Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

Source category: Electroplating
Plant name: Metal Finishing Assoc. of So. CA
Process: Chromic Acid Anodizing

Filename: ELEC_R62.WQ1
Location: Sherman Oaks, CA
Test date: 1/24-2/8/90

Date: 12/15/94
Ref. No.: 4-62
Process rate basis: production

Source	Type of control	Pollutant	Run No.	Test Method	Samp. time, min	Isokinetic, %	Gas volume, DSCF	Volum. flow rate, DSCFM	Mass, ug	Concen., gr/DSCF	Emission rate, lb/hr	Process rate, A-hr	Emission factor mg/A-hr	Emission factor gr/A-hr	Rat.
Anodizing tank	none	total Cr	1	CARB	40	100.6	37.37	3,318	688.60	2.8E-04	0.00809	143	17	0.26	
		total Cr	2	425	40	96.0	37.31	3,271	450.00	1.9E-04	0.00522	190	8.3	0.13	
												Average	13	0.20	B
		Cr+6	1	CARB	40	100.6	37.37	3,318	443.70	1.8E-04	0.00521	143	11	0.17	
		Cr+6	2	425	40	96.0	37.31	3,271	270.00	1.1E-04	0.00313	190	5.0	0.0769	
												Average	8.0	0.12	B
	AMA	total Cr	3	CARB	40	106.0	40.58	3,432	34.90	1.3E-05	0.00039	177	0.67	0.010	
		total Cr	4	425	40	104.6	39.24	3,344	23.30	9.2E-06	0.00026	177	0.45	0.0069	
												Average	0.56	0.0086	B
		Cr+6	1	CARB	40	106.0	40.58	3,432				177			
		Cr+6	2	425	40	104.6	39.24	3,344				177			
												Average			

Basis for rating: Only two runs conducted.
Problems noted:
Other notes: AMA = antimisting agent; Cr+6 below quantitation limit for controlled runs.

ENCLOSURE 1
REFERENCE A

ELECTROPLATING
REF. 4-62

Efficiency of Harshaw Chemical's MSP-ST For Controlling Chrome Emissions From A Chromic Acid Anodizing Tank

Conducted for the
Metal Finishing Association of Southern California
5000 Van Nuys Blvd
Sherman Oaks, CA 91403

Prepared by
Pacific Environmental Services, Inc.
150 E. Foothill Blvd.
Arcadia, CA 91006
3/16/89

A

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Emission Test Calculation Sheets	Appendix
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A

Efficiency of Harshaw Chemical's MSP-ST For Controlling Chrome Emissions From A Chromic Acid Anodizing Tank

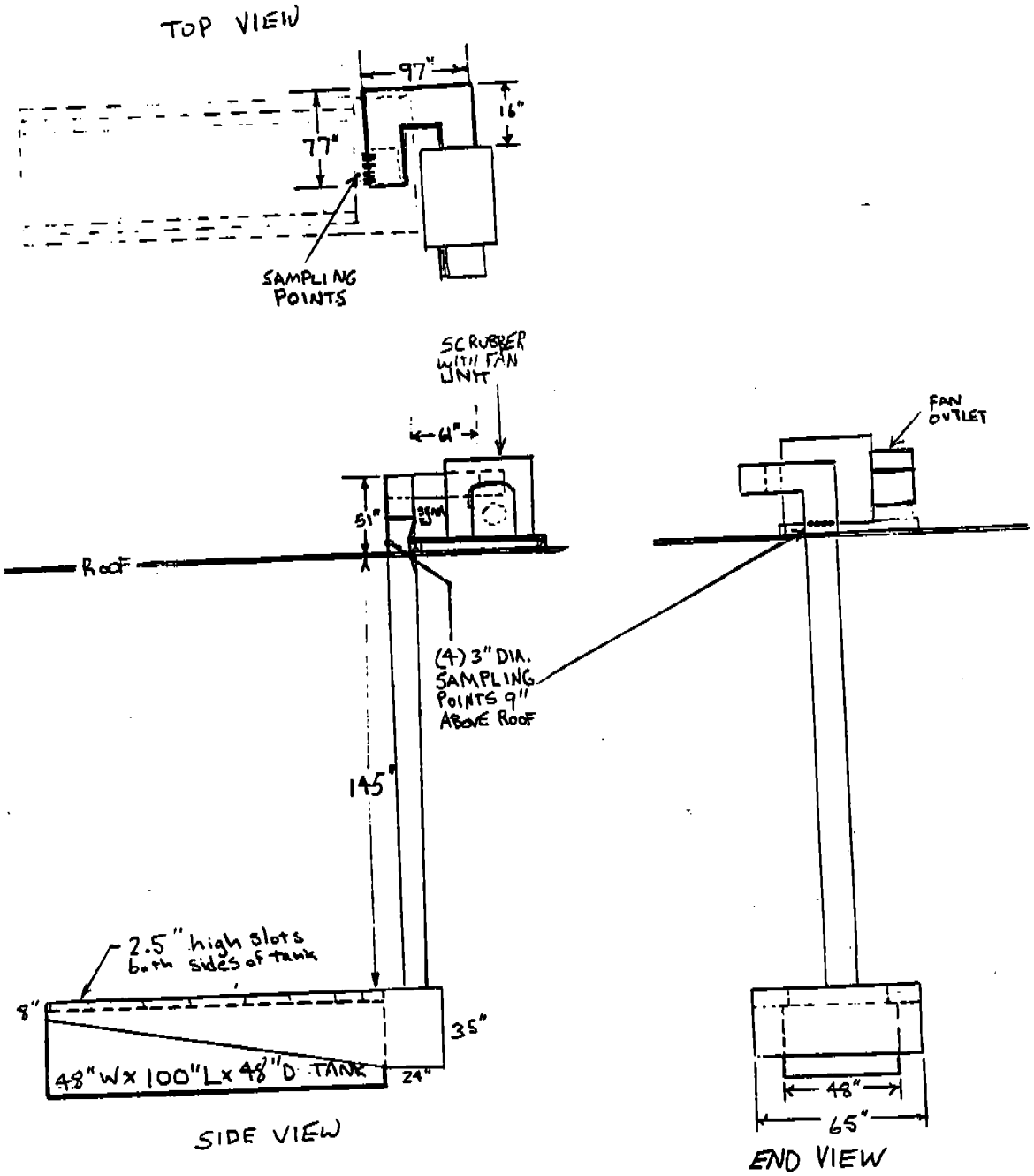
INTRODUCTION

Pacific Environmental Services, Inc. (PES) was contracted by the Metal Finishing Association of Southern California (MFASC), to evaluate the effectiveness of an anti-mist additive (Harshaw Chemical's MSP-ST) in reducing hexavalent chromium from chromic acid anodizing tanks. The coordinator for the MFASC was Peter J. LaBarbera, President of D.V. Industries. Testing was conducted on February 23, 1989 and March 1, 1989, at an MFASC host site. Two tests were conducted on each day using modified CARB method 425 to collect stack samples.

To conduct the evaluation, it was necessary to have an anodizing tank which was outfitted with an emission collection system. An anodizing tank was selected at the host site which met these requirements. All tests were made of the emissions from the tank between the anodizing tank and a scrubber on the roof (Figure 1). The first two tests, KL-I-1 and KL-I-2, were representative of uncontrolled emissions. The second set of tests, KL-I-5 and KL-I-6 were representative of controlled emissions when an anti-mist additive (Harshaw MSP-ST) was used in the plating solution. This particular additive was a surface tension reducing agent that also produced some foam on the anodizing solution surface.

EQUIPMENT AND PROCESS DESCRIPTION

All tests were made of the emissions of the same anodizing tank. The anodizing tank was used to anodize small metal parts using chromic acid solution. Dimensions of the tank were 42" x 96" x 48" with a nominal volume of 800 gallons. During the testing the anodizing tank was operated with a 6" freeboard. Air agitation was used for tests 1 and 2 but not for tests 5 and 6. The bath temperature was maintained at approximately 103 Fahrenheit and the amperage applied to the anodizing tank, for the four tests, ranged from 215 to 285 amps at 20 to 22 volts (Table 1). The chrome concentration of the anodizing solution ranged from 51 to 59.6 g/l. The significant difference was that tests 1 and 2 had no process controls (baseline), while for tests 5 and 6, anti-mist additive Harshaw MSP-ST was added to the anodizing bath solution. (Tests 3 and 4 were voided because of changing process conditions).



