

**REDACTED TO REMOVE PROPRIETARY BUSINESS INFORMATION**

# **REPORT**

## **FLASH DRYERS AIR EMISSIONS TEST**

*Prepared for*

**Omya Inc**  
Florence, Vermont

*Prepared by*

**TRC Environmental Corporation**  
Windsor, Connecticut

June 19, 2006

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*Prepared for*  
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*Prepared by*  
TRC Environmental Corporation  
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June 19, 2006

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## **1.0 INTRODUCTION**

TRC Environmental Corporation (TRC) was retained by Omya Inc (Omya) to conduct air emissions testing on flash dryers operated at the Florence, Vermont facility. The primary purpose of the testing was to quantify emission rates of all exhaust gas constituents to determine which, when further evaluated via dispersion modeling, may result in detectable odor at the property boundary. A secondary purpose was emission rate quantification of all con-combustion related constituents for comparison to Action Levels to determine if any need to be addressed under Section 5-261. The emissions test and health risk assessment comprise the third and final phase of a work plan submitted to the Vermont Department of Environmental Conservation (DEC) relative to odor complaints

The test program was conducted on May 3-4, 2006 under the supervision of Mr. Jim Canora of TRC. Mr. Michael Laurent of Omya provided coordination between testing and unit operation.

The Omya East Plant in Florence operates two flash dryers (dryers #4 and #5) exhausted through separate stacks. The dryers are used in a mineral processing operation that involves the mixing/coating of a food grade, vegetable-based stearic acid with/onto calcium carbonate powder in a hot air stream resulting directly from the external combustion of #2 fuel oil. Air emissions are potentially generated from thermal decomposition of stearic acid and incomplete combustion of the fuel oil; DEC developed an air emissions target compound list based on these two methods of generation. The primary target compounds are aldehydes and ketones (including formaldehyde and acrolein), which are potentially generated from both stearic acid decomposition and fuel oil incomplete combustion. Other target compounds include volatile and semi-volatile organic compounds.

The emissions test strategy was to use three test methods to measure emissions of a broad range of EPA recognized organic air pollutants potentially emitted from the two dryers. The test methods included an aldehydes and ketones method, a method for volatile organic compounds, and a method for semi-volatile organic compounds. Each method has a specific target compound list, and the target lists for the volatiles and semi-volatiles were expanded to include tentatively identified compounds based on the mass spectrometry ion matching technique.

Testing was conducted under two process conditions including normal production and baseline. During the baseline tests, no raw materials were introduced to the dryers and only hot

combustion air and water (for temperature control purposes) were in the flash dryers. The purpose of sampling the baseline condition was to determine what air contaminants are generated from combustion, so that they could be accounted for in the normal production condition. The stearic acid application during the normal production portion of the testing was maintained at the target rate of [ ] as measured on the product.

Under each condition, triplicate or quadruplicate samples were collected on each of the two flash dryer stacks. Gas flow rate, molecular weight, and moisture content were measured in accordance with EPA Methods 1, 2, 3, and 4 and pollutant concentrations were measured according to the methods shown in the table below.

Sampling Location	Target Pollutants	Test Method	Number and Duration of Tests (at each process condition)
Dryer No. 4 Stack	aldehydes and ketones	CARB Method 430	3, 60-minute
	volatile organics	SW-846 0030 (VOST)	4, 40-minute
	semi-volatile organics	SW-846 0010	3, 180-minute
Dryer No. 5 Stack	aldehydes and ketones	CARB Method 430	3, 60-minute
	volatile organics	SW-846 0030 (VOST)	4, 40-minute
	semi-volatile organics	SW-846 0010	3, 180-minute

Section 2 of this report presents a summary of results and Section 3 presents descriptions of the mineral processing operation. Section 4 outlines the sampling and analytical methods and Section 5 outlines quality assurance.

## **2.0 SUMMARY OF RESULTS**

The tests showed that carbonyl compounds were the primary organic compounds emitted during normal dryer operation and that the same compounds were not emitted during the baseline operation. Table 2-1 presents average emission concentrations of the primary compounds detected on both dryers and Table 2-2 presents the average mass emission rates; fuel firing rate and production rate are also included in these tables. The compounds reported in these two tables represent all of the CARB Method 430 target compounds, three volatile organic target compounds (2-butanone, benzene and 2-hexanone) detected with Method 0030, and phenol and n-hexadecanoic acid detected with Method 0010. Other compounds, detected at low levels or detected inconsistently over the replicate tests, were excluded from Tables 2-1 and 2-2; however, complete data are contained in the appendices.

### **2.1 Modified CARB Method 430**

Carbonyl compounds including aldehydes and ketones were consistently measured at elevated levels during normal operation as compared to baseline. Formaldehyde, acetaldehyde, acrolein, propionaldehyde and other aldehyde emissions were elevated during the normal production tests on both dryers. Tables 2-3 and 2-4 present the complete CARB Method 430 test results for each dryer and sampling and analytical data are contained in Appendix A.

### **2.2 SW-846 Method 0030 (VOST)**

VOST samples showed elevated emission of several compounds during the normal production tests; however, the concentrations were much lower than the aldehydes. Three compounds reported in Tables 2-1 and 2-2 represent the primary compounds detected with the VOST method; these compounds include 2-butanone, benzene and 2-hexanone. Complete results and all sampling and analytical data are contained in Appendix B.

### **2.3 SW-846 Method 0010 (Semi-Volatiles)**

Method 0010 samples showed elevated emissions of only a single target compound during the normal production tests. The one target compound was phenol and the concentrations were low relative to the carbonyl compounds. Complete results and all sampling and analytical data are

contained in Appendix B.

The semi-volatile tests also showed elevated concentrations of several phthalate compounds and n-hexadecanoic acid. Most of the phthalate compounds were at higher levels during the baseline tests with lower levels on subsequent tests. The decreasing phthalate emissions indicate that they were likely generated from the higher gas temperature that occurred during baseline. Phthalates are a class of organic compounds normally detected in processes involving plastics, and emissions may have occurred temporarily from heated plastic components.

