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EPA

# Plywood/Veneer

## Emission Test Report Georgia-Pacific Springfield Plant Springfield, Oregon

PLYWOOD/VENEER  
EMISSION TEST REPORT  
GEORGIA-PACIFIC PLYWOOD PLANT  
SPRINGFIELD, OREGON  
JUNE 1981



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## PREFACE

The work described herein was conducted by personnel from TRC - Environmental Consultants, Inc., Research Triangle Institute (RTI), Del Green Associates (DGA); CH<sub>2</sub>MHill, Engineers, Planners, Economists and Scientists; Pollution Control Science, Inc., (PCS); Georgia-Pacific (G-P) in Springfield, Oregon; the National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI); and the United States Environmental Protection Agency (EPA) Emission Measurement Branch (EMB).

The scope of work was issued under EPA Contract 68-02-3543, Work Assignment 1. The work was performed under the supervision of Eugene A. Brackbill, P.E., TRC work assignment manager, and John H. Powell, TRC field crew chief.

Robert L. Chessin of RTI monitored process operations and was assisted by Paul Willhite of DGA. RTI was responsible for preparing Section 3 and Appendix I of this report, both of which deal with process descriptions and operations. Mark S. Boedigheimer supervised Method 5X analyses performed by CH<sub>2</sub>MHill. David Robinson supervised Method 25 analysis performed by PCS. Victor Dallons supervised NCASI sampling and analysis activities as well as providing helpful suggestions and comments in support of the test program. Mitch Steffensen and Pete Fetter of Georgia-Pacific, provided invaluable assistance and guidance to TRC, EPA and RTI in the performance of the test program. Clyde E. Riley, Office of Air Quality Planning and Standards (OAQPS), Emission Measurement Branch, EPA, served as task manager and was responsible for coordinating the test program.

Edwin J. Vincent, OAQPS, Chemical and Petroleum Branch, EPA, served as project lead engineer. He was also responsible for coordinating and directing the process operations monitoring.

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## 1.0 INTRODUCTION

### 1.1 Background

Section 111 of the Clean Air Act of 1970 charges the administrator of the United States Environmental Protection Agency with the responsibility of establishing Federal Standards of Performance for New Stationary Sources (SPNSS) that may significantly contribute to air pollution. When promulgated, these standards of performance for new stationary sources are to reflect the degree of emission limitation achievable through application of the best demonstrated emission control technology. Emission data collected from controlled sources in the plywood industry will provide a portion of the database used by EPA to develop SPNSS.

EPA's Office of Air Quality Planning and Standards selected the Georgia-Pacific (G-P) plywood plant in Springfield, Oregon, as a site for an emission test program because it is considered to employ process and emission technology representative of modern plywood manufacturing plants.

The test program was designed to determine the emission rate of particulate matter and condensible and noncondensable organic material emitted from the veneer drying operation. A second objective was to measure the collection efficiency of the Georgia-Pacific scrubber system for condensible and noncondensable organic emissions.

TRC - Environmental Consultants, Inc. was retained by the EPA Emissions Measurement Branch (EMB) to perform emission measurements at the G-P plywood plant in Springfield, Oregon. Testing was performed during the week of June 8, 1981 on the veneer dryer emissions and their pollution control, a G-P scrubber system. This report has been prepared in accordance with EPA Contract No. 68-02-3543 under the provisions of Work Assignment No. 1.

The Research Triangle Institute (RTI), the New Source Standard (NSS) contractor, was responsible for coordinating the overall test program with G-P personnel and for assuring that process and control equipment operating conditions were suitable for testing. All process data were monitored and recorded by RTI. Fugitive emissions from the veneer dryers, ambient air temperature and relative humidity were monitored and recorded by RTI.

Additional testing for total organic compounds was performed by the National Council of the Paper Industry for Air and Stream Improvement, Inc, (NCASI) simultaneously with the TRC test program. This testing was performed at the request of the American Plywood Association (APA) for research purposes and to provide an additional measure of quality assurance.

## 1.2 Summary of Process and Emissions

The G-P Springfield plant is a combination veneer and lay-up facility, and is considered to employ process and emission control technology representative of modern plywood manufacturing plants. The plywood production rate for the drying operation is approximately 800,000 square feet (3/8-inch basis) per 24-hour day.

The veneer drying operation begins after the veneer has been peeled from the log at the lathe operation and is transferred to the drying operation. Here, the veneer is continuously hand-fed onto the dryer feed conveyor and into the dryer. The purpose of the operation is to thermally drive the moisture out of the veneer in preparation for the lay-up and laminating operations which follow. During the drying operation, organic compounds are driven out of the veneer. These organic compounds are the emissions of interest.

The G-P Springfield plant has four veneer dryers. Each is a steam heated, multideck unit, with the number of drying zones varying. Each dryer has two exhausts from the heated zones, except dryer 4, which has three exhausts. The nine exhausts are ducted to a common manifold which carries the dryer emissions to the G-P scrubber system. A schematic drawing of the veneer dryer exhaust system is presented in Figure 1-1.

### 1.3 Applicability of EPA Reference Test Methods

EPA is required to publish a national reference test method for each regulated source category and pollutant for which a New Source Performance Standard (NSPS) is established. Reference test methods are usually specified by a State regulatory agency during the State Implementation Planning process and may be different from national reference test methods.