NOTE: ALL DUCTS ARE 3/8" THICK WHITE PVC SHEET WITH SILICONE SEALER ON SEAMS.
DUCT INTERIORS ARE 18" SQUARE

NOTE: DRAWING IS NOT TO SCALE BUT DIMENSIONS SHOWN ARE EXACT

FIGURE 1

Sketch Of Tank 8 Emission Collection System

3/1/89

TABLE 1
PROCESS DATA
FOR
ANODIZING TESTS

DATE	TEST NUMBER	VOLTS/ AMPS	FREE BOARD INCHES	ANODIZING BATH TEMPERATURE DEGREES F	PLATING SOLUTION CHROME g/l	ANTI-MIST ADDITIVE	SURFACE TENSION dynes/cm
2/23/89	1	20.5/215	6	103	59.6	No	70.0
2/23/89	2	22/285	6	103	59.6	No	70.0
3/01/89	5	23/265	6	98	51.0	Yes	40.0
3/01/89	6	23/265	6	98	51.0	Yes	40.0

TESTING METHODOLOGY

Prior to sampling, velocity, static pressure, and temperature were measured to determine sampling rates and nozzle sizes as prescribed in CARB reference method 5. The samples at each location were extracted with modified CARB method 425 source testing trains as described in the 1/20/89 CARB testing protocol (Figure 2). The source trains consisted of a 0.3" I.D. glass nozzle, a glass probe, two impingers each with 100 ml of 0.1N sodium hydroxide, an empty impinger, an 89mm teflon coated glass fiber filter placed after the empty impinger, an impinger filled with silica gel, an umbilical cord connected to a vacuum pump, a dry gas meter, and a calibrated orifice connected to an inclined manometer.

20 points
40 minutes

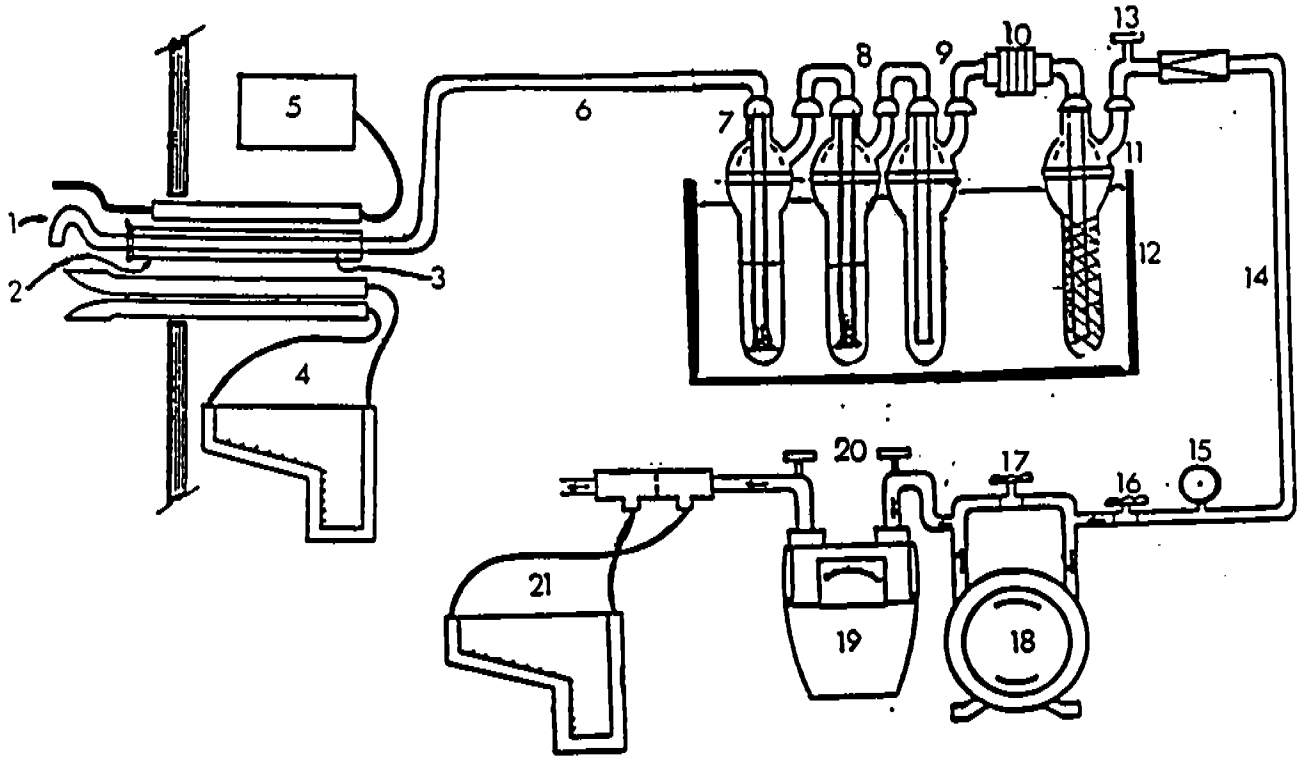
Each test was conducted for a period of 40 minutes which was one batch anodizing operation. Sampling was done by traversing at 20 different points inside the stack. Velocity and temperature of the gas streams were measured and recorded every 2 minutes during the tests. The meter temperature and the volume of the gas passing through the meter were also measured and recorded every 2 minutes. The volume of the impinger solution and the weight of the silica gel were recorded before and after the tests to determine the moisture content of the flue gas stream. Applied voltage, bath temperature, surface tension and amperage applied to the chrome plating tanks were also recorded. All information was recorded on field data sheets (Appendix).

500 ml sample

After sampling was concluded, the contents of the impingers were placed in 500 ml polyethylene containers and then rinsed with 0.1N sodium hydroxide three times to ensure that the sample was transferred to the sample containers. The sampling train from the nozzle to the impingers also was rinsed three times with a 0.1N sodium hydroxide solution and added to the sample containers. After the sample was collected, an additional rinse of the sampling train was done and put into a separate container, the train blank, to check the effectiveness of the sample retrieval method (Table 2). All samples were kept at approximately 50° Fahrenheit during the test and prior to laboratory analyses in order to prevent sample deterioration.

Laboratory analyses were conducted by Thermo Analytical Laboratory in Monrovia, CA. Volume, total chrome concentration and hexavalent chrome concentration were determined. Analyses for total chrome used atomic absorption spectrophotometry and analyses for hexavalent chrome used diphenylcarbazide colorimetric techniques. Analyses were conducted of blank reagents and filters used in the tests to provide assurance that they had not been contaminated by chromium. Blank results were not subtracted from the tested concentrations.

Total Cr AA



1. Glass or stainless steel sampling nozzle
2. Stainless steel probe sheath
3. Stainless steel, glass, or Teflon-lined probe
4. Type S pitot tube and manometer for ΔP readings
5. Stack temperature sensor
6. 15 ft. teflon probe line with ball and socket connectors
7. Greenburg-Smith impinger with 100 ml. of .1 N NaOH solution
8. Greenburg-Smith impinger with 100 ml. of .1 N NaOH solution
9. Modified Greenburg-Smith impinger - drv
10. Filter holder with teflon-lined glass fiber filter
11. Modified Greenburg-Smith impinger filled with 200 grams of silica gel
12. Impinger case filled with ice
13. Impinger exit gas temperature sensor
14. Umbilical line to meter box
15. Vacuum gauge
16. Coarse adjustment valve
17. By-pass valve to adjust ΔH
18. Leak free vacuum pump
19. Dry gas meter
20. Dry gas meter inlet and outlet temperature sensors
21. Orifice meter with manometer for ΔH readings

FIGURE 2
Diagram Of Sampling Train

SUMMARY OF EMISSIONS

PLANT PES Test-Efficiency of Harshaw Chem MSP-5T LOCATION Anodizing Tests

SAMPLED SOURCE Scrubber Inlet

RUN	DATE	1 V_m Std.	2 DSCFM	FRONT HALF MILLIGRAMS PROBE	CYCLONE	FILTER	Hex Cr 3 ~~TOTAL~~	Total Cr 4 ~~BACK HALF~~	5 FRONT + BACK TOTAL
1	23 Feb 89	37.373	3318				.4437	.6886	
2	23 Feb 89	37.313	3271				.2700	.4500	
5	1 Mar 89	40.576	3432				.0101	.0349	
6	1 Mar 89	39.240	3344				.0083	.0233	

CONCENTRATIONS

RUN	FRONT HALF Hex Chrome Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr	BACK HALF Total Chrome Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr	TOTAL Gr/DSCF	Mg/M³	Lb/Hr	Kg/Hr
1		.4193	.0052			.6507	.0081					
2		.2555	.0031			.4259	.0052					
5		.00879	.000113			.030374	.000390					
6		.00747	.000094			.020969	.000263					
	6	7	8	9	10	17	18	19	20	21	22	23

Remarks: Note the difference between hex and total number

SAMPLING SUMMARY SHEET

PLANT _____ LOCATION _____

SAMPLED SOURCE _____

Run	Date	N_p	Y_m	ΔH	P Bar.	V_m	T_m	V_m Std.	%	P_{st}	P_s	T_s	VP	V_w	$V_{w_{gas}}$	%M	M_d
			3	4	5	6	7	8	9	10	17	18	19	20	21	22	23

Run	CO_2	O_2	N_2	CO	MW_d	MW	$C_p - \sqrt{\Delta P_s (T_s + 460)}$	T_t	D_n	V_s	D_s	Area	ACFM	DSCFM	%I
	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	Kg/Hr	Lb/Hr	Mg/M³	Gr/DSCF			Kg/Hr	Lb/Hr	Mg/M³	Gr/DSCF			Kg/Hr	Lb/Hr	Mg/M³	Gr/DSCF	