TABLE 2-1  
FLASH DRYERS EMISSIONS TEST - CONCENTRATION SUMMARY  
Omya - Florence, Vermont  
May 3-4, 2006

Dryer No Operating Condition	Dryer No. 4			Dryer No. 5	
	No Product	Normal		No Product	Normal
<b><u>Operating</u></b>					
Fuel Firing Rate (liters/minute)	[ ]	[ ]		[ ]	[ ]
Production Rate (tons-short/hour)	[ ]	[ ]		[ ]	[ ]
<b><u>Exhaust Gas Physical Data</u></b>					
Flow Rate (acfm)	13301	15459		10354	12903
Velocity (m/s)	37.5	44.4		29.7	37.0
Temperature (°F)	239	204		220	196
Moisture (%)	7.7	18.5		6.1	15.8
<b><u>Average Emission Concentration (ug/dscm)</u></b>					
<b><u>CARB Method 430</u></b>					
Formaldehyde	<383	8835		<122	12422
Acetaldehyde	<223	6592		<136	7783
Acetone	<1564	<1697		<1586	<2477
Acrolein	<46	2177		<46	1963
Propionaldehyde	<36	3030		<46	2857
Crotonaldehyde	<56	1325		<46	1806
Butyraldehyde	<36	2368		<46	2961
Benzaldehyde	<385	<1055		<419	<1528
Isovaleraldehyde	<50	1684		<46	2131
Valeraldehyde	<36	3276		<46	2473
o-Tolualdehyde	<36	286		<46	270
m & p-Tolualdehyde	<36	1105		<46	1124
Hexaldehyde	<36	2548		<46	2128
2,5-Dimethylbenzaldehyde	<36	<264		<46	<35
<b><u>SW-846 Method 0030</u></b>					
2-Butanone	4.17	60.1		4.73	97.2
Benzene	10.5	27.9		5.32	19.8
2-Hexanone	2.83	53.7		6.32	101
<b><u>SW-846 Method 0010</u></b>					
Phenol	81.7	198		38.8	189
n-Hexadecanoic Acid	169	313		3775	2460

TABLE 2-2  
FLASH DRYERS EMISSIONS TEST - MASS EMISSION SUMMARY

Omya - Florence, Vermont - May 3-4, 2006

Dryer No	Dryer No. 4			Dryer No. 5	
	No Product	Normal		No Product	Normal
<b>Operating Condition</b>					
<b>Operating</b>					
Fuel Firing Rate (liters/minute)	[ ]	[ ]		[ ]	[ ]
Production Rate (tons-short/hour)	[ ]	[ ]		[ ]	[ ]
<b>Exhaust Gas Physical Data</b>					
Flow Rate (acfm)	13301	15459		10354	12903
Velocity (m/s)	37.5	44.4		29.7	37.0
Temperature (°F)	239	204		220	196
Moisture (%)	7.7	18.5		6.1	15.8
<b>Average</b>					
<b>Emission Rate (lb/hour)</b>					
<u>CARB Method 430</u>					
Formaldehyde	<0.013	0.322		<0.003	0.396
Acetaldehyde	<0.008	0.241		<0.004	0.248
Acetone	<0.053	<0.062		<0.044	<0.079
Acrolein	<0.002	0.079		<0.001	0.063
Propionaldehyde	<0.001	0.111		<0.001	0.091
Crotonaldehyde	<0.002	0.048		<0.001	0.058
Butyraldehyde	<0.001	0.086		<0.001	0.094
Benzaldehyde	<0.013	<0.038		<0.012	<0.049
Isovaleraldehyde	<0.002	0.061		<0.001	0.068
Valeraldehyde	<0.001	0.120		<0.001	0.079
o-Tolualdehyde	<0.001	0.010		<0.001	0.009
m & p-Tolualdehyde	<0.001	0.040		<0.001	0.036
Hexaldehyde	<0.001	0.093		<0.001	0.068
2,5-Dimethylbenzaldehyde	<0.001	<0.010		<0.001	<0.001
<u>SW-846 Method 0030</u>					
2-Butanone	0.00014	0.0022		0.00013	0.0027
Benzene	0.00036	0.0010		0.00015	0.0005
2-Hexanone	0.00010	0.0020		0.00018	0.0028
<u>SW-846 Method 0010</u>					
Phenol	0.0028	0.0072		0.0011	0.006
n-Hexadecanoic Acid	0.0057	0.0114		0.107	0.078

TABLE 2-3  
 DRYER 4 - ALDEHYDES AND KETONES EMISSIONS TEST SUMMARY  
 Modified CARB Method 430  
 Omya - Florence, Vermont - May 3-4, 2006

