drain 002 was not sampled since it was not flowing at the time of the inspection.

Samples for organic priority pollutants and bioassay analyses were collected from drain 004 and the main process effluent only. Drain 003 and the east drain were not sampled for organic priority pollutants or bioassay since these were small discharges -- .001 MGD and .026 MGD, respectively. The west drain also was not analyzed for these parameters since previous USEPA sampling (USEPA, 1980e) identified only trace amounts (i.e., less than 1 µg/L) of 1,1,1-trichloroethane and acenaphthylene and/or phenanthrene to be present. Samples for organic analyses were hand composited into clean, one-gallon glass jars, while bioassay samples were hand composited into one-gallon cubitainers. The compositing period spanned approximately 4 hours in each case.

Phenols and oil/grease were collected as grab samples on all discharges. Temperature, specific conductance, pH, total chlorine residual, and flow were determined in the field.

The process effluent flow during the period of sample collection was determined from the plant totalizer. It was not possible to check the accuracy of the totalizer since the effluent weir is badly misaligned. Flows from discharges 004, 003, and the east and west drains were determined using a bucket and stopwatch.

Table 1. Grab and composite sample locations and collection times at Sound Refining Company, Tacoma, WA.

Conventional Pollutants and Metals - Automatic Composite

Sample	Date (time) Description	Location
Effluent 001	6/30/81 (0920) 24-hr. comp. 250 ml/30 min.	Outfall box below weir
Drain 004	6/30/81 (0940) 24-hr. comp. 250 ml/30 min.	Outfall box below weir

Conventional Pollutants and Metals - Grab Composite

Sample	Date (time) Description	Location
West Drain	6/30/81 (1100-1330) 1-liter aliquots to composite sample every 15 minutes	Behind bulkhead at point of discharge
Drain 003	Same as above	End of pipe
East Drain	Same as above	End of culvert

Priority Pollutant and Bioassay - Grab Composites

Location	Date (time) Description	Analyses
Drain 004	6/30/81 (1015-1420) 400 ml/30 min.	Volatile organics, pesticides, acid extractables, base/ neutral extractables, 48-hr. oyster embryo assay and daphnid assay
Effluent 001	6/30/81 (0945-1420) 400 ml/30 min.	Volatile organics, pesticides, acid extractables, base/ neutral extractables, 48-hr. oyster embryo assay and daphnid assay

Field Analysis - Time and Locations

Location	Date (time)	Analyses
West Drain	6/30/81 (1105)	pH, Sp. Cond., Temp., TCR, Flow
West Drain	7/01/81 (1100)	Temp., Flow
Drain 004	6/30/81 (0940)	pH, Sp. Cond., Temp., TCR, Flow
*Drain 004	7/01/81 (0940)	pH, Sp. Cond., Temp., TCR, Flow
Effluent 001	6/30/81 (0920)	pH, Sp. Cond., Temp., TCR
*Effluent 001	7/01/81 (0920)	pH, Sp. Cond., Temp., TCR
Drain 003	6/30/81 (1142)	pH, Sp. Cond., Temp., TCR, Flow
Drain 003	7/01/81 (1105)	Temp., Flow
East Drain	6/30/81 (1200)	pH, Sp. Cond., Temp., TCR, Flow
East Drain	7/01/81 (1110)	Temp., Flow

*Analysis performed on composite sample.

Grab Samples - Time and Location

Location	Date (time)	Analyses
West Drain	6/30/81 (1345)	Oil & grease, Phenols
Drain 004	6/30/81 (1040)	Oil & grease, Phenols, Cyanide
Drain 004	7/01/81 (1005)	Oil & grease, Phenols
Effluent 001	6/30/81 (1015)	Oil & grease, Phenols, Cyanide
Effluent 001	7/01/81 (1005)	Oil & grease, Phenols
Drain 003	6/30/81 (1330)	Oil & grease, Phenols
East Drain	6/30/81 (1335)	Oil & grease, Phenols

The samples collected during the inspection were analyzed at three laboratories as shown below in Table 2.

Table 2. Laboratories providing analytical services.

