

State of Oregon
Department of Environmental Quality

Memorandum

Date: 3/1/2023

To: File/Julia DeGagné
From: Thomas Rhodes

Subject: Source Test Review Report
Hollingsworth and Vose
Permit Number: 02-2173-ST-01

Test Date: December 13-15, 2022
Report Received: February 4, 2023
Source Testers: Bison Engineering, Inc.
DEQ Observed: Yes

I) Source Description: Glass fiber manufacturing.

II) Process (es)/Emissions Unit(s) Tested: Glass plant processes Rotary Coarse (RC), Ultra Rotary Coarse (URC), Glass Melting (GM), Flame Blown (FB), and Rotary Fine (RF) at the ceramic filtration unit (CFU) exhausts and the raw materials handling areas.

III) Test Purpose: Compliance with the September 22, 2022, letter that was sent to Hollingsworth & Vose in accordance with [OAR 340-245-0030\(2\)](#) to establish emission factors for organic toxic air contaminants (TACs) from plant process RF, RC, FB, and GM, and to demonstrate that the raw materials handling areas have 100 percent capture efficiency.

IV) Testing Location(s):

Rotary Coarse CFU 108 Exhaust:

Diameter:	30"
Distance A (Method 1):	102" (3.4 Diameter)
Distance B (Method 1):	128" (4.3 Diameters)
Number traverse points utilized:	16

Ultra Rotary Coarse CFU 112 Exhaust:

Diameter:	30"
Distance A (Method 1):	102" (3.4 Diameters)
Distance B (Method 1):	128" (4.3 Diameter)
Number traverse points utilized:	24

Glass Melt CFU 113 Exhaust:

Diameter:	20"
Distance A (Method 1):	96" (4.8 Diameter)
Distance B (Method 1):	165" (8.3 Diameters)
Number traverse points utilized:	8

Flame Blown CFU 115 Exhaust:

Diameter:	36"
Distance A (Method 1):	45" (1.3 Diameters)
Distance B (Method 1):	134" (3.7 Diameter)
Number traverse points utilized:	16

Rotary Fine CFU 118 Exhaust:

Diameter:	30"
Distance A (Method 1):	52" (1.7 Diameter)
Distance B (Method 1):	142" (4.7 Diameters)
Number traverse points utilized:	16

Raw Materials Handling Area

Pressure Differential Measurements Locations

- 1 – North Man Door
- 2 – NE Load In/Out Door
- 3 – SE Load In/Out Door
- 4 – Second Floor Load In/Out Door
- 5 – Second Floor Man Door

V) Testing Methodology: The following testing methods were utilized during the testing program:

- Flow Rate, O₂ & CO₂, & Moisture Content: EPA Methods 1, 2, 3A & 4
- Organic TACs (screening): EPA Method TO-15
- Organic TACs: EPA Method 18
- Permanent Total Enclosure Verification: EPA Method 204

VI) Summary of Results: The testing parameters, test results and operating parameters are summarized in the Tables below:

- Table 1: CFU 108
- Table 2: CFU 112
- Table 3: CFU 113
- Table 4: CFU 115
- Table 5: CFU 118
- Table 6: Raw Materials Handling Area