Operating Condition	No Product				Normal Operation			
	5/3/2006 1440-1540 D4-1	5/3/2006 1753-1853 D4-2	5/3/2006 1903-2003 D4-3	Average	5/4/2006 1232-1332 D4-4	5/4/2006 1337-1437 D4-5	5/4/2006 1539-1639 D4-6	Average
Fuel Oil Firing Rate (gpm)								
Production Rate (tons/hour)								
<b><u>Emission Concentration (ug/liter)</u></b>								
Formaldehyde	<0.31	<0.46	<0.38	<0.38	14.90	4.84	6.77	8.84
Acetaldehyde	<0.19	<0.25	<0.23	<0.22	11.17	3.59	5.01	6.59
Acetone	<1.34	<1.44	<1.91	<1.56	<2.20	<1.34	<1.55	<1.70
Acrolein	<0.04	<0.07	<0.03	<0.05	3.51	1.47	1.55	2.18
Propionaldehyde	<0.04	<0.04	<0.03	<0.04	5.35	1.55	2.18	3.03
Crotonaldehyde	<0.04	<0.04	<0.10	<0.06	1.99	0.88	1.11	1.32
Butyraldehyde	<0.04	<0.04	<0.03	<0.04	5.24	0.76	1.11	2.37
Benzaldehyde	<0.36	<0.48	<0.32	<0.39	<1.27	<0.81	<1.09	<1.05
Isovaleraldehyde	<0.04	<0.08	<0.03	<0.05	2.67	1.11	1.27	1.68
Valeraldehyde	<0.04	<0.04	<0.03	<0.04	5.97	1.64	2.22	3.28
o-Tolualdehyde	<0.04	<0.04	<0.03	<0.04	0.58	0.04	0.24	0.29
m & p-Tolualdehyde	<0.04	<0.04	<0.03	<0.04	2.07	0.46	0.79	1.11
Hexaldehyde	<0.04	<0.04	<0.03	<0.04	4.66	1.20	1.79	2.55
2,5-Dimethylbenzaldehyde	<0.04	<0.04	<0.03	<0.04	0.72	<0.04	<0.04	<0.26
<b><u>Emission Concentration (ppm)</u></b>								
Formaldehyde	<0.25	<0.37	<0.30	<0.31	11.94	3.88	5.42	7.08
Acetaldehyde	<0.10	<0.13	<0.12	<0.12	5.97	1.92	2.68	3.52
Acetone	<0.56	<0.60	<0.79	<0.65	<0.91	<0.56	<0.64	<0.70
Acrolein	<0.02	<0.03	<0.01	<0.02	1.51	0.63	0.67	0.93
Propionaldehyde	<0.02	<0.01	<0.01	<0.01	2.22	0.64	0.91	1.26
Crotonaldehyde	<0.01	<0.01	<0.03	<0.02	0.68	0.30	0.38	0.46
Butyraldehyde	<0.01	<0.01	<0.01	<0.01	1.75	0.25	0.37	0.79
Benzaldehyde	<0.08	<0.11	<0.07	<0.09	<0.29	<0.18	<0.25	<0.24
Isovaleraldehyde	<0.01	<0.02	<0.01	<0.01	0.75	0.31	0.36	0.47
Valeraldehyde	<0.01	<0.01	<0.01	<0.01	1.67	0.46	0.62	0.92
o-Tolualdehyde	<0.01	<0.01	<0.01	<0.01	0.12	0.01	0.05	0.06
m & p-Tolualdehyde	<0.01	<0.01	<0.01	<0.01	0.42	0.09	0.16	0.22
Hexaldehyde	<0.01	<0.01	<0.01	<0.01	1.12	0.29	0.43	0.61
2,5-Dimethylbenzaldehyde	<0.01	<0.01	<0.01	<0.01	0.13	<0.01	<0.01	<0.05
<b><u>Mass Emission Rate (lb/hour)</u></b>								
Formaldehyde	<0.011	<0.016	<0.013	<0.013	0.54	0.18	0.25	0.32
Acetaldehyde	<0.007	<0.008	<0.008	<0.008	0.41	0.13	0.18	0.24
Acetone	<0.046	<0.049	<0.065	<0.053	<0.08	<0.05	<0.06	<0.06
Acrolein	<0.001	<0.002	<0.001	<0.002	0.13	0.05	0.06	0.08
Propionaldehyde	<0.001	<0.001	<0.001	<0.001	0.20	0.06	0.08	0.11
Crotonaldehyde	<0.001	<0.001	<0.003	<0.002	0.07	0.03	0.04	0.05
Butyraldehyde	<0.001	<0.001	<0.001	<0.001	0.19	0.03	0.04	0.09
Benzaldehyde	<0.012	<0.017	<0.011	<0.013	<0.05	<0.03	<0.04	<0.04
Isovaleraldehyde	<0.001	<0.003	<0.001	<0.002	0.10	0.04	0.05	0.06
Valeraldehyde	<0.001	<0.001	<0.001	<0.001	0.22	0.06	0.08	0.12
o-Tolualdehyde	<0.001	<0.001	<0.001	<0.001	0.02	0.00	0.01	0.01
m & p-Tolualdehyde	<0.001	<0.001	<0.001	<0.001	0.08	0.02	0.03	0.04
Hexaldehyde	<0.001	<0.001	<0.001	<0.001	0.17	0.04	0.07	0.09
2,5-Dimethylbenzaldehyde	<0.001	<0.001	<0.001	<0.001	0.03	<0.00	<0.00	<0.01

TABLE 2-4  
 DRYER 5 - ALDEHYDES AND KETONES EMISSIONS TEST SUMMARY  
 Modified CARB Method 430  
 Omya - Florence, Vermont - May 3-4, 2006