The purpose of establishing a national reference test method is to ensure that emission data collected from a specific source is representative of that source and comparable to data collected at other designated sources. The primary purpose of this test program was to collect emission data using standardized test methods which allow the data to be evaluated to develop a national SPNSS. Two different test methods were selected by EPA to measure emissions from plywood veneer drying operations. These methods are briefly described in the following subsections and are described in detail in Section 5.

#### 1.3.1 EPA Method 5X (Provisional)

Provisional Method 5X is similar to the Oregon Department of Environmental Quality (ODEQ) Method 7 used to measure condensible organic emissions. EPA Method 5X measures particulate matter and condensible organic matter. "Particulate matter" is defined as any finely divided solid or liquid material,

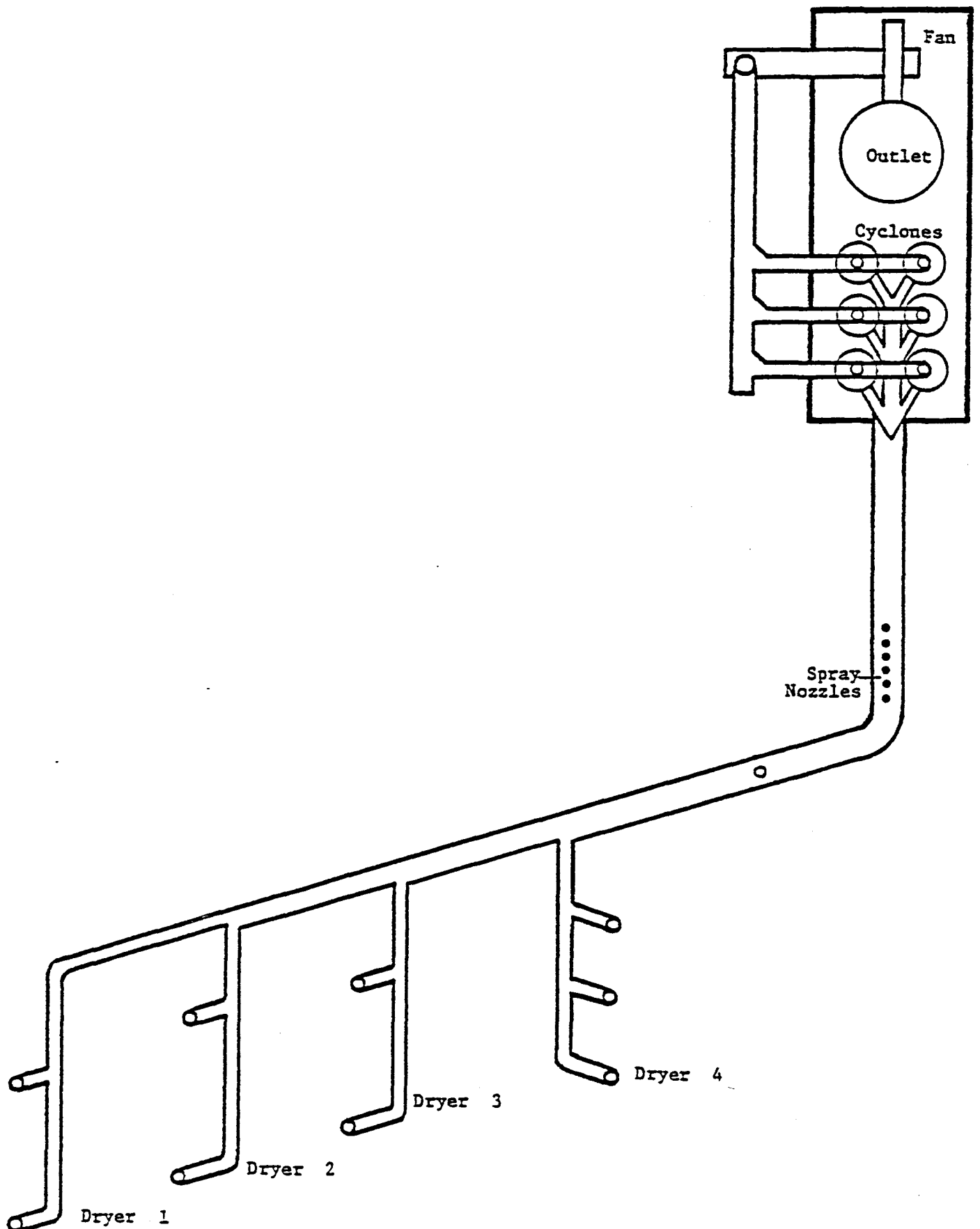


Figure 1-1. Veneer Dryer Exhaust and Scrubber System  
Georgia-Pacific Plywood Plant  
Springfield, Oregon

other than uncombined water, that condenses at or above the filtration temperature range of  $350 \pm 25^{\circ}\text{F}$  ( $177 \pm 14^{\circ}\text{C}$ ), and is collected by the probe and filter (front half of the sampling train). "Condensible organic matter" is defined as any material remaining after extraction, filtration and ambient evaporation of the ether-chloroform extract of the impinger portion of the sampling train. Particulate matter and condensible organic matter are quantified gravimetrically and results are expressed as the mass of collected material.