TOTAL — BACK HALF — FRONT HALF

CONCENTRATIONS

$$V_m \text{ Std.} = Y_m \frac{17.64 \times V_m \left(P \text{ Bar.} + \frac{\Delta H}{13.6}\right)}{(T_m + 460)}$$

$$\%M = \frac{100 \times V_{w_{gas}}}{V_m \text{ Std.} + V_{w_{gas}}}$$

$$V_{w_{gas}} = 0.0471\ V_w$$

$$M_d = \frac{100 - \%M}{100}$$

$$MW_d = \%CO_2 \times .44 + (\%O_2 \times .32) + (\%CO + \%N_2) \times .28 + (\%\text{Other} \times \frac{\text{Mol. wt.}}{100})$$

$$MW = MW_d \times M_d + 18(1 - M_d)$$

$$P_s = P \text{ Bar.} \pm \frac{P_{st}}{13.6}$$

$$V_s = 85.49 \times C_p \sqrt{\Delta P_s (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2}$$

$$\%I = \frac{0.09450 \times (T_s + 460) \times V_m \text{ Std.}}{V_s \times T_t \times P_s \times M_d \times A_n}$$

N_p = Total No. of Sampling points

Y_m = Meter Box Correction Factor

ΔH = Average Orfice Pressure Drop, inches H_2O

P Bar. = Barometric Pressure, Inches Hg, Absolute

V_m = Volume of Dry Gas at Meter Conditions, DCF

T_m = Average Meter Temperature, °F.

V_m Std. = Volume of Dry Gas at STP, DSCF

% = Per Cent other gas removed before Dry Gas Meter

P_{st} = Static Pressure of Stack Gas, inches H_2O

P_s = Stack Gas Pressure, inches Hg.

T_s = Average Stack Temperature, °F

VP = Vapor Pressure of H_2O At Stack Temperature

V_w = Total H_2O Collected in Impingers and Silica Gel

$V_{w_{gas}}$ = Volume of water vapor collected at STP, SCF[b]

%M = Per Cent Moisture by volume

M_d = Mole Fraction of Dry Gas

$\%CO_2$ = Volume % Dry

$\%O_2$ = Volume % Dry

$\%N_2$ = Volume % Dry

%CO = Volume % Dry

MW_d = Molecular Weight of Stack Gas Dry Basis

MW = Molecular Weight of Stack Gas, Wet Basis

C_p = Pitot Tube Coefficient

$\sqrt{\Delta P_s (T_s + 460)}$ is determined by averaging the square root of the product of the velocity head (P_s) and the absolute stack temperature from each sampling point.

T_t = Net time of test in minutes

D_n = Sampling Nozzle Diameter, inches

A_n = Area of Nozzle opening, ft².

V_s = Stack Gas Velocity at Stack Conditions, Feet per second.

D_s = Diameter of Stack, inches

Area = Area of duct in ft²

ACFM = Actual Cubic Feet per minute

DSCFM = Dry Standard Cubic Feet per minute

%I = Per Cent Isokinetic

[a] Dry Standard Cubic Feet @ 68°F, 29.92 in. Hg.

[b] Standard Conditions @ 68°F. 29.92 in. Hg.

SUMMARY OF EMISSIONS

PLANT PES Test - Efficiency of Hg

SAMPLED SOURCE Scrubber Inlet

RUN	DATE	(1) V_m Std.	(2) DSCFM
1	23 Feb 89	37.373	3318
2	23 Feb 89	37.313	3271
5	1 Mar 89	40.576	3432
6	1 Mar 89		

FROM "MASSFLO"

RUN NUMBER (1) 1.0000 RUN
VOL MTR STD ? 37.3730 RUN
STACK DSCFM ? 3318.0000 RUN
FRONT 1/2 MG ? .4437 RUN
BACK 1/2 MG ? .6886 RUN

HEX
F GR/DSCF = 0.0002
F MG/NMM = 0.4193
F LB/HR = 0.0052
F KG/HR = 0.0024

TOTAL
B GR/DSCF = 0.0003
B MG/NMM = 0.6507
B LB/HR = 0.0081
B KG/HR = 0.0037

FROM "MASSFLO"

RUN NUMBER (5) 5.0000 RUN
VOL MTR STD ? 40.5760 RUN
STACK DSCFM ? 3432.0000 RUN
FRONT 1/2 MG ? .0101 RUN
BACK 1/2 MG ? .0349 RUN
FIX 6 .034900 RUN

HEX
F GR/DSCF = 0.000004
F MG/NMM = 0.008790
F LB/HR = 0.000113
F KG/HR = 0.000051

Total
B GR/DSCF = 0.000013
B MG/NMM = 0.020374
B LB/HR = 0.000390
B KG/HR = 0.000177

FROM "MASSFLO"

RUN NUMBER (2) 2.0000 RUN
VOL MTR STD ? 37.3130 RUN
STACK DSCFM ? 3271.0000 RUN
FRONT 1/2 MG ? .2700 RUN
BACK 1/2 MG ? .4500 RUN

HEX
F GR/DSCF = 0.0001
F MG/NMM = 0.2555
F LB/HR = 0.0031
F KG/HR = 0.0014

TOTAL
B GR/DSCF = 0.0002
B MG/NMM = 0.4259
B LB/HR = 0.0052
B KG/HR = 0.0024

RUN	Gr/DSCF	6	7	8	9
1					
2		.2555	.0031		
5		.00879	.000113		
6		.00747	.000094		

RUN	FRONT + BACK TOTAL	22	23
1			
2			
5			
6			

| | | | | |

TABLE I

EFFECTIVENESS OF SAMPLE RETRIEVAL METHODS:

Test Number	Test Date	Total Chrome From Initial Sample Recovery mg	Total Chrome From Train Blank Recovery mg		Effectiveness Of Sample Retrieval %
1	2/23/89	0.6885	688.5	<0.020	>97.1
2	3/01/89	0.0283	28.3	0.0070	75.3
3	3/01/89	0.0179	17.9	0.0030	83.2

Test Number	Test Date	Hexavalent Chrome From Initial Sample Recovery mg	Hexavalent Chrome From Train Blank Recovery * mg		Effectiveness Of Sample Retrieval %
1	2/23/89	0.4437	443.7	<0.00300	>99.3
2	3/01/89	0.0101	10.1	<0.00129	>87.2
3	3/01/89	0.0083	8.3	<0.00138	>81.0

* The level of detection for hexavalent chrome was 0.003 mg/l, so the actual retreival efficiency is very likely near the 97-99% as was demonstrated on the test trains for the uncontrolled emissions.

RESULTS OF SOURCE TESTS

Calculations were made from the field data sheets to determine sample volume, moisture content, molecular weight, velocities, flow rates, and percent isokinetic testing for the exhaust gas stream. Results are shown on the emission test calculation sheets (Appendix).

Tests 1 and 2, conducted without the anti-mist additive in the bath solution, showed an average emissions rate of 12.7 mg/amp-hour for total chrome and a rate of 7.99 mg/amp-hour for hexavalent chrome (Table 3). Tests 5 and 6, with the anti-mist additive in the anodizing solution, showed an average emissions rate of 0.56 mg/amp-hour for total chrome and a rate of 0.18 mg/amp-hour for hexavalent chrome (Table 4). From these results the reduction efficiency of Harshaw Chemical's MSP-ST additive was calculated. The efficiency for reducing total chrome emissions was 95.6% and for reducing hexavalent chrome emissions was 97.8% (Table 5).

Total chrome concentration cannot be used to define removal efficiency for Rule 1169; however, the reduction was 95.6% which was consistent with the hexavalent chrome measurements. Rule 1169 applies only to hexavalent chrome which is the compound of health concern so the emphasis of the analysis should be on Cr 6.

Results can be compared to SCAQMD Rule 1169 which regulates Cr 6 emissions from chromic acid anodizing tanks. The rule has a required control efficiency for control equipment. As an alternate compliance procedure, an anodizing tank can meet a mg/amp-hour loading in the total stack effluent. The three levels of control are based on total shop emissions as shown below:

Plating Shop	Control Efficiency	Stack Discharge
Cr 6 Emissions <2 lb/yr	95%	0.15 mg/amp-hour
Cr 6 Emissions 2-10 lb/yr	99% *	0.03 mg/amp-hour
Cr 6 Emissions >10 lb/yr	99.8% *	0.006 mg/amp-hour

* As an interim measure, all chromic acid anodizing tanks must meet a 95% reduction efficiency or a 0.15 mg/amp-hour emission rate by November 1, 1989.