Operating Condition	No Product				Normal Operation			
	5/3/2006 1327-1427 D5-1	5/3/2006 1644-1744 D5-2	5/3/2006 1849-1949 D5-3	Average	5/4/2006 0826-0926 D5-4	5/4/2006 0955-1055 D5-5	5/4/2006 1109-1209 D5-6	Average
Fuel Oil Firing Rate (gpm)								
Production Rate (tons/hour)								
<b><u>Emission Concentration (ug/liter)</u></b>								
Formaldehyde	<0.11	<0.18	<0.08	<0.12	no data	17.51	7.33	12.42
Acetaldehyde	<0.14	<0.17	<0.10	<0.14		10.38	5.18	7.78
Acetone	<1.29	<1.73	<1.74	<1.59		<3.09	<1.87	<2.48
Acrolein	<0.06	<0.04	<0.04	<0.05		2.71	1.22	1.96
Propionaldehyde	<0.06	<0.04	<0.04	<0.05		3.67	2.04	2.86
Crotonaldehyde	<0.06	<0.04	<0.04	<0.05		2.37	1.24	1.81
Butyraldehyde	<0.06	<0.04	<0.04	<0.05		3.94	1.98	2.96
Benzaldehyde	<0.44	<0.47	<0.35	<0.42		<1.17	<1.88	<1.53
Isovaleraldehyde	<0.06	<0.04	<0.04	<0.05		2.43	1.83	2.13
Valeraldehyde	<0.06	<0.04	<0.04	<0.05		3.19	1.76	2.47
o-Tolualdehyde	<0.06	<0.04	<0.04	<0.05		0.50	<0.04	0.27
m & p-Tolualdehyde	<0.06	<0.04	<0.04	<0.05		1.55	0.69	1.12
Hexaldehyde	<0.06	<0.04	<0.04	<0.05		2.70	1.55	2.13
2,5-Dimethylbenzaldehyde	<0.06	<0.04	<0.04	<0.05		<0.03	<0.04	<0.03
<b><u>Emission Concentration (ppm)</u></b>								
Formaldehyde	<0.09	<0.14	<0.06	<0.10	no data	14.04	5.88	9.96
Acetaldehyde	<0.08	<0.09	<0.05	<0.07		5.55	2.77	4.16
Acetone	<0.53	<0.72	<0.72	<0.66		<1.28	<0.78	<1.03
Acrolein	<0.03	<0.02	<0.02	<0.02		1.16	0.52	0.84
Propionaldehyde	<0.03	<0.02	<0.01	<0.02		1.52	0.85	1.18
Crotonaldehyde	<0.02	<0.01	<0.01	<0.02		0.82	0.43	0.62
Butyraldehyde	<0.02	<0.01	<0.01	<0.02		1.32	0.66	0.99
Benzaldehyde	<0.10	<0.11	<0.08	<0.09		<0.27	<0.43	<0.35
Isovaleraldehyde	<0.02	<0.01	<0.01	<0.01		0.68	0.51	0.60
Valeraldehyde	<0.02	<0.01	<0.01	<0.01		0.89	0.49	0.69
o-Tolualdehyde	<0.01	<0.01	<0.01	<0.01		0.10	<0.01	0.05
m & p-Tolualdehyde	<0.01	<0.01	<0.01	<0.01		0.31	0.14	0.23
Hexaldehyde	<0.01	<0.01	<0.01	<0.01		0.65	0.37	0.51
2,5-Dimethylbenzaldehyde	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	<0.01
<b><u>Mass Emission Rate (lb/hour)</u></b>								
Formaldehyde	<0.003	<0.005	<0.002	<0.003	no data	0.56	0.23	0.40
Acetaldehyde	<0.004	<0.005	<0.003	<0.004		0.33	0.17	0.25
Acetone	<0.036	<0.048	<0.048	<0.044		<0.10	<0.06	<0.08
Acrolein	<0.002	<0.001	<0.001	<0.001		0.09	0.04	0.06
Propionaldehyde	<0.002	<0.001	<0.001	<0.001		0.12	0.07	0.09
Crotonaldehyde	<0.002	<0.001	<0.001	<0.001		0.08	0.04	0.06
Butyraldehyde	<0.002	<0.001	<0.001	<0.001		0.13	0.06	0.09
Benzaldehyde	<0.012	<0.013	<0.010	<0.012		<0.04	<0.06	<0.05
Isovaleraldehyde	<0.002	<0.001	<0.001	<0.001		0.08	0.06	0.07
Valeraldehyde	<0.002	<0.001	<0.001	<0.001		0.10	0.06	0.08
o-Tolualdehyde	<0.002	<0.001	<0.001	<0.001		0.02	0.00	0.01
m & p-Tolualdehyde	<0.002	<0.001	<0.001	<0.001		0.05	0.02	0.04
Hexaldehyde	<0.002	<0.001	<0.001	<0.001		0.09	0.05	0.07
2,5-Dimethylbenzaldehyde	<0.002	<0.001	<0.001	<0.001		<0.00	<0.00	<0.00

### **3.0 PROCESS DESCRIPTION AND OPERATING CONDITIONS**

The #4 and #5 Flash Dryer processes involve the mixing/coating of stearic acid with/onto calcium carbonate powder in a hot air stream resulting directly from the external combustion of #2 fuel oil. Some of the air components in the emissions are believed to be pyrolytic (formed by heat) products of stearic acid. The stearic acid is applied to and coats the surface of the ground calcium carbonate, and is of vegetable (typically palm oil) origin. Some of the identified compounds also likely result from the combustion of the #2 fuel oil in the dryers.

Each dryer is exhausted through a separate 18-inch diameter stack accessed from the building roof. The sampling ports are located 6 feet downstream of a pipe reducer and 18 feet upstream of the stack exit.