TABLE 1: Rotary Coarse (CFU 108) – Organic TACs

	Run 1	Run 2	Run 3	Average
Date	12/13/2023			
Exhaust Gas Temperature (°F)	194	208	209	204
Exhaust Gas Flow Rate (dscf/m)	17,607	18,441	18,097	18,048
Glass Production (lb/hr)	385.7	390.4	380.1	385.4
Acetone Emissions:	--	--	--	--
· ppb	24	11	9.3	14.77
· lb/hr	3.82E-03	1.84E-03	1.52E-03	2.39E-03
· lb/ton glass	1.98E-02	9.40E-03	8.01E-03	1.24E-02
2-Butanone Emissions:		--	--	--
· ppb	0.63	< 0.5	< 0.5	< 0.54
· lb/hr	1.25E-04	< 1.04E-04	< 1.02E-04	< 1.10E-04
· lb/ton glass	6.46E-04	< 5.31E-04	< 5.35E-04	< 5.71E-04
Hexane Emissions:	--	--	--	--
· ppb	2.8	1.3	0.71	1.60
· lb/hr	6.62E-04	3.22E-04	1.73E-04	3.85E-04
· lb/ton glass	3.43E-03	1.65E-03	9.08E-04	2.00E-03
Benzene Emissions:	--	--	--	--
· ppb	1.7	0.65	0.56	0.97
· lb/hr	3.64E-04	1.46E-04	1.23E-04	2.11E-04
· lb/ton glass	1.89E-03	7.47E-04	6.49E-04	1.10E-03
Toluene Emissions:	--	--	--	--
· ppb	7.5	2.3	1.8	3.87
· lb/hr	1.90E-03	6.09E-04	4.68E-04	9.91E-04
· lb/ton glass	9.83E-03	3.12E-03	2.46E-03	5.14E-03
Ethyl benzene Emissions:	--	--	--	--
· ppb	0.72	< 0.5	< 0.5	< 0.57
· lb/hr	2.10E-04	< 1.53E-04	< 1.50E-04	< 1.71E-04
· lb/ton glass	1.09E-03	< 7.81E-04	< 7.88E-04	< 8.85E-04
m,p-Xylene Emissions:	--	--	--	--
· ppb	2.1	< 1.0	< 1.0	< 1.37
· lb/hr	6.12E-04	< 3.05E-04	< 2.99E-04	< 4.05E-04
· lb/ton glass	3.17E-03	< 1.56E-03	< 1.58E-03	< 2.10E-03
o-Xylene Emissions:	--	--	--	--
· ppb	0.94	< 0.5	< 0.5	< 0.65
· lb/hr	2.74E-04	< 1.53E-04	< 1.50E-04	< 1.92E-04
· lb/ton glass	1.42E-03	< 7.81E-04	< 7.88E-04	< 9.96E-04

'<' denotes results calculated using the Reporting Limit (RL) for results that were non-detect

TABLE 2: Ultra Rotary Coarse (CFU 112) – Organic TACs

	Run 1	Run 2	Run 3	Average
Date	12/13/2023			
Exhaust Gas Temperature (°F)	188	191	191	190
Exhaust Gas Flow Rate (dscf/m)	17,558	16,954	17,698	17,403
Glass Production (lb/hr)	700.8	692.8	700.0	697.9
1,3-Butadiene Emissions:	--	--	--	--
· ppb	0.58	< 0.5	< 0.5	< 0.53
· lb/hr	8.58E-05	< 7.14E-05	< 7.46E-05	< 7.73E-05
· lb/ton glass	2.45E-04	< 2.06E-04	< 2.13E-04	< 2.21E-04
Acetone Emissions:	--	--	--	--
· ppb	67	46	15	42.67
· lb/hr	1.06E-02	7.06E-03	2.40E-03	6.70E-03
· lb/ton glass	3.04E-02	2.04E-02	6.86E-02	1.92E-02
2-Butanone Emissions:		--	--	--
· ppb	2.3	1.4	< 0.5	< 1.40
· lb/hr	4.54E-04	2.67E-04	< 9.94E-05	< 2.73E-04
· lb/ton glass	1.29E-03	7.70E-04	< 2.84E-04	< 7.83E-04
Hexane Emissions:	--	--	--	--
· ppb	47	22	4.8	24.6
· lb/hr	1.11E-02	5.01E-03	1.14E-03	5.74E-03
· lb/ton glass	3.16E-02	1.45E-02	3.26E-03	1.64E-02
Benzene Emissions:	--	--	--	--
· ppb	12	7.3	1.7	7.00
· lb/hr	2.56E-03	1.51E-03	3.66E-04	1.48E-03
· lb/ton glass	7.32E-03	4.35E-03	1.05E-04	4.24E-03
Toluene Emissions:	--	--	--	--
· ppb	31	16	5.9	17.63
· lb/hr	7.81E-03	3.89E-03	1.50E-03	4.40E-03
· lb/ton glass	2.23E-02	1.12E-02	4.28E-03	1.26E-02
Ethyl benzene Emissions:	--	--	--	--
· ppb	0.68	< 0.5	< 0.5	< 0.56
· lb/hr	1.97E-04	< 1.40E-04	< 1.46E-04	< 1.61E-04
· lb/ton glass	5.64E-04	< 4.05E-04	< 4.18E-04	< 4.625E-04