TABLE 3 - TESTS 1 AND 2 - CHROME EMISSIONS WITH NO ADDITIVE IN THE ANODIZING SOLUTION

SAMPLE RUN NUMBER	SAMPLE VOLUME (ml)	Conc. Cr T (mg/l)	Impinger Catch Cr T (mg)	Filter Catch Cr T (mg)	Total Catch Cr T (mg)	SAMPLE METER VOL (dscf)	EMISSIONS Cr T (mg/dscf)	STACK FLOW RATE (dscfm)	ACTUAL EMISSIONS Cr T (mg/hour)	AVERAGE AMPERAGE	EMISSIONS Cr T (mg/amp-hour)	AVERAGE EMISSIONS Cr T (mg/amp-hour)
KL-II-L	765	0.9	0.6885									
KL-II-F				0.0001								
TOTAL					0.6886	37.373	0.0184	3318	3665.01	215	17.061	
					688.6							
KL-II-L	900	0.5	0.4500									
KL-II-F				0.0000								
TOTAL					0.4500	37.313	0.0121	3271	2366.92	185	6.305	12.683
					450.0							

SAMPLE RUN NUMBER	SAMPLE VOLUME (ml)	Conc. Cr 6 (mg/l)	Impinger Catch Cr 6 (mg)	Filter Catch Cr 6 (mg)	Total Catch Cr 6 (mg)	SAMPLE METER VOL (dscf)	EMISSIONS Cr 6 (mg/dscf)	STACK FLOW RATE (dscfm)	ACTUAL EMISSIONS Cr 6 (mg/hour)	AVERAGE AMPERAGE	EMISSIONS Cr 6 (mg/amp-hour)	AVERAGE EMISSIONS Cr 6 (mg/amp-hour)
KL-II-L	765	0.58	0.4437									
KL-II-F				0.0000								
TOTAL					0.4437	37.373	0.0119	3318	2362.52	215	10.993	
					443.7							
KL-II-L	900	0.3	0.2700									
KL-II-F				0.0000								
TOTAL					0.2700	37.313	0.0072	3271	1420.15	185	4.983	7.988
					270.0							

TABLE 4 - TESTS 5 AND 6 - CHROME EMISSIONS WITH HARSHAW CHEMICAL'S MSP-ST IN THE ANODIZING SOLUTION

SAMPLE RUN NUMBER	SAMPLE VOLUME (ml)	Conc. Cr T (mg/l)	Impinger Catch Cr T (mg)	Filter Catch Cr T (mg)	Total Catch Cr T (mg)	SAMPLE METER VOL (dscf)	EMISSIONS Cr T (mg/dscf)	STACK FLOW RATE (dscfm)	ACTUAL EMISSIONS Cr T (mg/hour)	AVERAGE AMPERAGE	EMISSIONS Cr T (mg/amp-hour)	AVERAGE EMISSIONS Cr T (mg/amp-hour)
KL-15-L	841	0.0337	0.0283									
KL-15-F				0.0066								
TOTAL					0.0349	40.576	0.0009	3432	177.33	265	0.669	
					34.9							
KL-16-L	829	0.0216	0.0179									
KL-16-F				0.0054								
TOTAL					0.0233	39.240	0.0006	3344	119.37	265	0.450	0.560
					23.3							

SAMPLE RUN NUMBER	SAMPLE VOLUME (ml)	Conc. Cr 6 (mg/l)	Impinger Catch Cr 6 (mg)	Filter Catch Cr 6 (mg)	Total Catch Cr 6 (mg)	SAMPLE METER VOL (dscf)	EMISSIONS Cr 6 (mg/dscf)	STACK FLOW RATE (dscfm)	ACTUAL EMISSIONS Cr 6 (mg/hour)	AVERAGE AMPERAGE	EMISSIONS Cr 6 (mg/amp-hour)	AVERAGE EMISSIONS Cr 6 (mg/amp-hour)
KL-15-L	841	0.012	0.0101									
KL-15-F				0.0000								
TOTAL					0.0101	40.576	0.0002	3432	51.22	265	0.193	
					10.1							
KL-16-L	829	0.01	0.0083									
KL-16-F				0.0000								
TOTAL					0.0083	39.240	0.0002	3344	42.39	265	0.160	0.177
					8.3							

97.87

1363.

1920.15

TABLE 5:

EFFICIENCY OF HARSHAW CHEMICAL'S MSP-ST FOR CONTROLLING CHROME EMISSIONS FROM A CHROMIC ACID ANODIZING TANK

Run Numbers	Average Emissions Cr T (mg/amp-hour)	Reduction Efficiency Cr T Percent	Average Emissions Cr 6 (mg/amp-hour)	Reduction Efficiency Cr 6 Percent
KL-1 & KL-2	12.683	----	7.983	---
KL-5 & KL-6	0.560	95.6	0.177	97.8

Since total controlled chrome emissions from nearly all chromic acid anodizing tanks will be less than 2 lb/yr, the 95% requirement will apply not only as an interim but as a permanent requirement.

Results also showed a Cr 6 concentration of 0.177 mg/amp-hour which is slightly above the 11/1/89 standard of the SCAQMD. However, the 0.15 mg/amp-hour standard is more stringent than the 95% reduction requirement.

APPENDIXES

PES

Plant: Anodizing Tests
Date: 8-23-89
Source/Sample Number: T-1 (Inlet)

1. $V_{m(std)} = 17.64\ V_m\ Y \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m}\right]$

$V_{m(std)} = 17.64(36.792)(1.020)\left[\frac{(30.37) + (3.11/13.6)}{(542)}\right]$

$V_{m(std)}$ = 37.373 dscf

2. Volume Water Vapor Collected, Standard Conditions

V_{lc} = 9.2 condensate from impingers and Silica Gel

$V_{W(std)} = .04707\ V_{lc}$ = 0.433 scf

$V_{W(std)}$ = 0.433 scf

3. Percent Moisture, by volume

$B_{Ws} = \frac{V_{W(std)}}{V_{W\ std} + V_{m\ (std)}} = \frac{(0.433)}{(0.433) + (37.373)} = 0.011$

B_{Ws} = 1.1 %

4. Molecular Weight, Stack gas

Dry Molecular Wight

$M_d = 0.440\ (\%\ CO_2) + 0.320\ (\%\ O_2) + 0.280\ (\%\ N_2 + \%\ CO)$

$M_d = 0.440(\quad) + 0.320(\quad) + 0.280(\quad)$

M_d = 29.0 lb/lb-mole

$M_s = M_d + B_{Ws}(18 - M_d) = (29.0) + (0.011)(18 - 29.0)$

M_s = 28.88 lb/lb-mole

Plant: Anodizing Tests
Date: 2-23-89
Source/Sample Number: I-1 (Inlet)

5. Stack Gas Velocity Average

$$V_{s(avg)} = 85.49\ C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_{s(avg)} = 85.49(0.84)(0.57)\sqrt{\frac{(537)}{(30.3)(28.88)}}$$

$V_{s(avg)}$ = 32.1 ft/sec.

6. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_s = 60\ V_s\ A = 60\ (32.1)\left(\frac{18 \times 14}{144}\right)$$

Q_s = 3371 acfm

7. Stack volumetric flow rate, standard conditions (68° F, 29.92 Hg)

$$Q_{(std)} = 17.64\ Q_s\ (1-B_{ws})\ \frac{P_s}{T_s} =$$

$$Q_{(std)} = 17.64(3371)(1-0.011)\frac{(30.3)}{(537)}$$

Q_{std} = 3318 dscfm

8. Isokinetic Variation

$$\%I = K\ \frac{T_s\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1-B_{ws})}$$

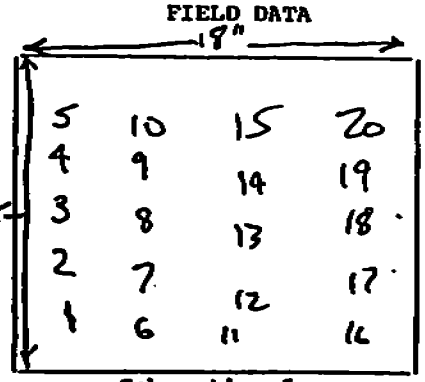
$$= 0.0945\ \frac{(537)(37.38)}{(30.3)(32.1)(0.00044)(40)(1-0.011)}$$

%I = 100.6 %

About This
Gas Volume! Signed MJB

FIELD DATA

Plant Annodizing Tests
Date 2-23-89
Sampling Location Scrubber Inlet
Sample Type CHROME
Run Number KL-31
Operator Simon, Purcell
Ambient Temperature 70°, clear
Barometric Pressure 30.37
Static Pressure (P_s) -0.97" H_2O
Filter Number(s) —
Pretest Leak Rate = 0.007 cfm @ 10 in. Hg
Pretest Pitot Leak Check ✓
Pretest Orsat Leak Check ✓(N.A)
Read and Record all Data Every 2 Minutes



Schematic of Traverse Point Layout

Probe Length and Type 3' glass, sheath #1
Pitot Tube I.D. No. Type S
Nozzle I.D. 0.299 AVE
Assumed Moisture, % 1.0
Temp. Readout S/N —
Meter Box Number NUTECH 1A
Meter $\Delta H_@$ 1.92
C Factor 1.15
Meter Gamma 1.003
Heater Box Setting (N.A)
Reference Δp 0.19
Post Test Leak Rate = 0.008 cfm @ ~~10~~ 12 in. Hg
Post Test Pitot Leak Check ✓
Post Test Orsat Leak Check ✓(N.A)

SAMPLE BOX 1B

Time Point Ends; (1 minute shutoffs during port changes.)