Constituents	Responsible Agency	Laboratory
Oils & grease, phenols, COD, BOD, pH, conductivity, solids, nutrients, metals	WDOE	WDOE Tumwater Laboratory (except for mercury, WDOE Redmond Laboratory)
Organic priority pollutants	USEPA	California Analytical Laboratories, Inc., Sacramento, CA.
Oyster embryo and daphnid bioassays	USEPA	USEPA Laboratory, Manchester, WA.

RESULTS AND DISCUSSION

Compliance With NPDES Permit Limits

NPDES waste discharge permit No. WA 000320-4 which sets Sound Refining's wastewater effluent limitations expired on September 30, 1980. It was extended by letter pending publication by USEPA of standards for "Best Available Technology" for the control and treatment of pollutants (Fenske, 1982). Currently, Sound Refining is operating under the interim effluent limitations specified in their NPDES permit. Table 3 compares laboratory results on effluent samples collected during the present survey and split between the WDOE Tumwater laboratory and Sound Refining for analysis of permit parameters, chlorine and COD.

Examination of Table 3 indicates that Sound Refining was well within their permitted NPDES limits at the time of the WDOE Class II inspection. Agreement between laboratories was good on split samples with the exception of ammonia (NH_3-N) and biochemical oxygen demand (BOD_5). Details of the BOD_5 analyses are presented below in Table 4 which also includes results on a second sample collected July 14, 1981.

Table 4. Split sample BOD_5 results on process effluent (001) collected June 30 - July 1, 1981, and July 14, 1981, at Sound Refining, Tacoma, WA.

	June 30 - July 1, 1981				July 14, 1981	
	WDOE Analysis		Sound Analysis		Sound Comp.	
Dilution	WDOE Comp.	Sound Comp.	WDOE Comp.	Sound Comp.	WDOE Analysis	Sound Analysis
25%	30	25			>32	>31
5%	91	85			81	>152
2.5%	--	--	>332	>314	160	>304
1.0%	--	--			230	680
COD (mg/L)	82	82	--	70	180	210

Table 3. Comparison of laboratory results on samples collected June 30 - July 1, 1981, and split for analyses between WDOE Tumwater Laboratory and Sound Refinery, Tacoma, WA.

Parameter	Sound Refining Effluent Sample		WDOE Effluent Sample				NPDES Permit Limit Daily Maximum
	Sound Analysis Composite	WDOE Analysis Composite	Sound Analysis Composite	Sound Analysis Grab	WDOE Analysis Composite	WDOE Analysis Grab	
Flow (MGD)	.053	.0529	.053		.0529		
COD (mg/L)	70	82	NA		82		
(lbs/day)	30.8	36			36		
BOD_5 (mg/L)	>314[1]	55[1]	>332[1]		60[1]		
(lbs/day)	>139[1]	24[1]	>146[1]		27[1]		180
TSS (mg/L)	36	42	36		42		
(lbs/day)	15.9	19	15.9		19		110
Oil & Grease (mg/L)				12.2		13	
(lbs/day)				5.4		6	55
pH (S.U.)	6.8	7.2	6.9		7.2		6-9
NH_3-N (mg/L)	.9	.05	.7		.12		
(lbs/day)	.4	.022	.3		.053		22.4
Phenols (mg/L)	.006		.005			.005	
(lbs/day)	.0026		.0022			.0022	1.35
Total Chlorine Residual (mg/L)	ND	ND	.4		ND		
(lbs/day)			.2				

NA = Sample not analyzed.

[1] Values questionable - see text for further discussion.

ND = None detected.

Generally, BOD_5 values increased as sample dilution increased and in several instances the BOD_5 values were actually greater than the COD results shown. Since only a fraction of the organic matter in a sample that can be chemically oxidized is capable of being biologically oxidized, COD should not exceed BOD. Water quality data supplied with USEPA oyster embryo bioassay results, discussed later in the text, indicated that no dissolved oxygen depletion occurred in effluent samples tested from Sound Refining (Cummins, 1982). Typically, bioassay samples from other sources with BOD_5 in the range of 200 to 300 mg/L show marked drops in dissolved oxygen concentrations (Cummins, 1981). Based on the above considerations, it is unlikely that Sound's reported BOD_5 values represent the actual BOD_5 concentrations in their process effluent.

