AIR SCIENCES INC. DENVER • PORTLAND	ENGINEERING CALCULATIONS	PROJECT TITLE: Solvay Minerals Inc.	BY: Ejaz Memon		
		PROJECT NO: 170-4	PAGE: 1	OF: 4	SHEET: 1
		SUBJECT: Calciners A and B Emissions	DATE: November 15, 2002		

CALCINERS A & B (SOURCE # 17)

SOURCE CHARACTERISTICS

	Units	Existing	Modified
Control Device		ESP	ESP
Exhaust Flow Rate	ACFM	312,000	650,000
Trona Feed Capacity	TPH	400	320
Thermal Capacity	MMBtu/hr	500	400
Operation Schedule	hrs/yr	8,760	8,760
Fuel Type		Natural Gas	Sub-bituminous Coal

POTENTIAL EMISSION DIFFERENCE (tpy)

Pollutant	Existing	Modified	Difference
PM_{10}	97.7	180.2	82.5
NOx	131.4	788.4	657.0
CO	6,675.1	5,532.7	-1,142.4
VOC	3,398.9	2,714.0	-684.9

EMISSION DIFFERENCE FOR COMPARISON TO MAJOR SOURCE TRIGGER THRESHOLDS (tpy)

Pollutant	Existing Actual [a]	Modified PTE	Difference
PM_{10}	32.4	180.2	147.8
NOx	49.2	788.4	739.2
CO	1,077.4	5,532.7	4,455.3
VOC	1,199.2	2,714.0	1,514.7

[a] *Average of years 2,000 and 2,001 actual emissions, as reported to WYDEQ*

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MODIFIED CONDITIONS
CALCINERS A & B (SOURCE # 17)

SOURCE CHARACTERISTICS

			Reference
Furnace Type	Detroit Stoker Underthrow Fuel (Pneumatically Assisted) Spreader		
Control Device	ESP		
Exhaust Flow Rate	650,000	ACFM	Solvay
	240,000	DSCFM	Solvay
Trona Feed Capacity	320	TPH	Solvay
Thermal Capacity	400	MMBtu/hr	Solvay
Operation Schedule	8,760	hrs/yr	Solvay

FUEL DATA

Fuel Type	Sub-Bituminous Coal			Solvay
Heating Value	10,150	Btu/lb		Solvay
	20.3	MMBtu/ton		
Fuel Consumption	19.7	ton/hr	400 MMBtu / hr	ton / 20.3 MMBtu

EMISSION FACTORS

Pollutant	**Emission Factor**					
PM_{10}	0.02	grain/DSCF			Manufacturer Guarantee for ESP	
	41.1	lb/hr	0.02 grain / DSCF	240,000 DSCF / min	1 lb / 7000 grain	60 min / hr
NOx	0.45	lb/MMBtu			Manufacturer Guarantee	
CO	5	lb/ton-coal			AP-42, Table 1.1-3 (Spreader Stoker)	
	0.19	lb/MMBtu			AP-42, Table 1.1-3 (Based on 26 MMBtu/ton)	
CO (process)	3.7	lb/ton-trona			See Calculations on Sheet 4	
VOC	0.05	lb/ton-coal			AP-42, Table 1.1-19 (Spreader Stoker)	
VOC (process)	1.9	lb/ton-trona			See Calculations on Sheet 4	

POTENTIAL EMISSIONS

Pollutant	g/sec	lb/hr	tpy
PM_{10}	5.18	41.1	180.2
NOx	22.68	180.0	788.4
CO	159.16	1,263.2	5,532.7
VOC	78.07	619.6	2,714.0

STACK PARAMETERS

Location	603,686	m East
	4,594,808	m North
Stack Height	55.02	m
Stack Diameter	3.66	m
Exhaust Temperature	400	^{o} F
Exhaust Velocity	29.2	m/s

Numbers in blue are entries, and black are calculations

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EXISTING CONDITIONS

CALCINERS A & B (SOURCE # 17)

SOURCE CHARACTERISTICS

			Reference
Control Device	ESP		Permit 30-126
Exhaust Flow Rate	312,000	ACFM	Permit 30-126
Trona Feed Capacity	400	TPH	Permit 30-126
Thermal Capacity	500	MMBtu/hr	Permit 30-126
Operation Schedule	8,760	hrs/yr	

POTENTIAL EMISSIONS

Pollutant	lb/hr	tpy	
PM_{10}	22.3	97.7	Permit 30-126
SO_2	0.0	0.0	Permit 30-126
NOx	30.0	131.4	Permit 30-126
CO	1,524.0	6,675.1	Permit CT-1347
VOC	776.0	3,398.9	Permit CT-1347

ACTUAL EMISSIONS [a]

Pollutant	2000 tpy	2001 tpy	Average tpy
PM_{10}	40.2	24.5	32.4
NOx	64.5	33.9	49.2
CO	1,322.0	832.8	1,077.4
VOC	1,446.1	952.3	1,199.2