Traverse Point Number	Sampling Time, (min)	/Clock/ Time /(24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Orifice Pres. Differential (ΔH) in. H_2O Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Dry Gas Meter Temp. Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
							4	6	7			5
1	0	/ 0936	401.036	0.28	~~2.70~~	4.25	73				—	57
1	2	/ 0938	402.8	0.21	~~2.21~~	2.2	76	82	78	5.5	—	51
2	4	/ 0940	404.5	0.25	2.4		76	83	78	5.5	—	49
3	6	/ 0942	406.0	0.30	2.8		76	84	78	6.5	—	48
4	8	/ 0944	407.8	0.38	3.6		77	86	79	9.0		47
5	10	/ 0946	409.7	0.31	3.0		75	85	80	7.5		51
SWITCH 6	12	/ 0949	411.7	0.28	2.7		76	87	80	7.5		52
7	14	/ 0951	413.3	0.31	3.0		78	88	80	7.5		53
8	16	/ 0953	415.1	0.35	3.4		78	89	81	9.0		54
9	18	/ 0955	417.1	0.39	3.7		78	89	81	9.5		55
SWITCH 10	20	/ 0957	419.3	0.34	3.3		77	88	82	8.0		59
11	22	/ 1000	421.2	0.31	3.0		77	89	82	7.5		58
12	24	/ 1002	423.1	0.29	2.8		77	89	82	7.0		58
13	26	/ 1004	424.7	0.35	3.4		79	89	82	9.0		58
14	28	/ 1006	426.6	0.39	3.7		79	90	83	10.0		58
SWITCH 15	30	/ 1008	428.7	0.28	2.7		77	88	83	7.0		60
16	32	/ 1011	430.4	0.31	3.0		77	89	83	8.0		60
17	34	/ 1013	432.2	0.27	2.45		78	90	83	6.5		60
18	36	/ 1015	433.9	0.33	3.2		78	90	83	8.0		61
19	38	/ 1017	435.8	0.37	3.6		78	90	83	9.0		62
20	40	/ 1019	437.828	END of TEST								
		/										
		/		VAVE=								
		/	36.792	0.57	3.11		77	83.25	81.2			55.55
				✓	✓			82.25				

20.5=V
A=215

Probe had brown residue at end of test.

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

SAMPLE RECOVERY DATA

Plant: Anodizing Tests

Date: 2-23-89

Sampling Location: Inlet

Sample Type: Chrome (Total) & Cr+6

Run Number: I 1

Sample Box Number: 1B

Clean-up Man: Simon

Job Number:

Comments:

FRONT HALF

Filter Number: KL-IF-1

Description of Filter: No discoloration

MOISTURE

	#1	#2	#3
Impingers			
Final Volume:	ml	ml	ml
Initial Volume:	100 ml	100 ml	0 ml
Net Volume:	ml	200 ml	ml
Total H_2O:	0 ml		
Silica Gel + Impinger			
Final Volume:	882.1 g	g	g
Initial Volume	872.9 g	g	g
Net Volume	9.2 g	g	g
Total Moisture:	9.2		

Description of Impinger Catch: both clear, no discoloration

Plant: Anodizing Tests
Date: 2-23-89
Source/Sample Number: - I2

1. $V_{m(std)} = 17.64\ V_m\ Y \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m}\right]$

$V_{m(std)} = 17.64(37.338)(1.020)\left[\frac{(30.37) + (3.17/13.6)}{(551)}\right]$

$V_{m(std)}$ = 37.313 dscf

2. Volume Water Vapor Collected, Standard Conditions

V_{lc} = 12.3 condensate from impingers and Silica Gel

$V_{W(std)} = .04707\ V_{lc}$ = 0.58 scf

$V_{W(std)}$ = 0.58 scf

3. Percent Moisture, by volume

$B_{Ws} = \frac{V_{W(std)}}{V_{W\ std} + V_{m\ (std)}} = \frac{(0.58)}{(0.58) + (37.313)} = 0.015$

B_{Ws} = 0.015 = 1.5%

4. Molecular Weight, Stack gas

Dry Molecular Wight

$M_d = 0.440\ (\%\ CO_2) + 0.320\ (\%\ O_2) + 0.280\ (\%\ N_2 + \%\ CO)$

$M_d = 0.440(\quad) + 0.320(\quad) + 0.280(\quad)$

M_d = 29.0 lb/lb-mole

$M_s = M_d + B_{Ws}(18 - M_d) = (29.0) + (0.015)(18 - 29.0)$

M_s = 28.84 lb/lb-mole

Plant: Anodizing Tests
Date: 2-23-89
Source/Sample Number: KL-I2

5. Stack Gas Velocity Average

$$V_{s(avg)} = 85.49\ C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_{s(avg)} = 85.49 (0.94)(0.57) \sqrt{\frac{(547.5)}{(30.30)(28.84)}}$$

$V_{s(avg)}$ = 32.4 ft/sec.

6. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_s = 60\ V_s\ A = 60\ (32.4)\left(\frac{13.14}{144}\right)$$

Q_s = 3402 acfm

7. Stack volumetric flow rate, standard conditions (68° F, 29.92 Hg)

$$Q_{(std)} = 17.64\ Q_s\ (1-B_{ws})\ \frac{P_s}{T_s} =$$

$$Q_{(std)} = 17.64(3402)(1-0.015)\frac{(30.3)}{(547.5)}$$

Q_{std} = 3271 dscfm

8. Isokinetic Variation

$$\%I = K\ \frac{T_s\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1-B_{ws})}$$

$$= 0.0945\ \frac{(547.5)(37.303)}{(30.3)(32.4)(0.00052)(40)(1-0.015)}$$

%I = 96.0 %

FIELD DATA

Plant: Annodizing Tests
Date: 2-23-89
Sampling Location: Scrubber Inlet
Sample Type: Chrome
Run Number: KL-I2
Operator: Simon, Purcell
Ambient Temperature: 75°F clear
Barometric Pressure: 30.37
Static Pressure (P_s): −0.97" H_2O
Filter Number(s):
Pretest Leak Rate = 0.006 cfm @ 12 in. Hg
Pretest Pitot Leak Check: ✓
Pretest Orsat Leak Check: ✓ (N.A.)
Read and Record all Data Every 2 Minutes

See KL-I1 data sheet of same date.

Schematic of Traverse Point Layout

Probe Length and Type: 3' glass, sheath #2
Pitot Tube I.D. No.: Type S
Nozzle I.D.: 0.31 RVE
Assumed Moisture, %: 1.0
Temp. Readout S/N: —
Meter Box Number: NUTECH 2A
Meter $\Delta H_@$: 1.92
C Factor: 1.15
Meter Gamma: 1.003
Heater Box Setting: —
Reference Δp: 0.19
Post Test Leak Rate = 0.003 cfm @ 13 in. Hg
Post Test Pitot Leak Check: ✓
Post Test Orsat Leak Check: ✓ (N.A.)

Time Point Ends; Exactly 1 minute to change points. shutoffs 4 6 7 5

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft^3	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
—	0	1038	438.318	0.35	3.30		79	88	85	10.0		63
1	2	1040	440.1	0.29	2.80		80	89	85	8.0		60
2	4	1042	441.8	0.28	2.7		80	92	85	7.5		58
3	6	1044	443.6	0.31	3.0		80	93	86	8.0		57
4	8	1046	445.5	0.39	3.6		80	95	87	9.5		55
5	10	1048	447.410	0.340	3.8		81	94	88	10.0		58
6	12	1051	449.3	0.29	2.8		81	96	88	7.5		57
7	14	1053	451.1	0.30	2.9		81	97	89	8.5		59
8	16	1055	MISSED READ	0.34	3.2		81	98	89	9.0		61
9	18	1057	454.8	0.31	3.3		81	98	90	10.5		62
10	20	1059	456.912	0.37	3.6		81	97	90	10.0		62
11	22	1102	458.9	0.29	2.8		82	98	91	8.0		65
12	24	1104	460.5	0.33	3.2		82	99	91	7.0		66
13	26	1106	462.5	0.35	3.4		82	100	92	9.0		67
14	28	1108	464.3	0.38	3.7		83	100	92	9.5		69
15	30	1110	466.580	0.36	3.6		83	99	92	9.5		73
16	32	1113	468.6	0.26	2.5		83	101	93	7.0		65
17	34	1115	470.2	0.24	2.3		83	101	93	6.5		62
18	36	1117	472.2	0.30	2.9		84	101	93	9.0		62
19	38	1119	473.8	0.34	3.5		83	102	94	9.0		62
20	40	1121	475.657		END of TEST							
		/										
		/		✓ AVE =								
		/	37.338	0.57	3.165		81.5		91.175			62A

22 volts
285 AMPS
(ADDED ICE)

Probe Nozzle Had brown residue at end of test.