Total chlorine residual measurements were made during the survey using both the DPD colorimetric and the starch iodide iodometric method No. 1 (APHA, 1980). No chlorine was detected using the DPD method. Chlorine was initially not detected using the iodometric method either. However, after allowing the effluent samples to age for several minutes, a dark blue color developed which normally indicates the presence of chlorine in the starch iodide test. It is unlikely that chlorine was present in the samples tested since the refinery does not chlorinate its wastewaters (Burke, 1981). In addition, no chlorinated organics were found in Sound's main effluent which also suggests that chlorine was absent (Table 5).

An unidentified oxidant may be present in Sound's effluent which interferes with the BOD_5, iodometric chlorine and, perhaps, COD tests. These findings raise doubts about the accuracy of BOD_5 values reported on Sound's monthly discharge monitoring reports. In addition, it appears that BOD_5 concentrations measured by Sound Refining have not compared acceptably with WDOE measurements over the last two years (Bishop, 1981). Because these discrepancies pose substantial difficulties in determining permit compliance and accuracy of data reported in the DMRs, this issue should be investigated and resolved. Subsequent inspections of the refinery by the WDOE Industrial Section should focus on this issue. An additional concern is that, if present, the unidentified oxidant may, in part, be responsible for adverse bioassay results.

Organic Priority Pollutants

The results of organic priority analyses performed on Sound Refining's point source discharges to Hylebos Waterway are summarized in Table 5.

Chloroform, at a concentration of 1.7 µg/L, was the only organic pollutant identified in discharge 004. No dilution would be required to bring this concentration within USEPA criteria for the protection of aquatic life (USEPA, 1980h). Five organic pollutants -- methylene

Cyanide					--	--				--	--	--	--				
Decanoic Acid*					--	--				--	--	--	--				
Tetradecanoic Acid*					--	--				150	2.3	--	--				
										16	63	.001					
Metals (total recoverable)										58	50	.03					
Arsenic											TI	.02					
Cadmium	71	<16	<.009								TI						
Chromium	.5	3	.002		<16	<.00052											
Copper	2	<10	<.006	<2	<2	<.000065	3										
Mercury	14	27	.02	14	<10	<.0033	1.5	.002	<5		22	.31					
Nickel	.21	.33	.0002		<1	<.000033	11	.0009	<2		<2	<.0009			37	.0003	
Lead	22	<50	<.03	10	.42	.000014	16	.007	<2		<10	<.005	<2		<2	<.00002	
Zinc	10	<1	<.0006	30	<50	<.0016	.83	.01	13		3	.001	19		<10	<.00008	
Silver	<20	<5	<.003	96	4	.00013	17	.0005	<1		.50	.0002			10	.00008	
Aluminum	<.4				72	.0023	21	.01	<10		<50	<.02	<10		.54	.000005	
Beryllium							90	.01	<20		<1	<.0004	40		<50	<.0004	
Manganese	<.3			270			1	.05	72		40	.01	200		8	.00007	
Magnesium								.0006	3.5						175	.001	
Molybdenum				25			.2		160								
Selenium				3400			40	.0001	<10				220				
Antimony	<2			<20				.02	35								
Tin	<2								3600				280				
Thallium	3			<2			7		<20				6300				
							2	.004	<5				<20				
								.001	<50								
							1		<2								
								.0006	<2				<2				

TI = Tentatively identified.
T = Trace; value is greater than limit of detection but less than limit of quantification.
T = Present, but also present in blank.
-- = Not detected.
* = Not priority pollutant.
** = Calculated using 1/2 the detection limit (detection limit = 1 ug/L).

chloride, 1,1,1-trichloroethane, phenol, pentachlorophenol, and cyanide -- were identified in Sound's main process effluent during the WDOE Class II inspection. Of these compounds, only pentachlorophenol and cyanide were measured at relatively large concentrations. Methylene chloride was detected in both effluent and blank samples and is used to clean sampling equipment. Its appearance in this sample is likely an artifact of the sampling method. A previous USEPA sampling (USEPA, 1980d) of Sound's main process effluent identified four organic pollutants -- methylene chloride, 1,1,1-trichloroethane, benzene, and hexachlorobenzene. Benzene was not detected in Sound's process effluent during the WDOE survey.