The purpose of the  $350^{\circ}\text{F}$  filtration temperature is to precondition the Method 25 slipstream sample being withdrawn from the Method 5X sample stream. This temperature was selected on the basis of average veneer dryer operating temperatures throughout the industry. This temperature condition excludes from the Method 25 samples only matter that can condense at or above  $350^{\circ}\text{F}$ . It does not affect Method 5X results because the remaining sample is caught in the condenser portion of the train.

#### 1.3.2 EPA Method 25

EPA Reference Method 25, as promulgated in the October 3, 1980 Federal Register (volume 145, no. 194, 65959 ff.), applies to the measurement of organic compounds as total gaseous nonmethane organics (TGNMO). Emissions are expressed as equivalent carbon ( $\text{C}_1$ ) mass. Method 25 sample fractions are separated by a gas chromatographic column, oxidized to carbon dioxide ( $\text{CO}_2$ ), and reduced to methane ( $\text{CH}_4$ ) prior to analysis by flame ionization detector (FID). Since all the sample organic compounds are reduced to  $\text{CH}_4$ , the problems associated with the variable FID response characteristic for different organic compound structures is eliminated. This allows comparison of emission data on a uniform  $\text{C}_1$  basis. Method 25 is discussed in greater detail in Section 5 of this report.

Major procedural modifications made to Method 25 were required to measure accurately emissions from plywood veneer drying facilities. These modifications are discussed in Section 5. An additional condensate trap immersed in water ice was placed in the sampling train ahead of the standard dry ice immersed condensate trap. The purpose of the additional trap is to condense moisture that would freeze in the dry ice immersed trap and cause a premature sample flow stoppage. In this manner gas stream moisture content, which may range from 30 to 60 percent by volume, may effectively be reduced to 3 percent or less before entering the dry ice immersed trap.

The use of the Method 5X sampling train as a sample preconditioner also represents a major modification. In addition to the 350<sup>o</sup>F sample stream temperature, isokinetic sample extraction from the source using Method 5X was also deemed necessary to obtain a representative Method 25 sample. This is particularly the case when moisture-saturated gas streams, such as those following wet scrubbing devices, are being sampled. Entrained water droplets may contain organic materials that would not be collected using the normal Method 25 constant sampling rate procedure.

#### 1.3.3 Comparability of Test Methods

Methods 5X and 25 are not related and measured results can not be compared under any circumstances. Condensation temperatures differ by more than 100<sup>o</sup>F between the two methods, and consequently different condensible compounds are collected by each method. In addition, it has been demonstrated that Method 5X has limited collection capabilities for organic compounds with high-vapor pressures. A loss of organic material is experienced even during normal Method 5X sample recovery and analysis operations.

#### 1.4 Measurement Program Summary

The measurement program was conducted at the G-P Springfield facility during the week of June 8, 1981. The emission tests were designed to measure the veneer dryer organic emissions and to determine the collection efficiency of the G-P scrubber system for those emissions. Tests were performed at the veneer dryer exhaust duct (scrubber inlet) and at the outlet of the scrubber system.

All emission testing was performed by TRC and NCASI personnel. RTI personnel monitored process operating conditions, while DGA personnel monitored fugitive emissions, ambient temperature and relative humidity. Scrubber operational data and solution samples were collected by TRC personnel.

##### 1.4.1 Scrubber Inlet

###### Preliminary Measurements

Preliminary testing was performed on June 8 to determine volumetric flow rate and stack gas moisture content.

###### Method 5X - Particulate and Condensible Organics Tests

Three Method 5X tests were performed, one each on June 9, 10, and 11, concurrently with tests performed at the scrubber outlet.

###### Method 25 - Total Organic Tests

Eighteen Method 25 samples were taken at this location concurrently with the Method 5X tests performed. Six Method 25 samples were taken concurrently with each Method 5X test.

##### 1.4.2 Scrubber Outlet

###### Preliminary Measurements

Preliminary tests were performed on June 8 to determine volumetric flow rate and stack gas moisture content.

###### Method 5X - Particulate and Condensible Organics Tests

Three Method 5X tests were performed at this location, one each on June 9, 10, and 11 concurrently with tests performed at the scrubber inlet.

#### Method 25 - Total Organic Tests

Eighteen Method 25 samples were taken at this location concurrently with the Method 5X samples (six per test run), and simultaneously with Method 25 samples taken at the scrubber inlet.

#### Method 9 - Visible Emissions

Scrubber outlet visible emissions were not monitored as planned because of overcast sky background conditions. The scrubber outlet plume was bluish-white and was therefore indistinguishable from the overcast sky. Overcast skies were present on June 8, 9 and 10. During the last test day, June 11, the sky began to clear and only scattered clouds were present in the afternoon. However, the final test sequence was nearly completed by this time. Consequently, no visible emission observations were recorded.

Although the scrubber outlet stack had an attached steam plume, the Method 9 observations were not cancelled because of this condition. The method provides for attached steam plumes by requiring that observations be made at the point where the condensed water vapor is no longer visible.

#### 1.4.3 Georgia-Pacific Scrubber System

Static pressure upstream and downstream of the system induced draft fan was measured with U-tube water manometers and recorded at 30-minute intervals. These measurements were used to calculate pressure drop ( $\Delta P$ ) across the scrubber system.