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

SAMPLE RECOVERY DATA

Plant: Anodizing Tests

Date: 2-23-89

Sampling Location:

Sample Type: Total Chrome & Cr+6

Run Number: KL-I2

Sample Box Number: 23

Clean-up Man: Simon

Job Number:

Comments:

FRONT HALF

Filter Number: KL-IF-2

Description of Filter: No discoloration

MOISTURE

	#1	#2	#3
Impingers			
Final Volume:	101 ml	101 ml	0 ml
Initial Volume:	100 ml	100 ml	0 ml
Net Volume:	1 ml	1 ml	0 ml
Total H_2O:	2 ml		
Silica Gel + Impinger			
Final Volume:	882.1 g	g	g
Initial Volume	871.8 g	g	g
Net Volume	10.3 g	g	g
Total Moisture:	12.3		

Description of Impinger Catch: both clear, no discoloration

CHROME PLATING PROCESS DATA
METAL FINISHING ASSOCIATION OF SOUTHERN CALIFORNIA

PLATING SHOP Annodizing Inc
TEST DATE 2-23-89
TANK NUMBER 8
LENGTH 96 INCHES
WIDTH 48 INCHES
DEPTH ____ INCHES
ADDITIVE NONE (Anti-mist)
FREEBOARD 6 INCHES
POLYBALLS NONE INCH DIA, ____ PERCENT COVERAGE
HOOD TYPE SLOT BOTH SIDES
MIX AIR YES (AGITATION)

BATH TEMPERATURE 103°F
CONTROLS

ACID STRENGTH ____ OUNCES CHROME ACID/GALLON OF SOLUTION

RECTIFIER ALLIED KELITE
CAL DATE 12-19-88

TIME	DC VOLTS	AMPS	DC VOLTS	AMPS	DC VOLTS	AMPS
Due to short duration of tests, Voltage & Amperage readings were constant. See Field data sheet for these readings.						
	#1					

TMA Inc. REPORT Work Order # 89-02-099

Received: 02/23/89 02/28/89 14:43:55

REPORT TO: Pacific Environmental Service
150 E. Foothill Blvd.
Arcadia, CA 91006

ATTEN: Mr. Dean High

CLIENT: PACIFIC ENVI SAMPLES: 8
COMPANY: Pacific Environmental Service
ACTIVITY:

WORK ID: 3626
TAKEN: By Pacific Environment. Staff
TRANS: By Pacific Environment. Staff
TYPE: Liquids & Filters
P.O. #: 3626
INVOICE: under seperate cover

PREPARED BY: Thermo Analytical, Inc.
160 Taylor Street
Monrovia, CA 91016

ATTEN:
PHONE: 818-357-3247

Robert S. Ferguson
CERTIFIED BY

CONTACT RSF

This report is for the sole and exclusive use of the client to whom it is addressed and represents only those samples herein described. Samples not destroyed in testing are retained a maximum of 30 days unless otherwise requested.

SAMPLE IDENTIFICATION

1 KL-I1
2 KL-I2
3 KL-IF-1
4 KL-IF2
5 KL-TB1
6 KL-FB1
7 KL-RB1
8 KL-PR1

TEST CODES and NAMES used on this report

CRHEXS	Hexavalent Chromium
CRHBAA	Chromium - Air
CR HEX	Hexavalent Chromium
CR L	Chromium - Liquids
SG	Specific Gravity (pycnom.)
WC	General Chemical Testing

TMA Inc. REPORT Work Order # 89-02-099

Received: 02/23/89

Results by Sample

SAMPLE ID KL-I1 SAMPLE # 01 FRACTIONS: A

Date & Time Collected 02/23/89 Category

CR_HEX	CR_L	WC
0.58 mg/L	0.90 mg/L	765 mL

SAMPLE ID KL-I2 SAMPLE # 02 FRACTIONS: A

Date & Time Collected 02/23/89 Category

CR_HEX	CR_L	WC
0.30 mg/L	0.50 mg/L	900 mL

SAMPLE ID KL-IF-1 SAMPLE # 03 FRACTIONS: A

Date & Time Collected 02/23/89 Category

CRHEXS	CRHGAA
< 0.5 ug/filter	1.22 Total ug

SAMPLE ID KL-IF2 SAMPLE # 04 FRACTIONS: A

Date & Time Collected 02/23/89 Category

CRHEXS	CRHGAA
< 0.5 ug/filter	0.74 Total ug

Received: 02/23/89

Results by Sample

SAMPLE ID KL-TB1 SAMPLE # 05 FRACTIONS: A
Date & Time Collected 02/23/89 Category

CR_HEX	< 0.003 mg/L	CR_L	< 0.02 mg/L

SAMPLE ID KL-FB1 SAMPLE # 06 FRACTIONS: A
Date & Time Collected 02/23/89 Category

CRHEXS	< 0.5 ug/filter	CRHGAA	1.13 Total ug

SAMPLE ID KL-RB1 SAMPLE # 07 FRACTIONS: A
Date & Time Collected 02/23/89 Category

CR_HEX	< 0.003 mg/L	CR_L	< 0.02 mg/L

SAMPLE ID KL-PR1 SAMPLE # 08 FRACTIONS: A
Date & Time Collected 02/23/89 Category

CR_HEX	43,500. mg/L	CR_L	59,600. mg/L	SG	1.082 N/A

Pacific Environmental Service

Three filters and five liquids were analyzed for hexavalent and total chromium, according to EPA method 425. The volumes of the liquids were measured. Please see the enclosed tables for the results.

Plant: Anodizing Tests
Date: 3-3-89
Source/Sample Number: -I5 (Inlet)

1. $V_{m(std)} = 17.64\ V_m\ Y \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m}\right]$

$V_{m(std)} = 17.64(39.897)(1.020)\left[\frac{(30.35) + (3.43/13.6)}{(541.4)}\right]$

$V_{m(std)}$ = 40.576 dscf

2. Volume Water Vapor Collected, Standard Conditions

V_{lc} = 11.0 condensate from impingers and Silica Gel

$V_{W(std)} = .04707\ V_{lc}$ = 0.518 scf

$V_{W(std)}$ = 0.518 scf

3. Percent Moisture, by volume

$B_{Ws} = \frac{V_{W(std)}}{V_{W\ std} + V_{m\ (std)}} = \frac{(0.518)}{(0.518)+(40.576)} = 0.013$

B_{Ws} = 1.3%

4. Molecular Weight, Stack gas

Dry Molecular Wight

$M_d = 0.440\ (\%\ CO_2) + 0.320\ (\%\ O_2) + 0.280\ (\%\ N_2 + \%\ CO)$

$M_d = 0.440(\quad) + 0.320(\quad) + 0.280(\quad)$

M_d = 29.0 lb/lb-mole

$M_s = M_d + B_{Ws}(18 - M_d) = (29.0) + (0.013)(18 - 29.0)$

M_s = 28.86 lb/lb-mole

Plant: Anodizing Tests
Date: 3-1-89
Source/Sample Number: -T5

5. Stack Gas Velocity Average

$$V_{s(avg)} = 85.49\ C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_{s(avg)} = 85.49(0.84)(0.567)\sqrt{\frac{(529.1)}{(30.28)(28.86)}}$$

$V_{s(avg)}$ = 32.8 ft/sec.

6. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_s = 60\ V_s\ A = 60\ (32.8)(1.75)$$

Q_s = 3444 acfm

7. Stack volumetric flow rate, standard conditions (68° F, 29.92 Hg)

$$Q_{(std)} = 17.64\ Q_s\ (1-B_{ws})\ \frac{P_s}{T_s} =$$

$$Q_{(std)} = 17.64(3444)(1-0.013)\frac{(30.28)}{(529.1)}$$

Q_{std} = 3432 dscfm

8. Isokinetic Variation

$$\%I = K\ \frac{T_s\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1-B_{ws})}$$

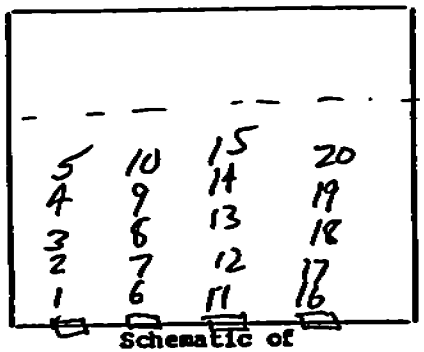
$$= 0.0945\ \frac{(529.1)(40.576)}{(30.28)(32.8)(0.000488)(40)(1-0.013)}$$

%I = 106.0 %

FIELD DATA

Plant: Annodizing Tests
Date: 3-1-89
Sampling Location: Scrubber Inlet
Sample Type: Chrome
Run Number: KL-I5
Operator: Simon, Purcell
Ambient Temperature: 65°F
Barometric Pressure: 30.35
Static Pressure (P_s): -0.94
Filter Number(s): KL-5I-F
Pretest Leak Rate = 0.010 cfm @ 12 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: —
Read and Record all Data Every 2 Minutes

NOTE: Exactly 1 minute pump shutoff during the port changes.