Table 6 compares the concentrations of benzene, pentachlorophenol, and cyanide found in Sound's process effluent during the WDOE and USEPA surveys to USEPA's receiving water criteria for the protection of aquatic life and human health. The ratio of sample concentration to criteria concentration shown in the table provides a means of assessing the significance of the concentrations measured since effluent concentrations are not directly comparable to receiving water criteria. Ratios greater than 1 indicate that the pollutant concentration exceeds the criteria and gives an estimate of the dilution ratio required to bring effluent concentrations down to the criteria concentration (Yake, 1981).

Benzene in the main process effluent exceeded a ratio of 1 when compared to USEPA chronic criteria for the protection of marine life and the human health criterion (USEPA, 1980h). Although an elevated level of benzene is of potential concern, it does not appear to be a continuous problem since it was only identified once in Sound's main process effluent. Benzene was not detected in receiving waters adjacent to the refinery (Johnson and Prescott, 1982).

Pentachlorophenol was detected in Sound's main process effluent at levels above USEPA's criteria for the protection of aquatic life (i.e., dilution required), but was not detected in receiving waters adjacent to the refinery (Johnson and Prescott, 1982). Prior to the WDOE survey, pentachlorophenol was being used at the refinery in a herbicide formulation for slime and algae control (Burke, 1981). Sound Refining has since discontinued use of pentachlorophenol. The main process effluent should be sampled during the next scheduled inspection by the WDOE Industrial Section to ascertain if a problem continues to exist with respect to pentachlorophenol.

Cyanide was identified in Sound's process effluent at a concentration of 50 µg/L, which would require dilution to meet USEPA's acute and chronic criterion for the protection of aquatic life. Cyanide was not detected adjacent to the facility in the accompanying receiving environment survey (Johnson and Prescott, 1982). Compounds containing the cyanide group (CN^-) are readily formed in a variety of industrial processes including petroleum refining (USEPA, 1980c). Recent studies (Crecelius, 1981) have shown that cyanide is unstable in seawater and thus may be of limited concern in the marine environment.

Table 6. Comparison of selected priority pollutants in process effluent 001 from Sound Refining, Tacoma, WA. to USEPA criteria (concentrations in µg/L).

Constituent	Process Effluent (001)	Water Quality Criteria									
		Aquatic Life								Human Health Food Intake	
		Freshwater				Saltwater					
		Criteria		Sample/Criteria Ratio		Criteria		Sample/Criteria Ratio			
		Acute	Chronic	Acute	Chronic	Acute	Chronic	Acute	Chronic	Criteria	Sample/ Criteria Ratio
Benzene	2500**	5300	--	.47	--	5100	700	.49	/3.6/	40*	/62.5/
Pentachlorophenol	63***	55	3.2	/1.1/	/20/	53	34	/1.2/	/1.9/	1010t	6.2×10^{-2}
Cyanide	50***	52	3.5	.96	/14.3/	30	2.0	/1.7/	/25/	****	

t = Based on toxicity data.
* = Based on the risk of 1 additional cancer per 10^6 exposures (consumption of seafood only).
** = Sample collected 6-30-80 by USEPA during Commencement Bay/Port of Tacoma field survey.
*** = Sample collected June 30 - July 1, 1981, during the WDOE Class II inspection.
**** = No applicable criteria.
/ / = Indicates ratio greater than 1.

Tentatively Identified Compounds

In addition to the organic priority pollutants identified in Sound's main process effluent, two other organic compounds, decanoic and tetradecanoic acid, were tentatively identified (Table 5). The decanoic acids are naturally occurring fatty acids found in plant and animal fats and oils.