[a] *Provided by Solvay Minerals Inc. as reported to WYDEQ as per requirement of permit 30-126*

STACK PARAMETERS

Location	603,686	m East
	4,594,808	m North
Stack Height	55.02	m
Stack Diameter	3.66	m
Exhaust Temperature	375	^{o} F
Exhaust Velocity	13.41	m/s

Numbers in blue are entries, and black are calculations

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CALCINERS A & B (SOURCE # 17) - ESTIMATION OF CO AND VOC EMISSION FACTORS (PROCESS ONLY)

EXISTING CONDITIONS

			Reference
Thermal Capacity	500	MMBtu/hr	Permit 30-126
Trona Feed Capacity	400	TPH	Permit 30-126
Total CO (Process + Combustion) Emissions	1524	lb/hr	Permit CT-1347
CO (Natural Gas Combustion) Emissions	84	lb/MMScf	AP-42 Table 1.4-1
	0.08	lb/MMBtu	(Based on 1,020 Btu/Scf)
	41.2	lb/hr	
CO (Process) Emissions	1482.8	lb/hr	
	3.7	lb/ton-ore	
Total VOC (Process + Combustion) Emissions	776.0	lb/hr	Permit CT-1347
VOC (Natural Gas Combustion) Emissions	5.5	lb/MMScf	AP-42 Table 1.4-2
	0.005	lb/MMBtu	(Based on 1,020 Btu/Scf)
	2.7	lb/hr	
VOC (Process) Emissions	773.3	lb/hr	
	1.9	lb/ton-ore	

Numbers in blue are entries, and black are calculations

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		SUBJECT: New Coal Bunker Baghouse Emissions	DATE: December 2, 2002		

NEW COAL BUNKER BAGHOUSE EMISSIONS (SOURCE # 100)

SOURCE CHARACTERISTICS

			Reference
Control Device	Baghouse		
Exhaust Flow Rate	3,000	ACFM	Solvay
	2,366	DSCFM	Solvay
Operation Schedule	8,760	hrs/yr	Solvay

EMISSION FACTORS

Pollutant	**Emission Factor**						
PM_{10}	0.01	grain/DSCF				Manufacturer Guarantee	
	0.2	lb/hr	0.01 grain / DSCF	2,366 DSCF / min	1 lb / 7000 grain	60 min / hr	

POTENTIAL EMISSIONS

Pollutant	**g/sec**	**lb/hr**	**tpy**
PM_{10}	0.02555	0.2	0.9

STACK PARAMETERS

Location	603,681	m East
	4,594,817	m North
Stack Height	38.40	m
Stack Diameter	0.3048	m
Exhaust Temperature	Ambient	^{o} F
Exhaust Velocity	19.4	m/s

Numbers in blue are entries, and black are calculations

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		SUBJECT: VOC Impact Analysis	DATE: February 4, 2003		

Sheet C.1: Estimation of O_3 Increment from VOC and NO_x Emissions
Using VOC/NOx Point Source Screening Tables (Richard D. Scheffe)

VOC Emission	1514.74	tpy
NOx Emission	739.23	tpy
VOC/NOx Ratio	2.0	

Using Table 1 of VOC/NOx Point Source Screening Tables for Rural Conditions
The applicable column in Table 1 is column 3:

Column 3 value for VOC emission rate of	1500	tpy is	3.3	pphm
Column 3 value for VOC emission rate of	2000	tpy is	3.7	pphm

By linear interpolation:

Column 3 value for VOC emission rate of	1515	tpy is	3.312	pphm

Thus, the O_3 increment from VOC emission is 0.033 ppm $\frac{3.31 \text{ pphm}}{} \cdot \frac{1 \text{ ppm}}{100 \text{ pphm}}$

3.31E-08 m^3 O_3 increment per m^3 of air

At ambient conditions (20 °C, 1 atm), 1 mole of a gas occupies 0.024057 m^3

3.31179E-08 m^3 O_3 /m^3 equals 1.377E-06 mole/m^3 $\frac{1 \text{ mole}}{0.024057 \text{ m}^3} \cdot \frac{3.3118\text{E-08 m}^3 \text{ O}_3}{}$

6.608E-05 g/m^3 $\frac{0.000001 \text{ mole O}_3}{} \cdot \frac{48 \text{ g}}{\text{mole O}_3}$

66.1 ug/m^3 $\frac{6.608\text{E-05 g}}{\text{m}^3} \cdot \frac{1000000 \text{ ug}}{\text{g}}$

Background O_3 Concentration	161	ug/m^3
Ambient O_3 Concentration	227.1	ug/m^3

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		SUBJECT: Scheffe's Screening Table 1	DATE: February 4, 2003		

Sheet C.2: Table 1. Rural based O_3 increment (pphm) as a function of NMOC emissions and NMOC/NOx ratios