Scrubber solution samples were taken every 30 minutes during the scrubber outlet Method 5X test period. One-hundred-ml samples were collected from the scrubber recirculation tank every 30 minutes during each test. The individual samples collected during each test were composited for analysis.

#### 1.4.4 Fugitive Emissions

Fugitive emissions from the veneer dryers were monitored by DGA during each Method 5X test.

#### 1.4.5 Ambient Air Measurements

Ambient air temperature and relative humidity were monitored and recorded by DGA at the beginning and end of each Method 5X test.



#### 1.4.6 Clean-Up Evaluations

Prior to any emission testing, two Method 5X sampling trains were prepared and charged, ready to perform a test. The unexposed trains were then cleaned according to the method and samples recovered. The samples were analyzed to establish background and/or contamination levels from the sample collection equipment.

#### 1.5 Report Sections

The remaining sections of this report present the Summary and Discussion of Results (Section 2), Process Description and Operations (Section 3), Description of Sampling Locations (Section 4), Sampling and Analytical Procedures (Section 5), and Quality Assurance (Section 6). Descriptions of methods and procedures, field and laboratory data, and calculations are presented in various appendices as noted in the Table of Contents.

## 2.0 SUMMARY AND DISCUSSION OF RESULTS

A summary of all emission measurements and collected data is presented in this section. Section 2.1 provides a brief background discussion and definitions of measured parameters. Section 2.2 presents Method 5X particulate/condensable organics results with a complete breakdown and discussion of parameters at both sampling sites. Method 25 total organic emission results are described in detail in Section 2.3, which includes a discussion of emissions at both sampling sites as well as a breakdown of major analytical data. Section 2.4 discusses visible emissions observations. A summary of scrubber operational data is presented in Section 2.5. Fugitive emissions are discussed in Section 2.6. A summary of ambient air measurements is presented in Section 2.7. A full discussion of the Method 5X clean-up evaluation and results may be found in Section 2.8.

### 2.1 Background and Definitions

The test program was designed to measure particulate matter, condensable and noncondensable organic material emitted from veneer dryers, and to determine the collection efficiency of the G-P scrubber system as a control for those emissions.

#### 2.1.1 Particulate Emissions

Particulate emissions are defined as any finely divided solid or liquid matter, other than uncombined water, that condenses at or above  $350 \pm 25^{\circ}\text{F}$  ( $177 \pm 14^{\circ}\text{C}$ ) and is collected in the probe and filter (front half) of the Method 5X sampling train.

### 2.1.2 Condensible Emissions

Condensible emissions are defined differently in Methods 5X and 25. Although called by the same name, these two sample fractions differ significantly in content and composition and may not under any circumstances be compared.

Method 5X condensibles are collected in glass impingers containing deionized distilled water and immersed in a water ice bath, and on a back-up filter following those impingers. Any material remaining after extraction, filtration and ambient evaporation of the impinger solution, plus any material collected on the desiccated back-up filter, is defined as condensible organic matter. Quantification of this matter is done gravimetrically.

Method 25 condensibles are collected in two stainless-steel traps, one immersed in water ice followed by another packed in dry ice. Material collected in the traps is oxidized, reduced and analyzed by flame ionization. Results are expressed as a concentration of carbon ( $C_1$ ).

### 2.1.3 Noncondensable Emissions

Noncondensable emissions are measured by Method 25 only and are those that pass through both ice traps to the evacuated sample tank at the end of the Method 25 train. These samples are oxidized, reduced and analyzed by FID. Results are expressed as concentrations of carbon ( $C_1$ ).

### 2.1.4 Total Organic Emissions

Total organic emissions are those collected by the complete Method 25 sampling train drawing a preconditioned sample slipstream from a Method 5X train. These emissions include condensible and noncondensable emissions as defined above.

## 2.2 Method 5X - Particulate/Condensible Organics Emission Tests

A summary of Method 5X data collected at the scrubber inlet and outlet is presented in Tables 2-1a (English units) and 2-1b (metric units). These tables include relevant emission data: stack gas temperature, moisture content and volumetric flow rate; veneer dryer production rate; and a summary of the total measured particulate/condensible emissions by concentration, mass emission rate, and emission rate per unit production.

Emission data are presented for the three test series. Testing was performed concurrently at the scrubber inlet and outlet. Emissions at the scrubber inlet averaged 18.3 lbs/hr (8.29 kg/hr) or 0.53 lbs/1000 ft<sup>2</sup> veneer on a 3/8-inch basis (2.56 kg/1000 m<sup>2</sup> on 9.5 mm basis) for the three tests. Emissions from the scrubber outlet averaged 14.9 lbs/hr (6.77 kg/hr) or 0.43 lbs/1000 ft<sup>2</sup> veneer (2.10 kg/1000 m<sup>2</sup>) for the three tests. The concentrations of the emissions from the two sources, however, differed markedly. The average scrubber inlet concentration was 0.164 gr/DSCF (0.376 g/NM<sup>3</sup>), while the scrubber outlet averaged only 0.103 gr/DSCF (0.236 g/NM<sup>3</sup>) for the three tests.

The removal efficiency of the G-P scrubber system for particulate/condensible organics averaged 16.4 percent for the three tests. Efficiencies ranged from 29 percent during test 1 to 6 percent during test 3.