Trace Metals

The results of trace metals analyses performed at Sound Refining are summarized in Table 5. Metals concentrations in all refinery discharges were low at the time of the WDOE survey and in approximately the same range as previously determined by USEPA (USEPA, 1980d,e). Sound Refining does not appear to be a major contributor of trace metals to Hylebos Waterway.

Bioassay Results

The results of oyster embryo and daphnid bioassays conducted on Sound Refining's main process effluent and drain 004 are presented in a separate report by Joe Cummins, EPA Region 10 Laboratory, Manchester, Washington (Cummins, 1982). Cummins' results for the effluents tested are presented in Table 7.

Examination of these data indicates that drain 004 was not substantially toxic to either the oysters or daphnids. The main process effluent exhibited some toxicity at 20 percent strength to the oyster embryos and was significantly toxic to the daphnids at full strength. Two pollutants identified in the main process effluent that exceeded USEPA's criteria (Table 6) and which may bear some responsibility for the mortality and abnormality observed are pentachlorophenol and cyanide. The previously mentioned, unidentified oxidant could also be a contributing factor. Additional testing would be necessary to clearly identify the agents responsible for the main process effluent's toxicity. Bioassay results on receiving water samples indicated that the receiving waters were not appreciably toxic to oyster embryos (Johnson and Prescott, 1982).

Conventional Pollutants

The results of conventional pollutants analyses performed on Sound Refining's discharges are summarized in Table 8. Concentrations of conventional pollutants were generally low in all discharges. Total

Table 7. Bioassay results on samples collected June 30 - July 1, 1981, during the WDOE Class II inspection of Sound Refining, Tacoma, WA.

Sample	EPA Lab Number	Response of Pacific Oyster (*Crassostrea gigas*) larvae to Sound's effluents*								Response of *Daphnia pulex* to Sound's effluents**
		Percent Oyster Larval Mortality				Percent Oyster Larval Abnormality				
		Percent Sample								
		20	2	.2	.02	20	2	.2	.02	Percent Daphnid Mortality in 100% Effluent
Process Eff.	26705	0	6.1	(a)	(a)	24.9	3.6	(a)	(a)	90
Drain 004	26706	9.2	.4	(a)	(a)	4.8	3.1	(a)	(a)	0

(a) Counts were not made on these replicates because only negligible effects were observed at the next lower dilution.

*Briefly, the oyster larvae bioassay test involves seeding oyster larvae to a test solution. In this case, effluent samples were tested at 20%, 2% .2% and .02% by volume using bioassay control water as a dilutant. After 48 hours, normal and abnormal larvae were counted and percent mortality and abnormality calculated (ASTM, 1980).

**The process effluent and 004 were tested for their acute toxicity to *Daphnia pulex* using a 48-hour test procedure proposed by EPA (USEPA, 1980). Toxicity measurements made with this technique were based solely on daphnid survival in 100% solution.

Table 8. Results of conventional pollutants analyses or samples collected June 30 to July 1, 1981, at Sound Refining, Tacoma, WA. (concentrations in mg/L unless otherwise specified).

Parameter	West Drain Composite		Drain 004 Composite		Effluent 001 Composite		Drain 003 Composite		East Drain Composite	
	Concentration	lbs/day	Concentration	lbs/day	Concentration	lbs/day	Concentration	lbs/day	Concentration	lbs/day
Flow (MGD)		.071		.0039		.0529		.001		.026
COD	4	2	16	.52	82	36	78	.7	4	.9
BOD_5	--	--	<4	<.1	2/	--	--	--	--	--
pH (S.U.)	6.7 1/	--	6.3 1/	--	6.9 1/	--	7.1 1/	--	6.6 1/	--
Cond. (μmhos/cm)	192	--	365	--	469	--	338	--	457	--
Temperature (°C)	11.0 1/	--	19.9 1/	--	22.8 1/	--	17.3 1/	--	12.5 1/	--
NO_3-N	1.5	.89	.21	.0068	19	8.4	.81	.007	.25	.054
NO_2-N	.01	.006	.01	.0003	.18	.080	.10	.0008	.01	.002
NH_3-N	.06	.04	.04	.001	.12	.053	.32	.003	.33	.072
O-PO_4-P	.04	.02	.01	.0003	2.6	1.1	2.6	.02	.04	.009
T-PO_4-P	.05	.03	.01	.0003	3	1	9	.08	.09	.02
Total Solids	140	83	280	9.1	370	160	290	2	290	63
Total Non-Volatile Solids	100	59	150	4.9	240	110	210	2	240	52
Total Suspended Solids	3	2	1	.03	42	19	7	.06	8	2
Total Non-Volatile Suspended Solids	1	.6	<1	<.03	11	4.9	3	.03	4	.9
Oil & Grease	2 3/	--	3/2 3/	--	9/13 3/	--	5 3/	--	2 3/	--
Recoverable Phenolics as Phenol	.004 3/	--	.003/ .001 3/	--	.011/ .005 3/	--	.007 3/	--	.002 3/	--