'<' denotes results calculated using the RL for results that were non-detect

TABLE 3: Glass Melt (CFU 113) - Organic TACs

	Run 1	Run 2	Run 3	Average
Date	12/13/2023			
Exhaust Gas Temperature (°F)	125	128	122	125
Exhaust Gas Flow Rate (dscf/m)	9,183	8,368	8,600	8,717
Glass Production (lb/hr)	3,959.3	4,143.4	4,077.5	4,060.0
1,3-Butadiene Emissions:	--	--	--	--
· ppb	16	17	15	16.0
· lb/hr	1.24E-03	1.20E-03	1.09E-03	1.17E-03
· lb/ton glass	6.25E-04	5.79E-04	5.33E-04	5.79E-04
Acetone Emissions:	--	--	--	--
· ppb	250	94	66	136.7
· lb/hr	2.08E-02	7.12E-03	5.14E-03	1.10E-02
· lb/ton glass	1.05E-02	3.44E-03	2.52E-03	5.48E-03
Carbon disulfide Emissions:	--	--	--	--
· ppb	0.77	0.80	0.68	0.75
· lb/hr	8.39E-05	7.94E-05	6.94E-05	7.76E-05
· lb/ton glass	4.24E-05	3.83E-05	3.40E-05	3.82E-05
2-Butanone Emissions:		--	--	--
· ppb	0.87	1.7	2.0	1.52
· lb/hr	8.98E-05	1.60E-04	1.93E-04	1.48E-04
· lb/ton glass	4.53E-05	7.71E-05	9.48E-05	7.24E-05
Hexane Emissions:	--	--	--	--
· ppb	20	12	8.3	13.4
· lb/hr	2.47E-03	1.35E-03	9.58E-04	1.59E-03
· lb/ton glass	1.25E-03	6.51E-04	4.70E-04	7.89E-04
Benzene Emissions:	--	--	--	--
· ppb	18	28	30	25.3
· lb/hr	2.01E-03	2.85E-03	3.14E-04	2.67E-03
· lb/ton glass	1.02E-03	1.38E-03	1.54E-04	1.31E-03
Toluene Emissions:	--	--	--	--
· ppb	0.96	4.4	11	5.45
· lb/hr	1.27E-04	5.29E-04	1.36E-03	6.71E-04
· lb/ton glass	6.39E-05	2.55E-04	6.66E-04	3.28E-04