Detailed summaries of this test data are presented in Sections 2.2.1 and 2.2.2 and in Appendix A. Sample equations and calculations are presented in Appendix B. Field data sheets appear in Appendix C. Sampling logs and summaries are shown in Appendix D. Calibration data for the Method 5X sampling train are found in Appendix F. Laboratory analysis data are presented in Appendix G.

TABLE 2-1a (English Units)

SUMMARY OF METHOD 5X PARTICULATE AND CONDENSIBLE ORGANIC  
COLLECTION EFFICIENCY FOR GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 6-9-81		Run 2 6-10-81		Run 3 6-11-81		Average	
Emission Description:	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled
Volume Gas Sampled (DSCF) <sup>a</sup>	45.3	38.3	42.1	37.3	42.4	37.4	43.3	37.7
Stack Gas Flow Rate (DSCFM) <sup>b</sup>	12400	15200	12000	17500	12600	16100	12300	16300
Stack Temperature (°F)	303	166	314	166	309	168	309	167
Percent Moisture of Volume <sup>c</sup>	31.9	38.3 (37.4) <sup>e</sup>	34.0	37.5 (37.4) <sup>e</sup>	31.8	39.6 (39.3) <sup>e</sup>	32.6	38.5 (38.0) <sup>e</sup>
Percent Isokinetic	116.5	120.4	111.4	102.1	99.2	111.3	109.0	111.3
Scrubber Pressure Drop (inches H <sub>2</sub> O)	14.2			15.0		13.9		14.4
Production Rate (1000 ft <sup>3</sup> /hr) <sup>d</sup>	35.7			34.4		34.1		34.7
<u>Particulate-Condensible Results</u>								
<u>Total Catch</u>								
gr/DSCF	0.198	0.115	0.169	0.107	0.124	0.086	0.164	0.103
lbs/hour	23.0 <sup>f</sup>	16.3 <sup>f</sup>	18.5 <sup>f</sup>	15.9	13.4	12.6 <sup>f</sup>	18.3	14.9
lbs/1000 ft <sup>3</sup>	0.644	0.456	0.538	0.462	0.393	0.370	0.525	0.429
Scrubber System Collection Efficiency (%)	29.1			14.1		5.97		16.4

<sup>a</sup> Standard conditions; 29.92 inches Hg at 68°F.<sup>b</sup> Outlet volumetric flows (DSCFM) suspected to be slightly biased high due to possible wind interference.<sup>c</sup> Outlet moisture results calculated with psychometric equation. (See Section 5.)<sup>d</sup> 1000 square feet veneer per hour on 3/8 inch basis; includes trim factor; does not account for redry material.<sup>e</sup> Theoretical moisture content at saturation ( ); all results based on this.<sup>f</sup> Results are average of concentration and area ratio methods due to high isokinetic values. (See Table 2-4.)

TABLE 2-1b (Metric Units)

SUMMARY OF METHOD 5X PARTICULATE AND CONDENSIBLE ORGANIC  
COLLECTION EFFICIENCY FOR GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 6-9-81		Run 2 6-10-81		Run 3 6-11-81		Average	
Emission Description:	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled
Volume Gas Sampled (NM <sup>3</sup> ) <sup>a</sup>	1.28	1.08	1.19	1.06	1.20	1.06	1.23	1.07
Stack Gas Flow Rate (NM <sup>3</sup> /Min) <sup>b</sup>	351	430	340	495	357	456	348	461
Stack Temperature (°C)	151	74.4	157	74.4	154	75.6	154	75.0
Percent Moisture of Volume <sup>c</sup>	31.9	38.3 (37.4) <sup>e</sup>	34.0	37.5 (37.4) <sup>e</sup>	31.8	39.6 (39.3) <sup>e</sup>	32.6	38.5 (38.0) <sup>e</sup>
Percent Isokinesis	116.5	120.4	111.4	102.1	99.2	111.3	109.0	111.3
Scrubber Pressure Drop (mm H <sub>2</sub> O)		55.9		59.1		54.7		56.7
Production Rate (1000 m <sup>3</sup> /hr) <sup>d</sup>	3.32		3.20		3.17		3.22	
<u>Particulate-Condensible Results</u>								
<u>Total Catch</u>								
g/NM <sup>3</sup>	0.454	0.263	0.387	0.245	0.284	0.197	0.376	0.236
kg/hour	10.4 <sup>f</sup>	7.39 <sup>f</sup>	8.39 <sup>f</sup>	7.21	6.08	5.72 <sup>f</sup>	8.29	6.77
kg/1000 ft <sup>3</sup>	3.14	2.23	2.62	2.26	1.92	1.80	2.56	2.10
Scrubber System Collection Efficiency %	28.9		14.1		5.92		16.3	

<sup>a</sup> Standard conditions: 760 mm Hg at 20°C.<sup>b</sup> Outlet volumetric flows (NM<sup>3</sup>/min) suspected to be slightly biased high due to possible wind interference.<sup>c</sup> Outlet moisture calculated with psychometric equation. (See Section 5.)<sup>d</sup> 1000 square meters veneer per hour on 9.5 millimeter basis; included trim factor; does not account for redry material.<sup>e</sup> Theoretical moisture content at saturation ( ); all results based on this.<sup>f</sup> Results are average of concentration and area ratio methods due to high isokinetic values. (See Table 2-4.)