## **4.0 SAMPLING AND ANALYTICAL METHODS**

### **4.1 Sampling Locations – EPA Method 1**

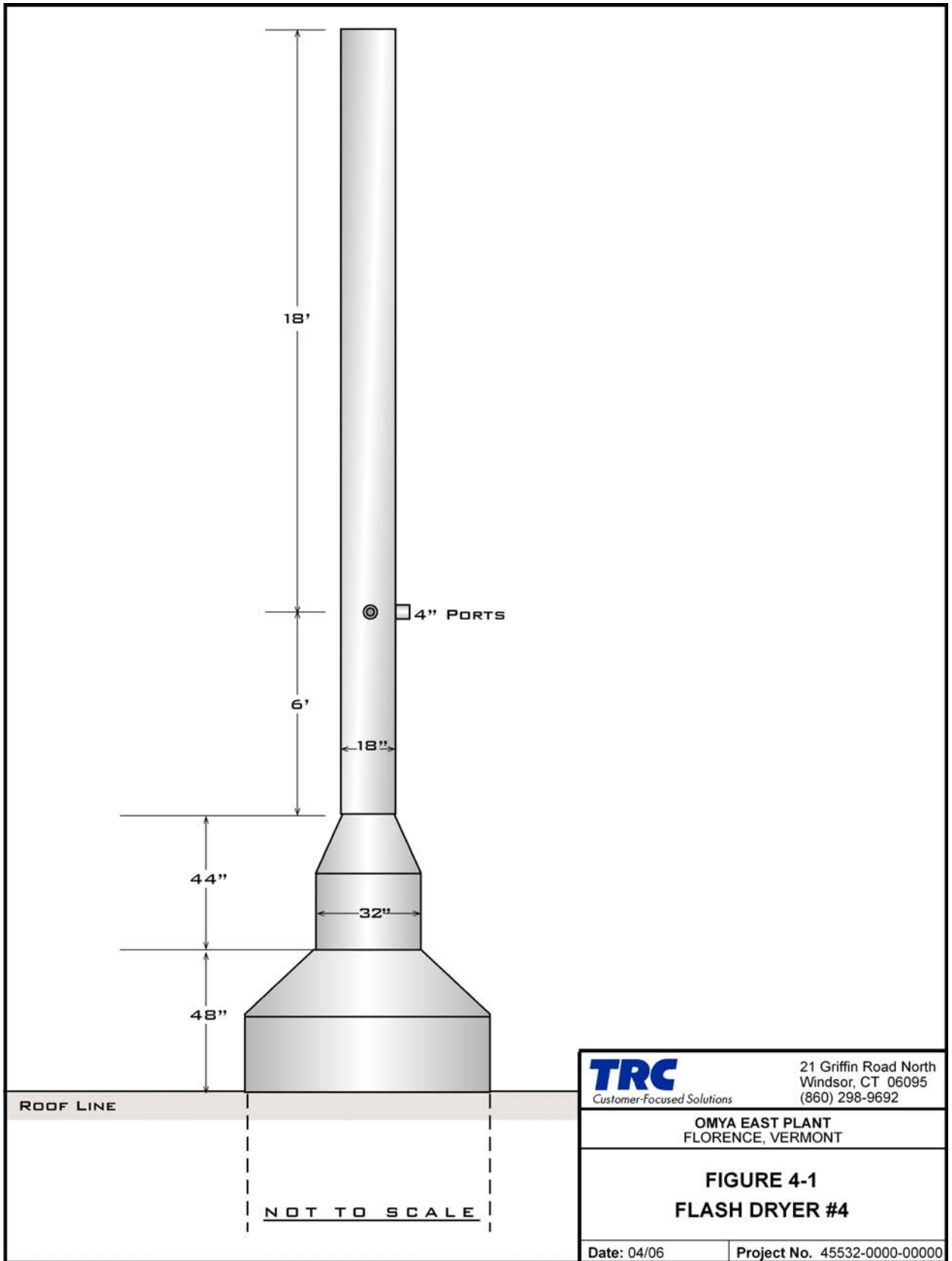
Sampling ports on Flash Dryers 4 and 5 are located in the 18-inch diameter stacks according to EPA Method 1. Schematic diagrams of the stacks are shown in Figures 4-1 and 4-2 and sampling ports and point locations are shown in Figure 4-3.

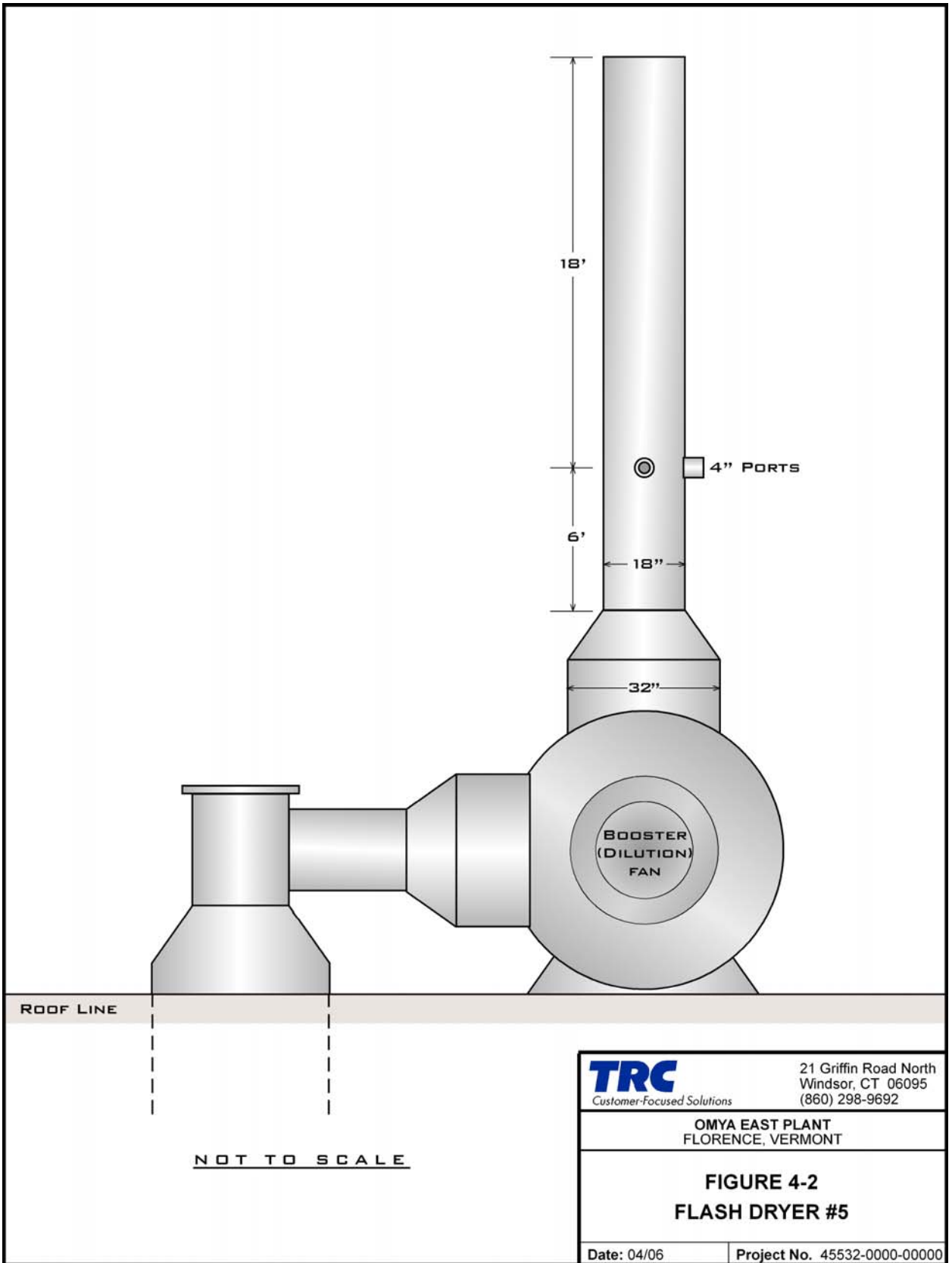
### **4.2 Aldehydes and Ketones – Modified CARB 430**

Aldehyde and ketone emission measurements were conducted in accordance with EPA Methods 1, 2, 4, modified CARB Method 430, and the Ashland Chemical CARB 430 modification. The modification includes the addition of toluene to the sample collection impingers. The purpose of the toluene is to continuously extract derivatized target compounds which greatly improves accuracy for acrolein. Three 60-minute tests were conducted on each of the dryer stacks under two process conditions for a total of 12 tests.