'<' denotes results calculated using the RL for results that were non-detect

TABLE 4: Flame Blown (CFU 115) – Organic TACs

	Run 4	Run 5	Run 6	Average
Date	12/14/2023			
Exhaust Gas Temperature (°F)	272	269	272	271
Exhaust Gas Flow Rate (dscf/m)	19,219	19,187	18,996	19,134
Glass Production (lb/hr)	63.0	63.0	63.0	63.0
Chloromethane Emissions:	--	--	--	--
· ppb	17	3.2	5.4	8.5
· lb/hr	2.57E-03	4.83E-04	8.07E-04	1.29E-03
· lb/ton glass	8.16E-02	1.53E-02	2.56E-02	4.08E-02
Chloroethane Emissions:	--	--	--	--
· ppb	0.5	< 0.5	< 0.5	< 0.5
· lb/hr	9.66E-05	< 9.64E-05	< 9.55E-05	< 9.62E-05
· lb/ton glass	3.07E-03	< 3.06E-03	< 3.03E-03	< 3.05E-03
Acetone Emissions:	--	--	--	--
· ppb	140	44	51	78.3
· lb/hr	2.43E-02	7.64E-03	8.77E-03	1.36E-02
· lb/ton glass	7.73E-01	2.43E-01	2.78E-01	4.31E-01
2-Butanone Emissions:		--	--	--
· ppb	3.1	1.5	1.4	2.0
· lb/hr	6.69E-04	3.23E-04	2.99E-04	4.30E-04
· lb/ton glass	2.12E-02	1.03E-02	9.48E-03	1.37E-02
Hexane Emissions:	--	--	--	--
· ppb	72	79	79	76.7
· lb/hr	1.86E-02	2.04E-02	2.01E-02	1.97E-02
· lb/ton glass	5.90E-01	6.46E-01	6.40E-01	6.25E-01
Benzene Emissions:	--	--	--	--
· ppb	16	15	13	14.7
· lb/hr	3.74E-03	3.50E-03	3.01E-03	3.42E-03
· lb/ton glass	1.19E-01	1.11E-01	9.54E-02	1.18E-01
Cyclohexane Emissions:	--	--	--	--
· ppb	1.5	< 0.5	< 0.5	< 0.8
· lb/hr	3.78E-04	< 1.26E-04	< 1.25E-04	< 2.09E-04
· lb/ton glass	1.20E-02	< 3.99E-03	< 3.95E-03	< 6.65E-03
Methyl isobutyl ketone Emissions:	--	--	--	--
· ppb	0.58	< 0.5	< 0.5	< 0.53
· lb/hr	1.74E-04	< 1.50E-04	< 1.48E-04	< 1.57E-04
· lb/ton glass	5.52E-03	< 4.75E-03	< 4.71E-03	< 4.99E-03
Toluene Emissions:	--	--	--	--
· ppb	7	9.7	21	12.6
· lb/hr	1.93E-03	2.67E-03	5.73E-03	3.44E-03
· lb/ton glass	6.13E-02	8.48E-02	1.81E-01	1.09E-01
Ethyl benzene Emissions:	--	--	--	--
· ppb	< 0.5	< 0.5	0.69	< 0.6
· lb/hr	< 1.59E-04	< 1.59E-04	2.17E-04	< 1.78E-04
· lb/ton glass	< 5.05E-03	< 5.04E-03	6.88E-03	< 5.66E-03
m,p-Xylene Emissions:	--	--	--	--
· ppb	< 1.0	< 1.0	1.5	< 1.2
· lb/hr	< 3.18E-04	< 3.17E-04	4.71E-04	< 3.69E-04
· lb/ton glass	< 1.01E-02	< 1.01E-02	1.50E-02	< 1.17E-02

'<' denotes results calculated using the RL for results that were non-detect

TABLE 5: Rotary Fine (CFU 118) – Organic TACs

	Run 1	Run 2	Run 3	Average
Date	12/15/2023			
Exhaust Gas Temperature (°F)	222	225	226	224
Exhaust Gas Flow Rate (dscf/m)	17,146	17,895	17,188	17,410
Glass Production (lb/hr)	108.7	110.3	110.3	109.8
Chloromethane Emissions:	--	--	--	--
· ppb	1.3	2	1.3	1.5
· lb/hr	1.75E-04	2.82E-04	1.76E-04	2.11E-04
· lb/ton glass	3.23E-03	5.10E-03	3.19E-03	3.84E-03
Acetone Emissions:	--	--	--	--
· ppb	23	13	16	17.3
· lb/hr	3.57E-03	2.11E-03	2.49E-03	2.72E-03
· lb/ton glass	6.57E-02	3.82E-02	4.51E-02	4.97E-02
2-Butanone Emissions:		--	--	--
· ppb	0.58	< 0.5	< 0.5	< 0.53
· lb/hr	1.12E-04	< 1.01E-04	< 9.65E-05	< 1.03E-04
· lb/ton glass	2.06E-03	< 1.82E-03	< 1.75E-03	< 1.88E-03
Hexane Emissions:	--	--	--	--
· ppb	17	7.3	10	11.4
· lb/hr	3.91E-03	1.75E-03	2.31E-03	2.66E-03
· lb/ton glass	7.20E-02	3.18E-02	4.18E-02	4.86E-02
Benzene Emissions:	--	--	--	--
· ppb	3.8	1.7	2.2	2.6
· lb/hr	7.93E-04	3.70E-04	4.60E-04	5.41E-04
· lb/ton glass	1.46E-02	6.71E-03	8.34E-03	9.88E-03
Toluene Emissions:	--	--	--	--
· ppb	6.4	3.2	5.9	5.2
· lb/hr	1.58E-03	8.22E-04	1.46E-03	1.28E-03
· lb/ton glass	2.90E-02	1.49E-02	2.64E-02	2.34E-02