### 2.2.1 Scrubber Inlet

A summary of Method 5X data collected at the scrubber inlet is presented in Table 2-2. Data presented include sample volume; stack gas flow rate, temperature, and moisture content; isokinesis for each test; veneer production rate; front half (particulate) and total (particulate/condensable) emissions.

Tests 1, 2 and 3 were performed at the scrubber inlet on June 9, 10, and 11, respectively. Measured particulate emissions ranged from 0.77 to 2.93 lbs/hr (0.02 to 0.08 lbs/1000 ft<sup>2</sup> veneer), averaging 1.83 lbs/hr (0.05 lbs/1000 ft<sup>2</sup> veneer). Total particulate/condensable emissions ranged from 13.4 to 23.0 lbs/hr (0.39 to 0.64 lbs/1000 ft<sup>2</sup> veneer) for an average of 18.3 lbs/hr (0.53 lbs/1000 ft<sup>2</sup> veneer). Particulate matter accounted for approximately 10 percent of the total sample weight while the remaining 90 percent of the catch was condensable organics.

Measured particulate grain loadings averaged 0.016 gr/DSCF for tests 1, 2 and 3; ranging from 0.007 to 0.025 gr/DSCF. Total particulate/condensable grain loadings ranged from 0.124 to 0.198 gr/DSCF, for a three-test average of 0.164 gr/DSCF. The bulk of the total emission concentration was accounted for by condensable organics (90 percent).

The average stack gas temperature was 309<sup>o</sup>F with an average moisture content of 32.6 percent. Moisture content varied from 31.8 percent to 34.0 percent over the three tests. The average stack gas flow rate was 12,300 DSCFM and did not vary significantly among the three tests.

Isokinesis averaged 109 percent for the three tests performed. Isokinesis for test 1 was 116.5 percent due to a nomograph calculation error, while test 2 was high at 111.4 percent due to a higher than expected gas stream moisture content. Isokinesis was acceptable for test 3 at 99.2 percent. Leak checks were performed at the conclusion of each test and leak rates were acceptable at less than 0.02 cfm.

TABLE 2-2

SUMMARY OF METHOD 5X PARTICULATE AND CONDENSIBLE ORGANIC MEASUREMENTS  
FOR GASES ENTERING THE GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 6-9-81	Run 2 6-10-81	Run 3 6-11-81	Average
Volume Gas Sampled (DSCF) <sup>a</sup>	45.3	42.1	42.4	43.3
Stack Gas Flow Rate (DSCFM)	12400	12000	12600	12300
Stack Temperature (°F)	303	314	309	309
Percent Moisture by Volume	31.9	34.0	31.8	32.6
Percent Isokinesis	116.5	111.4	99.2	109.0
Production Rate (1000 ft <sup>2</sup> /hr) <sup>b</sup>	35.7	34.4	34.1	34.7
<u>Particulate-Condensible Results</u>				
<u>Front Half Catch (Probe and Filter)</u>				
milligrams	74.2	44.2	19.7	46.0
gr/DSCF	0.0253	0.0162	0.0072	0.0162
lbs/hour	2.93 <sup>c</sup>	1.67 <sup>c</sup>	0.77	1.71
1000 ft <sup>2</sup>	0.082	0.049	0.023	0.049
<u>Total Catch</u>				
milligrams	582.3	459.6	340.6	460.8
gr/DSCF	0.198	0.169	0.124	0.164
lbs/hour	23.0 <sup>c</sup>	18.5 <sup>c</sup>	13.4	18.3
lbs/1000 ft <sup>2</sup>	0.644	0.538	0.393	0.525
Percent Condensible Emissions	87.3	90.4	94.2	90.0

<sup>a</sup> Standard Conditions: 29.92 inches Hg at 68°F.

<sup>b</sup> 1000 square feet veneer per hour on 3/8 inch basis; includes trim factor; does not account for redry material.

<sup>c</sup> Results are average of concentration and area ratio methods due to high isokinetic values. (See Table 2-4.)



The mass emission rates for tests 1 and 2 were recalculated using the area ratio method because of the unacceptable anisokinetic conditions. The results are presented in Table 2-4 and are only slightly higher than those obtained from the concentration method, which is the normal approach. This result is probably due to the small percentage of particulate matter in the gas stream which would escape collection by the sampling nozzle under superisokinetic sampling conditions. An explanation of the area ratio method for calculating mass emission rates is presented in Section 5.3.1.4 of this report. Mass emission rates presented in Tables 2-1 and 2-2 represent the average of the two calculation methods for tests 1 and 2.

#### 2.2.2 Scrubber Outlet

A summary of Method 5X data collected at the scrubber outlet is presented in Table 2-3. Data presented include sample volume; stack gas flow rate, temperature, and moisture content; isokinesis for each test; veneer production rate; front half (particulate) and total (particulate/condensable) emissions.

Three emission tests were performed at the scrubber outlet. Testing was performed concurrently with tests at the scrubber inlet on June 9, 10 and 11.