#### **4.2.1 Sample Collection**

The modified CARB 430 sampling train consists of a Teflon tube probe, ice bath, four 25-milliliter (ml) impingers, flow meter, vacuum pump, vacuum gauge and dry gas meter. The first, second and third impingers contain 2 ml of acidified DNPH reagent, 10 ml of H<sub>2</sub>O and 2 ml of toluene in each impinger. The fourth impinger contains silica-gel to absorb any remaining moisture prior to the flow metering devices and vacuum pump. The nominal sample flow rate is 400 ml per minute.





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	<b>OMYA EAST PLANT</b> FLORENCE, VERMONT
<b>FIGURE 4-2</b> <b>FLASH DRYER #5</b>	
Date: 04/06	Project No. 45532-0000-00000

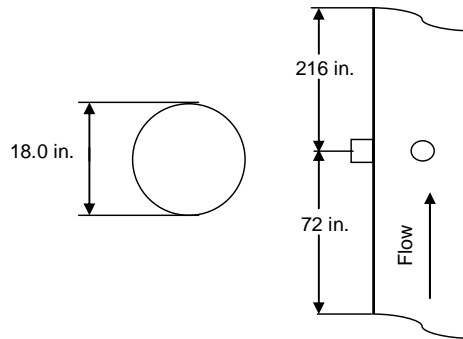
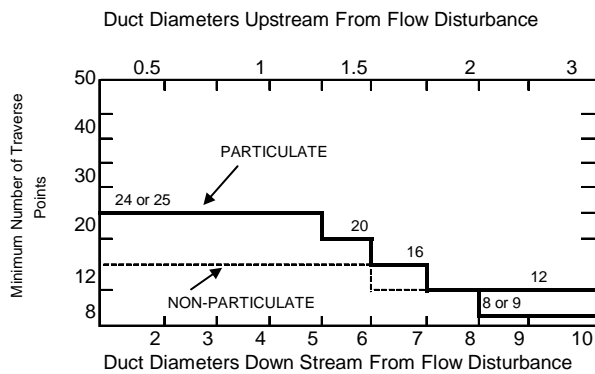
## EPA Method 1 – Dryer Sampling Locations

TRC Environmental Corporation  
EPA Method 1 Data Sheet

Firm Omya, Inc.  
 Location Dryers 4 and 5  
 Diameters Upstream 12  
 Diameters Downstream 4  
 Nipple Size (in.) 4

Total Traverse Points Required 24  
 Number of Ports 2  
 Points Per Port 12  
 Traverse (Horizontal or Vertical) Horizontal

### Minimum Number of Traverse Points For Particulate and Non-Particulate Traverses



Point Number On a Diameter	(Percent of Stack Diameter from Inside Wall to Traverse Point) (No. of Traverse Points on a Dia.)				
	4	6	8	10	12
1	6.7	4.4	3.2	2.6	2.1
2	25.0	14.6	10.5	8.2	6.7
3	75.0	29.6	19.4	14.6	11.8
4	93.3	70.4	32.3	22.6	17.7
5		85.4	67.7	34.2	25.0
6		95.6	80.6	65.8	35.6
7			89.5	77.4	64.4
8			96.8	85.4	75.0
9				91.8	82.3
10				97.4	88.2
11					93.3
12					97.9

### Traverse Point Location

Point Number	Distance From Wall	Nipple Size	Total Distance
1	0.4	4.0	4.4
2	1.2	4.0	5.2
3	2.1	4.0	6.1
4	3.2	4.0	7.2
5	4.5	4.0	8.5
6	6.4	4.0	10.4
7	11.6	4.0	15.6
8	13.5	4.0	17.5
9	14.8	4.0	18.8
10	15.9	4.0	19.9
11	16.8	4.0	20.8
12	17.6	4.0	21.6

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**Figure 4-3**  
**Dryers 4 and 5 Sampling Locations**

#### 4.2.2 Sample Recovery

The sampling trains are weighed before and after sampling to determine moisture concentration. One sample container is used to recover impinger samples as follows:

Container No. 1: The contents of the DNPH impingers are deposited into a 125-ml glass vial with a Teflon lined screw-top. The Teflon probe was rinsed into the same vial with 2 ml of DNPH solution and 2 ml of water.

#### 4.2.3 Sample Analysis

The samples are transported to a certified laboratory where the following analyses are performed:

Container No. 1: The contents of impingers 1, 2 and 3 are extracted and the organic phase is evaporated to dryness, dissolved in methanol, and analyzed for the target compound derivatives using GC/NPD.