'<' denotes results calculated using the RL for results that were non-detect

TABLE 6: EPA Method 204 Criteria for Permanent Total Enclosure

Method Section Requirement	Results	Pass/Fail
5.1 Any NDO shall be at least four equivalent opening diameters from each VOC emitting point	--	Fail*
5.3 Total area of all NDO's shall not exceed 5 percent of the surface area of the enclosure's four walls, floor and ceiling	--	Fail*
5.4 The facial velocity shall be at least 200 fpm (0.007 "H ₂ O). The direction of air flow through all NDO's shall be into the enclosure	0.0092 – 0.7430 --	Pass Fail*
5.5 All access doors and windows not included in section 5.3 and 5.4 shall be closed during routine operation	Closed	Pass

* See Section VII Comment 4 below for explanation

VII) Comments & Concerns:

- 1) Only compounds listed in [OAR 340-247-8010 Table 1](#) that were detected in at least one test run for a source are included in the Tables above. The full list that includes all compounds can be found in Appendix A thru E of the source test report.
- 2) The source test plan approval letter required quantification by EPA Method 18 for any compounds that were detected above 1 ppmv in the TO-15 samples. No compounds were detected above 1 ppmv, therefore none of the Method 18 samples collected on-site were analyzed.
- 3) DEQ observed that the TO-15 sample lines were not purged with stack gas prior to collecting the samples. Ambient air in the sample line can dilute the stack gas that is collected in the Summa cannisters. 10 feet of ¼ inch tubing is expected to have a volume of 0.054 L which is approximately 1% of the sample volume collected. Potential sample dilution is not expected to increase any of the reported concentrations above the 1 ppmv threshold which would have required quantification by EPA Method 18.
- 4) The Method 204 test data in Appendix F did not include information to show that the enclosure met the following criteria required for a Permanent Total Enclosure.
 - a. 5.1. Section 3.1.2 of the test report states that the building did not have any true NDOs and that field personnel did not measure the area of potential NDOs. DEQ staff onsite observed that there were small openings that should have been considered as NDOs. No apparent effort was made to determine an area for these NDOs or other potential NDOs. No measurements were provided for the distance of these potential NDOs to emission emitting point(s).
 - b. 5.3. No NDO area measurements were provided, and no area measurements were provided for the enclosure.
 - c. 5.4 Section 3.1.2 of the test report states that inward direction of air flow was not monitored because the average facial velocity (FV) was greater than 500 fpm. No volumetric flow rates were measured and no NDO areas were provided to calculate that the FV was greater than 500 fpm. The pressure drop measurements provided only demonstrate that the FV is greater than 200 fpm. No apparent effort was made to demonstrate continuous inward flow at any NDO or potential NDO.
- 5) Table 2 in the source test report should have shown that the pressure differential measurements were all ≥ -0.007 .
- 6) Pressure drop measurements taken at the second floor man door were significantly higher than the measurements taken at the other four locations. Care should be used when taking future measurements at this location to ensure no outside influences on the pressure drop measurements.

VIII) Overall Evaluation: For the purpose of completing an emissions inventory for the Cleaner Air Oregon program, the data provided is sufficient to establish emissions factors for organic TACs from the glass plant processes tested. The data provided **is not** sufficient to demonstrate that the raw materials handling area meet the criteria for a PTE and **cannot** be assumed to have a 100 percent capture efficiency.