Measured particulate emissions for tests 1, 2 and 3 ranged from 2.59 (0.08 lbs/100 ft<sup>2</sup>) to 3.70 lbs/hr (0.11 lbs/1000 ft<sup>2</sup>), averaging 3.20 lbs/hr (0.09 lbs/1000 ft<sup>2</sup> veneer). Total measured particulate/condensable emissions ranged from 12.6 lbs/hr (0.37 lbs/1000 ft<sup>2</sup>) for test 3 to 16.3 lbs/hr (0.46 lbs/1000 ft<sup>2</sup>) for test 1. The average total emission rate was 14.9 lbs/hr (0.43 lbs/1000 ft<sup>2</sup> veneer). Particulate material collected during these three tests accounted for approximately 21 percent of the total emissions on the average, while the remaining 79 percent was condensable organics.

TABLE 2-3

SUMMARY OF METHOD 5X PARTICULATE AND CONDENSIBLE ORGANIC MEASUREMENTS  
FOR GASES EXITING THE GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 6-9-81	Run 2 6-10-81	Run 3 6-11-81	Average
Volume Gas Sampled (DSCF) <sup>a</sup>	38.3	37.3	37.4	37.7
Stack Gas Flow Rate (DSCFM) <sup>b</sup>	15200	17500	16100	16300
Stack Temperature (°F)	166	166	168	167
Percent Moisture by Volume <sup>c</sup>	38.3 (37.4) <sup>e</sup>	37.5 (37.4) <sup>e</sup>	39.6 (39.3) <sup>e</sup>	38.5 (38.0) <sup>e</sup>
Percent Isokinesis	120.4	102.1	111.3	111.3
Production Rate (1000 ft <sup>3</sup> /hr) <sup>d</sup>	35.7	34.4	34.1	34.7
<u>Particulate-Condensible Results</u>				
<u>Front Half Catch (Probe and Filter)</u>				
milligrams	56.9	41.9	61.6	53.5
gr/DSCF	0.023	0.017	0.025	0.022
lbs/hour	3.30 <sup>f</sup>	2.59	3.70 <sup>f</sup>	3.20
lbs/1000 ft <sup>3</sup>	0.092	0.075	0.109	.092
<u>Total Catch</u>				
milligrams	286.9	257.6	208.8	251.1
gr/DSCF	0.115	0.107	0.086	0.103
lbs/hour	16.3 <sup>f</sup>	15.9	12.6 <sup>f</sup>	14.9
lbs/1000 ft <sup>3</sup>	0.457	0.462	0.370	0.430
Percent Condensible Emissions	80.2	83.7	70.5	78.7

<sup>a</sup> Standard Conditions: 29.92 inches Hg at 68°F.

<sup>b</sup> Outlet volumetric flows (DSCFM) suspected to be slightly biased high due to possible wind interference.

<sup>c</sup> Actual measured moisture adjusted to saturated conditions using psychometric equation. (See Section 5.)

<sup>d</sup> 1000 ft<sup>3</sup> per veneer hour on 3/8 in. basis; includes trim factor; does not account for redry material.

<sup>e</sup> Theoretical moisture content at saturation ( ), all results based on this.

<sup>f</sup> Results are average of concentration and area ratio methods due to high isokinetic values. (See Table 2-4.)

TABLE 2-4

COMPARISON OF PARTICULATE AND CONDENSIBLE MEASURED EMISSIONS  
WITH CALCULATED EMISSIONS  
(Concentration Method vs. Area Ratio Method)

Georgia-Pacific Plywood Plant, Springfield, Oregon

Sample No.	Sample Fraction	Emission Rate (lbs/hr)		Average
		Concentration Method	Area-Ratio Method	
5X-1-Inlet (%I* = 116.5)	Front half	2.69	3.16	2.93
	Back half	18.4	21.6	20.0
	Total	21.1	24.8	23.0
5X-2-Inlet (%I* = 111.4)	Front half	1.67	1.88	1.78
	Back half	15.7	17.7	16.7
	Total	17.4	19.6	18.5
5X-1-Outlet (%I* = 120.4)	Front half	2.98	3.59	3.30
	Back half	12.0	14.5	13.3
	Total	15.0	18.1	16.3
5X-3-Outlet (%I* = 111.3)	Front half	3.51	3.89	3.70
	Back half	8.39	9.30	8.85
	Total	11.9	13.2	12.6

\* isokinesis

Particulate grain loadings measured at the scrubber outlet averaged 0.022 gr/DSCF for these tests, ranging from 0.017 gr/DSCF to 0.025 gr/DSCF. Total grain loadings (particulate/condensable) ranged from 0.086 to 0.115 gr/DSCF, averaging 0.103 gr/DSCF for the three tests.

The average stack gas temperature measured during the three tests was 167°F. The measured moisture content of the gas stream averaged 38.5 percent for the three tests with slight variation.

The moisture content of the gas stream as measured during each test exceeded saturation at the measured temperature. This phenomenon was not surprising since entrained water droplets were observed in the gas stream by TRC and EPA personnel. In accordance with EPA Method 4, the gas stream moisture content was recalculated assuming saturation of the gas stream at the average stack gas temperature for each test. An explanation of this procedure is presented in Section 5.3.1.4. Recalculated gas stream moisture contents ranged from 37.4 percent for tests 1 and 2 to 39.3 percent for test 3, averaging 38.0 percent. These saturation moisture values were carried through the remainder of the emission calculations.

