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.

United States
Environmental Protection
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Office of Air Quality
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Research Triangle Park NC 27711

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SMELTING
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EPA

Arsenic
Non-Ferrous Smelters

AP-42
5th ed.
Section 12.3
#15

Emission Test Report
(Acid Plant)
Phelps-Dodge Copper
Smelter
Ajo, Arizona

EMISSION TESTING OF PHELPS-DODGE COPPER SMELTER

AJO, ARIZONA

TO

ENVIRONMENTAL PROTECTION AGENCY

Contract 68-02-2812

Work Assignment #15

January 12, 1978

By

Thomas Rooney

TRW

ENVIRONMENTAL ENGINEERING DIVISION

One Space Park, Redondo Beach, CA 90278

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TABLE 1

ESP Inlet #1 Arsenic/Sulfur Dioxide Results

RUN NUMBER	1		2		3		AVERAGE	
	ENGLISH UNITS	METRIC UNITS	ENGLISH UNITS	METRIC UNITS	ENGLISH UNITS	METRIC UNITS	ENGLISH UNITS	METRIC UNITS
I DATE	6/13/78	6/13/78	6/14/78 TEST	6/14/78 ABORTED	6/15/78	6/15/78		
II STACK PARAMETERS								
Pst - Static Pressure, "Hg (mmHg)	-.15	-3.81	---	---	-.15	-3.81	-.15	-3.81
Ps - Stack Gas Pressure, "Hg Absolute (mmHg)	27.95	709.9	---	---	27.91	70.9	27.93	709.4
% CO_2 - Volume % Dry	0.0	0.0	---	---	0.0	0.0	0.0	0.0
% O_2 - Volume % Dry	20.0	20.0	---	---	20.0	20.0	20.0	20.0
% SO_2 - Volume % Dry	3.83	3.83	---	---	4.18	4.18	4.01	4.01
% N_2 - Volume % Dry	76.17	76.17	---	---	75.82	75.82	76.00	76.00
Ts - Average Stack Temperature °F (°C)	378.8	192.67	---	---	404.5	207	391.7	199.8
% H_2O - % Moisture in Stack Gas, By Volume	0.0	0.0	---	---	4.04	4.04	2.02	2.02
As - Stack Area, ft^2 (m^2)	55.49	5.16	---	---	55.49	5.16	55.49	5.16
Md - Molecular Weight of Stack Gas, Dry Basis	30.18	30.18	---	---	30.30	30.30	30.24	30.24
Ms - Molecular Weight of Stack Gas, Wet Basis	30.18	30.18	---	---	29.80	29.80	29.99	29.99
Vs - Stack Gas Velocity, ft/sec, (m/sec)	14.34	4.37	---	---	14.63	4.46	14.50	4.42
Qa - Stack Gas Volumetric Flow at Stack Conditions, ACFM (Nm^3/min)	47697	1350.8	---	---	48682	1378.7	48191	1364.8
Qs - Stack Gas Volumetric Flow at Standard Conditions, DSCFM (Nm^3/min)	28075	795.1	---	---	26638	754.4	27358	774.8
% EA - Percent Excess Air	4.735	4.735	---	---	4.735	4.735	4.735	4.735
III TEST CONDITIONS								
Pb - Barometric Pressure, "Hg (mmHg)	28.10	713.74	---	---	28.06	712.72	---	---
Dn - Sampling Nozzle Diameter, in. (mm)	0.319	8.1	---	---	0.319	8.1	0.319	8.1