Schematic of Traverse Point Layout

Probe Length and Type: 3' glass
Pitot Tube I.D. No.: #1 type S
Nozzle I.D.: 0.299
Assumed Moisture, %: 1.0
Temp. Readout S/N: —
Meter Box Number: NUTECH 1A
Meter $\Delta H_@$: 1.92
C Factor: 1.15
Meter Gamma: 1.003
Heater Box Setting: —
Reference Δp: 0.19
Post Test Leak Rate = 0.006 cfm @ 14.5 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: —

Traverse Point Number	Sampling Time, (min)	Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F (ch5)	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F (ch6)	Outlet ($T_{m_{out}}$) °F (ch7)	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F (ch4)
START	0	1005	551.987	0.39	3.85	✓	63	66	64	11.5	—	55
1	2	1007	554.8	0.32	3.15	✓	67	69	64	9.0		46
2	4	1009	556.6	0.34	3.40	✓	68	71	65	10.0		44
3	6	1011	558.6	0.32	3.15	✓	68	73	65	9.5		43
4	8	1013	560.6	0.39	3.85	✓	69	75	66	11.5		43
5	10	1015	562.529	0.37	3.65	✓	66	73	66	11.0		46
6	12	1018	564.7	0.30	3.00	✓	68	76	67	9.0		48
7	14	1020	566.5	0.34	3.40	✓	69	76	67	10.0		50
8	16	1022	568.3	0.37	3.65	✓	70	78	68	11.0		51
9	18	1024	570.3	0.42	4.10	✓	70	79	69	12.0		52
10	20	1026	572.472	0.36	3.60	✓	68	77	67	10.0		54
11	22	1029	574.4	0.29	2.90	✓	69	79	70	8.5		54
12	24	1031	576.3	0.36	3.60	✓	70	80	71	10.5		55
13	26	1033	578.2	0.38	3.70	✓	71	81	71	11.0		56
14	28	1035	580.3	0.41	4.00	✓	71	82	72	12.0		57
15	30	1037	582.4	0.30	3.00	✓	70	81	73	8.5		59
16	32	1040	584.3	0.26	2.55	✓	70	82	73	7.5		59
17	34	1042	586.0	0.23	2.10	✓	71	81	74	8.0		57
18	36	1044	587.8	0.35	3.50	✓	71	84	74	10.0		56
19	38	1046	589.6	0.34	3.70	✓	72	85	75			56
20	40	1048	591.879	END OF TEST (NO RESIDUE IN TIP AT END OF TEST)								
				AVE $\sqrt{\Delta P}$ = 0.587								
					AVE $\sqrt{\Delta H}$ = 3.48				AVE = 81.4°F			
			V = 39.197				AVE = 69.1°F = 529.1°R		= 541.4°R			

SWITCH ST. AT 1016

SWITCH ST. AT 1027

SWITCH ST. AT 1038

checked process data at 10:20:
Temp = 98°F
Volts = 23
Amps = 265
No Air Agitation
Surface Tension = 54
Foam Blanket was 0.25" Thick.

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

SAMPLE RECOVERY DATA

Plant: Annodizing Tests

Date: 3-1-89

Sampling Location: Scrubber Inlet

Sample Type: Chromt

Run Number: KL-I5

Sample Box Number: 18

Clean-up Man: Simon

Job Number: ~~3627~~ 3626

Comments: No Discoloration of NaOH Sln.

FRONT HALF

Filter Number: KL-I5-F

Description of Filter: Clean

MOISTURE

Impingers			
Final Volume:	103 ml	100 ml	ml
Initial Volume:	100 ml	100 ml	ml
Net Volume:	ml	203 ml	ml
Total H_2O:	3		
Silica Gel			
Final Volume:	898.1 g	g	g
Initial Volume	889.8 g	g	g
Net Volume	8.3 g	g	g
Total Moisture:	11.3		

Description of Impinger Catch:

Plant: Anodizing Tests
Date: 3-1-89
Source/Sample Number: -I6

1. $V_{m(std)} = 17.64\ V_m\ Y \left[\frac{P_{bar} + (\Delta H/13.6)}{T_m}\right]$

$V_{m(std)} = 17.64(38.569)(1.020)\left[\frac{(30.35) + (3.27/13.6)}{(541)}\right]$

$V_{m(std)}$ = 39.240 dscf

2. Volume Water Vapor Collected, Standard Conditions

V_{lc} = 11.3 condensate from impingers and Silica Gel

$V_{W(std)} = .04707\ V_{lc}$ = 0.532 scf

$V_{W(std)}$ = 0.532 scf

3. Percent Moisture, by volume

$B_{Ws} = \frac{V_{W(std)}}{V_{W\ std} + V_{m\ (std)}} = \frac{(0.532)}{(0.532)+(39.24)} = 0.013$

B_{Ws} = 1.3%

4. Molecular Weight, Stack gas

Dry Molecular Wight

$M_d = 0.440\ (\%\ CO_2) + 0.320\ (\%\ O_2) + 0.280\ (\%\ N_2 + \%\ CO)$

$M_d = 0.440(\quad) + 0.320(\quad) + 0.280(\quad)$

M_d = 29.0 lb/lb-mole

$M_s = M_d + B_{Ws}(18 - M_d) = (29.0) + (0.013)(18 - 29.0)$

M_s = 28.86 lb/lb-mole

Plant: Anodizing Tests
Date: 3-1-89
Source/Sample Number: -I6

5. Stack Gas Velocity Average

$$V_{s(avg)} = 85.49\ C_p \left(\sqrt{\Delta P}\right)_{avg} \sqrt{\frac{T_s}{P_s M_s}}$$

$$V_{s(avg)} = 85.49(0.84)(0.573)\sqrt{\frac{(530.9)}{(30.28)(28.86)}}$$

$V_{s(avg)}$ = 3207 ft/sec.

6. Stack Volumetric Flow Rate, Actual Conditions (Stack Temperature and Pressure)

$$Q_s = 60\ V_s\ A = 60\ (3207)(1.75)$$

Q_s = 3367 acfm

7. Stack volumetric flow rate, standard conditions (68° F, 29.92 Hg)

$$Q_{(std)} = 17.64\ Q_s\ (1-B_{ws})\ \frac{P_s}{T_s} =$$

$$Q_{(std)} = 17.64(3367)(1-0.013)\frac{(30.28)}{(530.9)}$$

Q_{std} = 3344 dscfm

8. Isokinetic Variation

$$\%I = K\ \frac{T_s\ V_{m(std)}}{P_s\ V_s\ A_n\ \theta\ (1-B_{ws})}$$

$$= 0.0945\ \frac{(530.9)(39.246)}{(30.28)(32.07)(.00491)(40)(1-0.013)}$$

%I = 104.6 %

FIELD DATA

Plant: Annodizing Tests
Date: 3-1-89
Sampling Location: Scrubber Inlet
Sample Type: Chrome
Run Number: KL-I6
Operator: Simon, Purcell
Ambient Temperature: 65°F
Barometric Pressure: 30.35" Hg
Static Pressure (P_s): -0.99
Filter Number(s): KL-6I-F
Pretest Leak Rate = 0.006 cfm @ 13 in. Hg
Pretest Pitot Leak Check: O.K.
Pretest Orsat Leak Check: —
Read and Record all Data Every 2 Minutes

5	10	15	20
4	9	14	19
3	8	13	18
2	7	12	17
1	6	11	16

Schematic of Traverse Point Layout

Probe Length and Type: 3' glass
Pitot Tube I.D. No.: #2, Type S
Nozzle I.D.: 0.300
Assumed Moisture, %: 1.0
Temp. Readout S/N: —
Meter Box Number: NUTECH IA
Meter $\Delta H_@$: 1.92
C Factor: 1.15
Meter Gamma: 1.003
Heater Box Setting: —
Reference Δp: 0.19
Post Test Leak Rate = 0.006 cfm @ 14 in. Hg
Post Test Pitot Leak Check: O.K.
Post Test Orsat Leak Check: —

Note: Exactly 1 minute time interval of pump shutoff during port changes.
No residues seen in nozzle at end of test.