NMOC EMISSIONS (TONS/YR)	NMOC/NOx TONS NMOC/TONS NOx (PPMC/PPM) > 20.7 (> 20) (COL 1)	5.2 - 20.7 (5 - 20) (COL 2)	< 5.2 (<5) (COL 3)
50	0.4	0.4	1.1
75	0.4	0.4	1.2
100	0.4	0.5	1.4
300	0.8	1.0	1.7
500	1.1	1.4	1.9
750	1.6	1.9	2.3
1000	2.0	2.4	2.7
1500	2.7	3.0	3.3
2000	3.4	3.8	3.7
3000	4.8	5.2	4.3
5000	7.0	7.5	4.8
7500	9.8	10.1	5.1
10000	12.2	12.9	5.4

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		SUBJECT: HAP Emissions and Impacts	DATE: February 13, 2003		

Sheet C.3: HAP Impact and Risk Assessment

Source 17 NO_x Emissions and Maximum Annual Impact

Source	Emission g/sec	Maximum Impact ug/m^3
Source 17	21.266	0.634

HAP Emissions Based on AP-42 Tables 1.1-14 and 1.1-18 (ESP Controlled Emission Factors)

HAP	Emission Factor lb/ton	Emission lb/hr [a]	Emission g/sec
Arsenic	4.1E-04	8.1E-03	1.0E-03
Benzene	1.3E-03	2.6E-02	3.2E-03
Beryllium	2.1E-05	4.1E-04	5.2E-05
Ethylbenzene	9.4E-05	1.9E-03	2.3E-04
Formaldehyde	2.4E-04	4.7E-03	6.0E-04
Hexane	6.7E-05	1.3E-03	1.7E-04
Mercury	8.3E-05	1.6E-03	2.1E-04
Toluene	2.4E-04	4.7E-03	6.0E-04
Xylene	3.7E-05	7.3E-04	9.2E-05

[a] Based on 19.7 ton/hr coal consumption

Estimated Maximum Impacts Compared with Chronic Effect Thresholds and Risk Factors

HAP	Chronic Effect Threshold mg/m^3	Chronic Effect Threshold ug/m^3	Source	Maximum Impact [b] ug/m^3	Risk Factor 10^{-6}	Cancer Risk	Chronic Threshold Exceeded
Arsenic	5.0E-05	5.0E-02	IRIS [c]	3.0E-05	2.0E-04	1.5E-07	NO
Benzene	6.0E-02	6.0E+01	CalEPA [d]	9.6E-05	1.3E-01	7.4E-10	NO
Beryllium	2.0E-05	2.0E-02	IRIS [c]	1.6E-06	4.0E-04	3.9E-09	NO
Ethylbenzene	1.0E+00	1.0E+03	IRIS [c]	7.0E-06	N/A	N/A	NO
Formaldehyde	4.0E-03	4.0E+00	ATSDR [e]	1.8E-05	8.0E-02	2.2E-10	NO
Hexane	2.0E-01	2.0E+02	IRIS [c]	5.0E-06	N/A	N/A	NO
Mercury	3.0E-04	3.0E-01	IRIS [c]	6.1E-06	N/A	N/A	NO
Toluene	4.0E-01	4.0E+02	IRIS [c]	1.8E-05	N/A	N/A	NO
Xylene	4.0E-01	4.0E+02	ATSDR [e]	2.7E-06	N/A	N/A	NO
Cumulative Risk						**1.6E-07**	

[b] Annual maximum impacts calculated as toxin emission rate times the ratio of NO_x impact to NO_x emission rate

[c] EPA Integrated Risk Information System (IRIS) Inhalation Reference Concentration (RfC)

[d] California EPA (CalEPA) Chronic Reference Exposure Level

[e] Agency for Toxic Substances and Disease Registry (ATSDR) Chronic Exposure Minimal Risk Level (MRL)

Sample Calculations:

Arsenic Emission 8.1E-03 lb/hr

$$\frac{4.1E\text{-}04\ \text{lb-As}}{\text{ton-coal}} \cdot \frac{19.70\ \text{ton-coal}}{\text{hr}}$$

1.0E-03 g/sec

$$\frac{8.1E\text{-}03\ \text{lb-As}}{\text{hr}} \cdot \frac{453.6\ \text{g}}{\text{lb}} \cdot \frac{1\ \text{hr}}{3600\ \text{sec}}$$

Arsenic Impact 3.0E-05 ug/m^3

$$\frac{0.63404\ \text{ug-NO}_x}{\text{m}^3} \cdot \frac{1\ \text{sec}}{21.27\ \text{g-NOx}} \cdot \frac{1.0E\text{-}03\ \text{g-As}}{\text{sec}}$$

Arsenic Risk 1.5E-07

$$\frac{3.0E\text{-}05\ \text{ug-As}}{\text{m}^3} \cdot \frac{\text{m}^3}{2.0E\text{-}04\ \text{ug-As}} \cdot \frac{1}{1.0E+06}$$