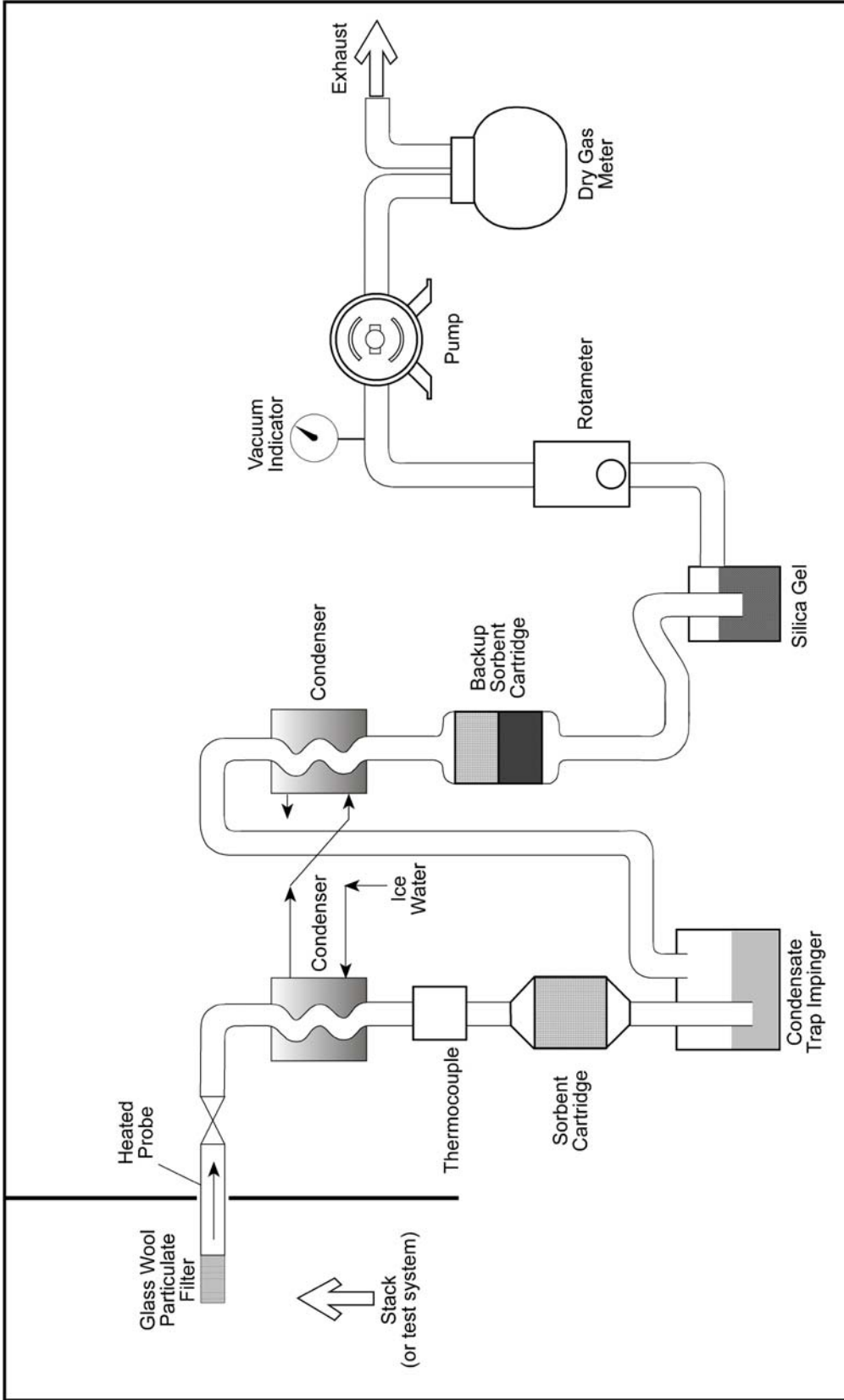
### 4.3 Volatile Organic Compounds – SW-846 Method 0030


The concentrations of volatile organic compounds were measured using the volatile organic sampling train (VOST) in accordance with EPA SW-846 Method 0030. Four samples were collected from each stack under each process condition for a total of 16 samples.

#### 4.3.1 Sample Collection

A 20-liter (nominal) sample of exhaust gas is collected at a flow rate of approximately 0.5 liter per minute (lpm). Sampling duration is 40 minutes per test and sampling data are recorded on appropriate field data sheets.

A schematic of the sampling train is shown in Figure 4-2. The sampling train includes a heated (250° F ± 25° F) glass-lined probe followed by a glass 3-way valve, and a condenser chilled to 20 °C. A Tenax® cartridge follows the first condenser which is followed by a second condenser and a second sorbent cartridge containing a 3:1 mix of Tenax® and activated charcoal.




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**FIGURE 4-4**  
**SCHEMATIC OF VOLATILE**  
**ORGANIC SAMPLING**  
**TRAIN (VOST)**

#### 4.3.2 Sample Recovery

At the completion of each test run, the sample cartridges are sealed with Swagelok fittings and stored on ice until shipment for analysis. One field blank and one trip blank are recovered in the same location as the samples.

#### 4.3.3 Sample Analysis

Sample analysis was performed by ALS Environmental according to EPA SW-846 Methods 5041A and 8260B. Each pair of sorbent cartridges (Tenax® and Tenax®/charcoal) are desorbed and analyzed together. The field blank and trip blank cartridge pairs are also desorbed and analyzed as a pair. The contents of the paired sorbent cartridges were spiked with an internal standard and thermally desorbed for 11 minutes at 180° C with organic-free nitrogen gas, bubbled through 5 ml of organic-free water, and trapped on an analytical absorbent trap. After the 11-minute desorption, the analytical absorbent trap was rapidly heated to 180° C with the carrier gas flow reversed so that the effluent flow from the analytical trap was directed into the GC/MS. The volatile compounds were separated by temperature-programmed gas chromatography and detected by low-resolution mass spectrometry.

The concentrations of volatile compounds are based on calibration runs performed with target compound standards and internal standard recovery; however, the normal production tests at Omya contained high concentration of organic material that inhibited internal standard recovery and interfered with target compound analyses. The analytical procedure was modified with a dilution procedure which consisted of desorbing the sorbent cartridges into a Tedlar bag and analyzing an appropriate portion of the gas collected in the bag.

Condensate from normal operation samples were collected in 40 milliliter vials. There was no condensate collected on the no product tests. The condensate samples were analyzed with a purge and trap concentrator for the EPA SW-846 Method 8260B compounds.

#### 4.4 Semi-Volatile Organic Compounds – SW-846 Method 0010

Sampling was conducted for semi-volatile organic compound emissions at the dryer stacks according to SW-846 Method 0010. Three 180-minute tests were conducted on each stack under each process condition for a total of 12 tests.

#### 4.4.1 Sample Collection

Sampling is performed isokinetically using an SW-846 Method 0010 train. The isokinetic sampling train consists of a glass nozzle, a heated glass-lined probe, a heated glass-fiber filter encased in a glass filter holder, a Graham spiral-type condenser, a water-jacketed sorbent module, and five Greenberg-Smith impingers.