Traverse Point Number	Sampling Time, (min)	/ Clock Time (24-hour clock)	Gas Meter Reading (V_m) ft³	Velocity Head (ΔP_s) in. H_2O	Orifice Pres. Differential (ΔH) in. H_2O Desired	Actual	Stack Temp. (T_s) °F	Dry Gas Meter Temp. Inlet ($T_{m_{in}}$) °F	Outlet ($T_{m_{out}}$) °F	Pump Vacuum in. Hg	Sample Box Temp. Filter Temp. °F	Impinger Temp. °F
							ch5	ch6	ch7			ch4
START	0	1057	592.303	0.27	2.70	✓	71	77	76	7.0	—	60
1	2	1059	594.2	0.27	2.70	✓	71	82	76	7.0		47
2	4	1101	596.7	0.30	3.00	✓	71	83	77	8.0		46
3	6	1103	597.6	0.31	3.10	✓	72	85	77	8.5		46
4	8	1105	599.4	0.36	3.60	✓	72	86	78	10.0		46
5	10	1107	601.496	0.24	2.35	✓	71	85	78	6.0		50
Switch St. At 1108 6	12	1110	603.0	0.27	2.70	✓	71	86	78	7.0		50
7	14	1112	604.8	0.30	3.00	✓	71	86	79	8.0		51
8	16	1114	606.7	0.37	3.65	✓	72	87	79	9.5		52
9	18	1116	608.8	0.41	4.00	✓	72	87	79	11.0		52
10	20	1118	610.952	0.42	4.10	✓	68	84	79	11.0		54
Switch St. At 1119 11	22	1120	613.1	0.32	3.15	✓	70	85	79	8.5		54
12	24	1122	615.0	0.32	3.15	✓	70	84	80	8.5		53
13	26	1125	616.9	0.37	3.65	✓	71	84	79	10.0		52
14	28	1127	618.9	0.41	4.00	✓	71	84	78	11.0		51
15	30	1129	621.135	0.35	3.50	✓	69	82	78	9.0		53
Switch St. At 1130 16	32	1132	623.1	0.28	2.75	✓	70	83	78	8.0		52
17	34	1134	624.9	0.28	2.75	✓	71	82	77	8.0		53
18	36	1136	626.7	0.36	3.60	✓	72	83	78	9.5		53
19	38	1138	628.8	0.40	4.00	✓	72	84	77	11.0		54
20	40	1140	630.872	(END OF TEST)								
		/										
		/		AVE. $\sqrt{\Delta P}$ = 0.573			AVE = 70.4°F		AVE = 81°F			
		/	V = 38.569		AVE. ΔH = 3.29		= 530.4°R		OR 541°R			

Process Parameters same as Run KL-5I; Surface Tension = 34 40 at begining of test.

Foam was 0.25" Thick

PACIFIC ENVIRONMENTAL SERVICES, INC.

PES

SAMPLE RECOVERY DATA

Plant: Annodizing Tests

Date: 3-1-89

Sampling Location: Scrubber Inlet

Sample Type: Chrome

Run Number: KL-I6

Sample Box Number: 2B

Clean-up Man: Simon

Job Number: 3626

Comments: No Discoloration of NaOH Sln.

FRONT HALF

Filter Number: KL-I6-F

Description of Filter: Clean

MOISTURE

Impingers			
Final Volume:	102 ml	100 ml	ml
Initial Volume:	100 ml	100 ml	ml
Net Volume:	ml	202 ml	ml
Total H_2O:	2		

Silica Gel			
Final Volume:	898.1 g	g	g
Initial Volume	~~882.1~~ 889.1 g	g	g
Net Volume	9.0 g	g	g
Total Moisture:	11.0		

Description of Impinger Catch:

TMA
Thermo Analytical Inc.

TMA/ARLI
160 Taylor Street
Post Office Box 2360
Monrovia, CA 91016
(818) 357-3247

Chain of Custody Record

DATE 3-1-89 PAGE 1 OF 1

CLIENT Pacific Environmental Services Inc.
ADDRESS 150 EAST FOOTHILL BLVD.
ARCADIA, CA. 91006

PROJECT 3626

SAMPLERS (SIGNATURE) Mark J. Simon

SAMPLE NO	DATE	TIME	LOCATION	CAM Metals (17)	Pr. Pollutant Metals (13)	Hazardous Char. (Request List)	Gen. Minerals (Request List)	TPHC 418.1	Base/Neu/Acids (Organics)	Pesticides	Volatile Orgs. (601/602)	8015 Modified	Volatile Orgs. (624/8240)	Total Chrome	Hexavalent Chrome	Volume	Sample Type	NUMBER OF CONTAINERS	Observations/ Comments
KL-I5-F	3-1-89													X	X		F	1	
KL-I6-F	"													X	X		F	1	
KL-I5-L	"													X	X	X	L	2	
KL-I6-L	"													X	X	X	L	2	
KL-I6-TB	"													X	X	X	L	1	
KL-I5-TB	"													X	X	X	L	1	
KL-I56-PR	"													X	X		L	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature: Mark J. Simon	3/1/89	Signature		Signature		Signature	
Printed Name: Mark J. Simon	TIME 3:50	Printed Name	TIME	Printed Name	TIME	Printed Name	TIME
Company: P.E.S.		Company		Company		Company	
RELINQUISHED BY	DATE	RECEIVED BY	DATE	RELINQUISHED BY	DATE	RECEIVED BY (laboratory)	DATE 3/1/89
Signature		Signature		Signature		Signature	
Printed Name	TIME	Printed Name	TIME	Printed Name	TIME	Printed Name: TMA, Inc./ARLI	TIME 3:52
Company		Company		Company			

TOTAL NUMBER OF CONTAINERS

METHOD OF SHIPMENT: Delivered Personally

SPECIAL REQUIREMENTS: Light Loadings - Use Long Light Path Cell: Cr^6 Graphite Furnace: Cr^T

 TMA Inc. REPORT Work Order # 89 _J-011

Received: 03/01/89 03/08/89 14:34:51

REPORT TO: Pacific Environmental Service
150 E. Foothill Blvd.
Arcadia, CA 91006

ATTEN: Mr. Dean High

CLIENT: PACIFIC ENVI SAMPLES 7
COMPANY: Pacific Environmental Service
FACILITY:

WORK ID: 3626
TAKEN: By Pacific Enviro. Staff
TRANS: By Pacific Enviro. Staff
TYPE: Liquids & Filter
P.O. #: 3626
INVOICE: under separate cover

PREPARED BY: Thermo Analytical, Inc
160 Taylor Street
Monrovia, CA 91016

ATTEN:
PHONE: 818-357-3247

Robert S. Ferguson
CERTIFIED BY

CONTACT: RSF

This report is for the sole and exclusive use of the client to whom it is addressed and represents only those samples herein described. Samples not destroyed in testing are retained a maximum of 30 days unless otherwise requested.

Verbal results to Mr. Dean High on March 7, 1989.

Previously Reported on 03/07/89.

SAMPLE IDENTIFICATION

01 KL-I5-F
02 KL-I6-F
03 KL-I5-L
04 KL-I6-L
05 KL-I6-TB
06 KL-I5-TB
07 KL-I56-PR

TEST CODES and NAMES used on this report

CRHEXS	Hexavalent Chromium
CRHGAA	Chromium - Air
CRHGAW	Chromium - Liquids
CR HEX	Hexavalent Chromium
CR L	Chromium - Liquids
WC	General Chemical Testing

Received: 03/01/89 Results by Sample

SAMPLE ID KL-I5-F SAMPLE # 01 FRACTIONS: A
Date & Time Collected 03/01/89 Category

DPC AA
CRHEXS <0.5 ug/filter CRHGAA 6.66 total ug
Filter
How much sample?

SAMPLE ID KL-I6-F SAMPLE # 02 FRACTIONS: A
Date & Time Collected 03/01/89 Category

DPC AA
CRHEXS <0.5 ug/filter CRHGAA 5.44 Total ug
Filter
How much sample?

SAMPLE ID KL-I5-L SAMPLE # 03 FRACTIONS: A
Date & Time Collected 03/01/89 Category

AA DPC
CRHGAW 0.0337 mg/L CR HEX 0.012. mg/L WC 841 mls
Too small

SAMPLE ID KL-I6-L SAMPLE # 04 FRACTIONS: A
Date & Time Collected 03/01/89 Category

AA DPC
CRHGAW 0.0216 mg/L CR HEX 0.010 mg/L WC 829 mls
To Small

Received: 03/01/89 Results by Sample

SAMPLE ID KL-16-TB SAMPLE # 05 FRACTIONS: A
Date & Time Collected 03/01/89 Category

CRHGAW 0.0058 mg/L CR HEX <0.003 mg/L WC 525 mls

To small

SAMPLE ID KL-15-TB SAMPLE # 06 FRACTIONS: A
Date & Time Collected 03/01/89 Category

CRHGAW 0.0163 mg/L CR HEX <0.003 mg/L WC 428 mls

Too Small

SAMPLE ID KL-156-PR SAMPLE # 07 FRACTIONS: A
Date & Time Collected 03/01/89 Category

CR HEX 55,000. mg/L CR L 51,000. mg/L

Hex higher than Total

Received: 03/01/89

TMA Inc. REPORT
03/08/89 14:34:51

Work Order # 89-__-011

Pacific Environmental Service

Two filters and five liquids were analyzed for hexavalent and total chromium content, according to EPA Method 425. The volumes of four liquids were measured. Please see the enclosed tables for the results.

... CA 91016 / (818) 357-3247 / FAX (818) 359-5036