T - Sampling Time, min	144	144	---	---	144	144	144	144
Vm - Sample Volume, ACF (m^3)	61.739	1.75	---	---	43.510	1.23	52.60	1.49
Np - Net Sampling Points	48	48	---	---	48	48	48	48
Cp - Pitot Tube Coefficient	0.84	0.84	---	---	0.84	0.84	0.84	0.84
Tm - Average Meter Temperature °F (°C)	125.35	51.86	---	---	116.65	47.03	121.00	49.45
Pm - Average Orifice Pressure Drop, "H_2O (mmH_2O)	0.51	12.95	---	---	.27	6.86	0.39	9.91
Vlc - Condensate Collected (Impingers and Gel), mls	---	0.0	---	---	---	34	---	17
ΔP - Stack Velocity Head "H_2O (mmH_2O)	0.04	1.016	---	---	0.04	1.016	.04	1.016
IV TEST CALCULATIONS								
Vw - Condensed Water Vapor, SDCF (Nm^3)	0.0	0.0	---	---	1.56	0.0442	0.78	0.0221
Vm - Volume of Gas Sampled at Standard Conditions, DSCF (Nm^3)	52.07	1.47	---	---	37.17	1.05	44.49	1.26
% H_2O - Percent Moisture, By Volume	0.0	0.0	---	---	4.04	4.04	2.02	2.02
Ms - Molecular Weight of Stack Gas, Wet Basis	30.18	30.18	---	---	29.80	29.80	29.99	29.99
Vs - Stack Velocity, ft/sec (m/sec)	14.34	4.37	---	---	14.63	4.46	14.50	4.42
% I - Percent Isokinetic	126.4	126.4	---	---	95.2	95.2	110.8	110.8
V ANALYTICAL DATA								
A) Arsenic Front Half								
Probe (mg)	---	0.0024	---	---	---	0.0043	---	0.0034
Cyclone (mg)	---	---	---	---	---	---	---	---
Filter (mg)	---	0.0081	---	---	---	0.0194	---	0.0137
Arsenic Front Half Total (mg)	---	0.0105	---	---	---	0.0237	---	0.0171
ppm, (mg/m^3)	0.0023	0.0071	---	---	0.0074	0.0226	0.0049	0.0149
#/hr, (kg/hr)	0.0007	0.0003	---	---	0.0022	0.0010	0.0015	0.0007
B) Arsenic - Impinger Collection								
Impinger #1, 2 (mg)	---	0.0042	---	---	---	0.0956	---	0.0499
ppm, (mg/m^3)	0.0009	0.0029	---	---	0.0297	0.0910	0.0153	0.0470
#/hr, (kg/hr)	0.0002	0.0001	---	---	0.0091	0.0041	0.0046	0.0021
Impinger #3,4,5 (mg)	---	---	---	---	---	---	---	---
ppm, mg/m^3)	---	---	---	---	---	---	---	---
#/hr, (kg/hr)	---	---	---	---	---	---	---	---
C) Arsenic - Impinger Total (mg)	---	0.0042	---	---	---	0.0956	---	---
ppm, (mg/m^3)	0.0009	0.0029	---	---	0.0297	0.0910	---	---
#/hr, (kg/hr)	0.0002	0.0001	---	---	---	---	---	---
D) Total Arsenic (mg)	---	0.0147	---	---	---	0.1193	---	0.0670
ppm, (mg/m^3)	0.0033	0.0100	---	---	0.0371	0.1136	0.0202	0.0618
#/hr, (kg/hr)	0.0011	0.0005	---	---	0.0112	0.0051	0.0062	0.0028
E) Total SO_2 (mg)	---	151838.30	---	---	---	118103.79	---	13497.1
ppm	---	38335.7	---	---	---	41808.1	---	40071.9
(mg/m^3)	---	103291	---	---	---	112480	---	107885.5
#/hr, (kg/hr)	10863	4927.6	---	---	11224	5091.3	11044	5009.5