The first impinger is empty (knockout) and has a short stem. The second and third impingers are charged with 100 milliliters (ml) deionized distilled water (DDH<sub>2</sub>O). The fourth impinger is empty, and the fifth impinger contains 200 grams (g) of indicating silica gel to remove any remaining moisture.

The sorbent module is water-jacketed and filled with cleaned XAD-2 resin. The sorbent module is located in a vertical position where the sample gases flow downward to prevent channeling. All glass and Teflon components of the sampling train are prewashed as described in Section 3A of the 1980 "Manual of Analytical Methods for Analysis of Pesticide Residues in Human and Environmental Samples." Special care is devoted to the removal of silicon grease sealants on the ground glass joints by soaking them for several hours in a chromic acid cleaning solution prior to the cleaning described above.

The sampling probe and filter temperatures are maintained at 250° F ± 25° F. The condenser-sorbent tube module jacket and the gas temperatures at the outlet of the fifth impinger are maintained at or below 68° F. No silicone vacuum grease is used on any of the sampling train components.

The remainder of the sampling train consists of flexible tubing, a vacuum gauge, a leak-free vacuum pump with a bypass and fine adjustment valve, a calibrated orifice, and a dual-inclined manometer. An S-type pitot is attached to the sampling probe. Flexible tubing connects the probe to a dual-inclined manometer in order to monitor velocity pressure in the stack. A programmable calculator is used to quickly determine the sampling rates required to maintain isokinesis. The sampling train is leak-checked with a Teflon plug prior to and following each test in accordance with EPA Method 5. Isokinetic sampling is performed at rates less than 1.0 cubic feet per minute (cfm).

#### 4.4.2 Sample Recovery

The probe is removed from the stack and the nozzle is capped with Teflon tape to prevent loss (or gain) of sample. The sampling train is transported to the recovery area where the samples

were recovered and placed in the appropriate containers as follows:

- Container No. 1: The 3½-inch filter is removed from its holder, placed in a petri dish, sealed, and labeled.
- Container No. 2: The sorbent module is sealed with glass caps, placed in a labeled Ziploc bag, and stored in a cooler with ice.
- Container No. 3: The probe, nozzle, and front half of the filter holder are brushed and rinsed sequentially three times with acetone and methylene chloride. The rinses are deposited into a 100 ml amber jar. The fluid level is marked and the sample jar is sealed and labeled.
- Container No. 4: The impingers are weighed to measure moisture gain and the contents of the first impinger are deposited into a 500 ml sample jar. The liquid level is marked and the jar was sealed and labeled. The first impinger is rinsed three times with acetone and methylene chloride and the rinses are added to Container 4.

#### 4.4.3 Sample Analysis

The samples are shipped on ice (to maintain 4° C) to ALS Environmental in Burlington, Ontario for analysis. The sample fractions are extracted with a Soxhlet apparatus and analyzed for the target compounds by EPA SW-846 Method 8270C using low-resolution gas chromatography/mass spectrometry.

## 5.0 QUALITY ASSURANCE

The TRC quality assurance (QA) program is designed to ensure that emission measurement work is performed by qualified people using proper equipment following written procedures in order to provide accurate, defensible data. This program is based upon the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III (EPA-600/4-94-027b). General QA issues are outlined in the below followed by method specific QA discussions.

### 5.1 General Sampling QA

The TRC quality assurance program for source measurements is designed so that the work is done:

1. by competent, trained individuals experienced on the specific methods being used;
2. using properly calibrated equipment; and
3. using approved procedures for sample handling and documentation.

TRC's measurement devices, pitot tubes, dry gas meters, thermocouples, and portable gas analyzers are uniquely identified and calibrated with documented procedures and acceptance criteria before and after each field effort. Records of all calibration data are maintained in TRC files. Data are recorded on standard forms. Bound field notebooks are used to record observations and miscellaneous elements affecting data, calculations, or evaluation. Specific details of TRC's QA program for stationary air pollution sources may be found in Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III (EPA-600/4-94-027b).

### 5.2 General Laboratory Analysis QA

All sample preparation and sample analyses are performed at or under the direction of TRC's laboratories. Standards of QA set forth in the *Quality Assurance Handbook for Air Pollution Measurement*, Volume III (EPA-600/4-94-27b) and the *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA-600/4-79-019, March 1979) will be strictly followed.

### 5.3 Modified CARB Method 430

A field blank (FB-1) and reagent blanks were free of target compounds with the exception of

acetone and benzaldehyde. A second field blank (FB-2) was collected from the dryer 5 sampling train after the last test was completed and this blank contained low levels (relative to the normal operation tests) of target compounds indicating that impingers rinses recovered less than 100% of the sample. The last dryer 5 sample contained 184 micrograms of formaldehyde and the final field blank contained 21.9 micrograms indicating that 12% of the formaldehyde remained in the impinger after the sample was recovered.

#### 5.4 SW-846 Method 0030 (VOST)

Blanks were clean with the exception of acetone, methylene chloride and toluene. These solvents were used for other stack testing methods and this was the most likely source of this contamination. Essentially, these three compounds are removed from the VOST target list when conducting VOST concurrently with the other stack test methods.

The d10-ethylbenzene surrogate spike (added to the tubes prior to sampling) recoveries were reasonable (62-145%) for all samples; however, internal standard surrogates (these surrogates are spiked onto the tubes after sampling and before analysis) on the normal operation test samples showed poor recovery. The poor recoveries on these spikes were likely caused by interference from the high levels of aldehydes in the normal operation samples. The exact mechanism of the interference is unknown; however, the spike recoveries were consistently poor on all of the normal operation samples and consistently good on all of the no product tests.

#### 5.5 SW-846 Method 0010 (Semi-Volatiles)

Blanks were clean and surrogate spike recoveries were within method specifications.

**APPENDIX A**  
**MODIFIED CARB METHOD 430 DATA**

APPENDIX B

**SW-846 METHOD 0030 (VOST) DATA**

**APPENDIX C**  
**SW-846 METHOD 0010 (SEMI-VOLATILES)**  
**DATA**

**APPENDIX D**  
**TEST METHOD CALIBRATION DATA**