1/ Field analysis. 2/ Results are reported in Table 4. 3/ Grab sample.

loadings of selected conventional pollutants from Sound Refinery to Hylebos Waterway are presented in Table 9 below.

Table 9. Total loading of selected conventional pollutants from Sound Refining, Tacoma, WA to Hylebos Waterway, June 30 - July 1, 1981.

Constituent	Total Loading (lbs/day) from Sound Refining to Hylebos Waterway
NO_3-N	9.4
NO_2-N	.089
NH_3-N	.17
O-PO_4-P	1.1
T-PO_4-P	1.1
Total Solids	320
Total Non-volatile Solids	230
Total Suspended Solids	23
Total Non-volatile Suspended Solids	6.4

CONCLUSIONS AND RECOMMENDATIONS

The major findings of the Sound Refinery Class II survey are as follows:

1. Sound Refinery was within their permitted NPDES limits at the time of the WDOE Class II inspection.

2. The NH_3-N, BOD_5, and COD analyses performed on Sound Refining effluent samples appear to be unrealiable based on split sample results. Further investigation into NH_3-N, BOD_5, and COD testing and possible interferences should be conducted during the next scheduled inspection of Sound Refining by the WDOE Industrial Section.

3. The following priority pollutant loads from Sound Refining to Hylebos Waterway were measured during the WDOE Class II inspection.

Constituent	Drain 004 Flow - .0039 MGD	Main Process Effluent (001) Flow - .0529 MGD
Organics		
Chloroform	.000055	--
1,1,1-trichloroethane	--	.0002*
Phenol	--	.001
Pentachlorophenol	--	.03
Cyanide	--	.02
Metals (Total Recoverable)		
Arsenic	<.00052	.01
Cadmium	<.000065	<.0009
Chromium	<.0033	<.005
Copper	<.000033	.001
Mercury	.000014	.0002
Nickel	<.0016	<.02
Lead	.00013	<.0004
Zinc	.0023	.02

-- = None detected.
* = Calculated using 1/2 detection limit (detection limit = 1 µg/L).

4. Four organic priority pollutants, 1,1,1-trichloroethane, phenol, pentachlorophenol, and cyanide, were detected in Sound's main process effluent during the WDOE survey. Of these compounds, pentachlorophenol and cyanide would require dilution to meet USEPA's criteria for the protection of aquatic life. Additional sampling should be conducted to ascertain if pentachlorophenol and cyanide are currently a problem.

5. Trace metals concentrations in all refinery discharges were low at the time of the survey and in approximately the same range as previously determined by USFPA. Sound Refinery does not appear to be a major contributor of trace metals to Hylebos Waterway.

6. Drain 004 did not display significant toxicity in either the oyster embryo or daphnid assays. The main process effluent, however, did exhibit some toxicity in the oyster embryo bioassay at 20 percent strength and was substantially toxic at full strength to *Daphnia pulex*.

Based on the results of the WDOE Class II inspection, Sound Refining was meeting their permitted NPDES effluent limitations and did not appear to be a major source of toxic chemicals to Hylebos Waterway.

DN:cp

Attachments

cc: Section Files

LITERATURE CITED

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