* change ratios to the smelter during test [illegible]
the above test data in Table C-44 of Low Arsenic [illegible]
NESHAP, EPA 450/3-83-010a p C 12

TABLE 2

ESP Inlet #2 Arsenic/Sulfur Dioxide Results

RUN NUMBER	1		2		3		AVERAGE	
	ENGLISH UNITS	METRIC UNITS	ENGLISH UNITS	METRIC UNITS	ENGLISH UNITS	METRIC UNITS	ENGLISH UNITS	METRIC UNITS
I DATE	6/13/78	6/13/78	6/14/78	6/14/78	6/15/78	6/15/78		
II STACK PARAMETERS								
P_{ST} - Static Pressure, "Hg (mmHg)	-.15	-3.81	-.15	-3.81	-.15	-3.81	-.15	-3.81
P_S - Stack Gas Pressure, "Hg Absolute (mmHg)	27.95	709.93	27.90	708.66	27.91	708.91	27.92	709.17
% CO_2 - Volume % Dry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% O_2 - Volume % Dry	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
% SO_2 - Volume % Dry	2.59	2.59	3.02	3.02	7.59	7.59	4.4	4.4
% N_2 - Volume % Dry	77.41	77.41	76.98	76.98	72.41	72.41	75.60	75.60
T_S - Average Stack Temperature °F (°C)	389.4	198.6	356.1	181.2	404.28	206.8	383.9	195.5
% H_2O - % Moisture in Stack Gas, By Volume	0.30	0.30	0.79	0.79	0.0	0.0	0.36	0.36
A_S - Stack Area, ft^2 (m^2)	55.49	5.16	55.49	5.16	55.49	5.16	55.49	5.16
M_D - Molecular Weight of Stack Gas, Dry Basis	29.73	29.73	29.89	29.89	31.53	31.53	30.38	30.38
M_S - Molecular Weight of Stack Gas, Wet Basis	29.69	29.69	29.80	29.80	31.53	31.53	30.34	30.34
V_S - Stack Gas Velocity, ft/sec, (m/sec)	17.78	5.42	14.24	4.34	15.42	4.70	15.81	4.82
Q_A - Stack Gas Volumetric Flow at Stack Conditions, ACFM (Nm^3/min)	59162	1675.5	47372	1341.6	51298.	1452.8	52612	1490.0
Q_S - Stack Gas Volumetric Flow at Standard Conditions, DSCFM (Nm^3/min)	34282	970.9	28312	801.8	29265	828.8	30621	867.2
% EA - Percent Excess Air	4.735	---	4.735	---	4.735	---	4.735	---
III TEST CONDITIONS								
P_B - Barometric Pressure, "Hg (mmHg)	28.10	713.74	28.05	712.47	28.06	712.72	28.07	713.16
D_N - Sampling Nozzle Diameter, in. (mm)	.319	8.1	.319	8.1	.319	8.1	.319	8.1
T - Sampling Time, min	144	144	144	144	144	144	144	144
V_M - Sample Volume, ACF (m^3)	73.23	2.07	45.23	1.28	49.73	1.41	56.07	1.59
N_P - Net Sampling Points	48	48	48	48	48	48	48	48
C_P - Pitot Tube Coefficient	.84	.84	.84	.84	.84	.84	.84	.84
T_M - Average Meter Temperature °F (°C)	127.0	52.8	123.65	50.9	118.38	84.0	123.01	50.6
P_M - Average Orifice Pressure Drop, "H_2O (mmH_2O)	.86	21.84	.89	7.37	.30	7.62	0.48	12.91
V_{LC} - Condensate Collected (Impingers and Gel), mls	---	4.0	---	6.6	---	0.0	---	3.53
ΔP - Stack Velocity Head "H_2O (mmH_2O)	0.60	1.524	0.40	1.016	0.047	1.194	0.049	1.245
IV TEST CALCULATIONS								
V_W - Condensed Water Vapor, SDCF (Nm^3)	0.18	0.0052	0.38	0.0086	0.0	0.00	0.16	.0046
V_M - Volume of Gas Sampled at Standard Conditions, DSCF (Nm^3)	61.65	1.75	38.17	1.08	42.37	1.20	47.40	1.34
% H_2O - Percent Moisture, By Volume	0.30	0.30	0.79	0.79	0.0	0.0	0.36	0.36
M_S - Molecular Weight of Stack Gas, Wet Basis	29.69	29.69	29.80	29.80	31.53	31.53	30.34	30.34
V_S - Stack Velocity, ft/sec (m/sec)	17.78	5.42	14.24	4.34	15.42	4.70	15.81	4.82
% I - Percent Isokinetic	123.2	123.2	92.1	92.1	99.0	99.0	106.6	106.6
V ANALYTICAL DATA								
A) Arsenic Front Half								
Probe (mg)	---	0.126	---	0.0045	---	0.0026	---	0.0444
Cyclone (mg)	---	---	---	---	---	---	---	---
Filter (mg)	---	0.0033	---	0.022	---	0.0098	---	0.0117
Arsenic Front Half Total (mg)	---	0.1293	---	0.0265	---	0.0124	---	0.0561
ppm, (mg/m^3)	0.0241	0.0739	0.0080	0.0245	0.0034	0.0103	0.0118	0.0362
#/hr, (kg/hr)	0.0095	0.0043	0.0026	0.0012	0.0011	0.0005	0.0044	0.0020
B) Arsenic - Impinger Collection								
Impinger #1, 2 (mg)	---	0.0037	---	0.0057	---	0.0265	---	0.0120
ppm, (mg/m^3)	0.0007	0.0021	0.0017	0.0053	0.0072	0.0221	0.0032	0.0098
#/hr, (kg/hr)	0.0002	0.0001	0.0007	0.0003	0.0024	0.0011	0.0011	0.0005
Impinger #3,4,5 (mg)	---	---	---	---	---	---	---	---
ppm, mg/m^3)	---	---	---	---	---	---	---	---
#/hr, (kg/hr)	---	---	---	---	---	---	---	---
C) Arsenic - Impinger Total (mg)	---	0.0037	---	0.0057	---	0.0265	---	0.0120
ppm, (mg/m^3)	0.0007	0.0021	0.0017	0.0053	0.0072	0.0221	0.0032	0.0098
#/hr, (kg/hr)	0.0002	0.0001	0.0007	0.0003	0.0024	0.0011	0.0011	0.0005
D) Total Arsenic (mg)	---	0.1330	---	0.0322	---	0.0309	---	0.0654
ppm, (mg/m^3)	0.0248	0.076	0.0097	0.0298	0.0085	0.026	0.0069	0.211
#/hr, (kg/hr)	0.0097	0.0044	0.0031	0.0014	0.0029	0.0013	0.0053	0.0024
E) Total SO_2 (mg)	---	120066.34	---	87900.68	---	234702.97	---	147556.65
ppm	---	25931.20	---	30290.87	---	75960.29	---	44061.01
(mg/m^3)	---	58609	---	81390	---	195586	---	115195
#/hr, (kg/hr)	7581.7	3411.8	8922.9	4047.4	21442	9726.1	12629	5728.4