Measured stack gas flow rates ranged from 15,200 DSCFM to 17,500 DSCFM, averaging 16,300 DSCFM. The average outlet stack gas flow rate was measured to be approximately 25 percent greater than that measured entering the scrubber system. One reason for the difference in the flow rate measurements may be leaks within the system (around spray nozzles, in the cyclone ductwork, and before the fan) which would draw ambient air into the system. Another reason may be the inherent inaccuracy of EPA Method 2 at stack gas velocities of approximately 500 feet per minute (fpm). A third possible reason is wind interference. Since sampling was performed only 9 feet from the top of a 9 foot i.d. stack, even a small gust of wind created turbulence within the

duct. Momentary negative flow rates were indeed observed during the test program. These reasons may account for the differences between the measured inlet and outlet flow rates as well as the wide variation in measured flow rates from test to test.

Isokinesis was acceptable only for test 2 at 102 percent. Isokinesis was unacceptable for tests 1 and 3 at 120.4 percent and 111.3 percent, respectively. The average isokinesis for the three tests performed was 111.3 percent. Varying stack gas moisture content was a major factor affecting the unacceptable isokinetic conditions. The preliminary determination indicated 15.8 percent moisture, but measured moistures were more than twice this during the subsequent tests. It was later discovered that different grades of veneer with varying moisture contents were dried throughout the test program, as shown in Table 3-1.

The mass emission rates for tests 1 and 3 were recalculated using the area ratio method because of unacceptable superisokinetic conditions. The results are presented in Table 2-4 and are only slightly higher than those obtained from the concentration method, which is the normal approach. This fact is probably due to the small percentage of particulate matter in the gas stream which would escape collection by the sampling nozzle under anisokinetic sampling conditions. An explanation of the area ratio method for calculating mass emission rates is presented in Section 5.3.1.4 of this report. Mass emission rates presented in Tables 2-1 and 2-3 are the average of the two calculation methods for tests 1 and 3. Leak checks were performed at the conclusion of each test and leak rates were acceptable at less than 0.02 cfm. Some difficulty was encountered maintaining probe and filter outlet temperatures at  $350 \pm 25^{\circ}\text{F}$  during these tests. Further discussion is presented in Section 5.3.1.1.

### 2.3 Method 25 - Total Organic Tests

A summary of the Method 25 total organic data (condensable and noncondensable) collected at the scrubber inlet and outlet is presented in Tables 2-5a (English units), 2-5b (metric units). These tables include TRC, PCS, and NCASI average emission data: stack gas flow rate, moisture content and temperature; veneer drying production rate, and a summary of the total organic emissions by concentration, mass emission rate, and emission rate per unit production. All emissions are expressed as carbon ( $C_1$ ). NCASI calculates the emission rate as lbs/hr equivalent methane ( $CH_4$ ) instead of carbon ( $C_1$ ). Their data in the tables have been converted to lbs/hr  $C_1$  to present the data on a consistent basis, conforming with Method 25.

Emission data are presented for the three test series. Testing was performed simultaneously at the scrubber inlet and outlet on June 9, 10 and 11. Total organic emissions entering the scrubber system ranged from 23.8 lbs/hr (10.6 kg/hr) or 0.67 lbs/1000 ft<sup>2</sup> veneer (3.20 kg/1000 m<sup>2</sup>) to 35.8 lbs/hr (16.2 kg/hr) or 1.05 lbs/1000 ft<sup>2</sup> (5.10 kg/1000 m<sup>2</sup>), averaging 30.2 lbs/hr (13.6 kg/hr) or 0.87 lbs/1000 ft<sup>2</sup> veneer (4.22 kg/1000 m<sup>2</sup>). Emissions exiting the scrubber system ranged from 30.9 lbs/hr (13.8 kg/hr) to 43.6 lbs/hr (19.6 kg/hr) or 1.22 lbs/1000 ft<sup>2</sup> (5.87 kg/1000 m<sup>2</sup>) for an average emission rate of 38.8 lbs/hr (17.5 kg/hr) or 1.12 lbs/1000 ft<sup>2</sup> veneer (5.39 kg/1000 m<sup>2</sup>). The collection efficiency of the system was measured to be less than zero for tests 1 and 2 and 13.7 percent for test 3. The average collection efficiency of the scrubber system was less than zero.

Detailed summaries of these test data are presented in Sections 2.3.1 and 2.3.2, and in Appendix A. Sample equations and calculations are presented in Appendix B. Field data sheets appear in Appendix C. Sampling logs and summaries are shown in Appendix D. Laboratory analysis data are presented in Appendix G.

TABLE 2-5a (English Units)

SUMMARY OF METHOD 25 TOTAL ORGANIC COLLECTION  
EFFICIENCY FOR GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 6-9-81		Run 2 6-10-81		Run 3 6-11-81		Average	
Emission Description:	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled
Stack Gas Flow Rate (DSCFM) <sup>a, b</sup>	12,400	15,200	12,000	17,500	12,600	16,100	12,300	16,300
Stack Temperature (°F)	303	166	314	166	309	168	304	167
Percent Moisture by Volume <sup>c</sup>	31.9	37.4	34.0	37.4	31.8	39.3	32.6	38.0
Scrubber Pressure Drop (inches H <sub>2</sub> O)	14.2		15.0		13.9		14.4	
Production Rate (1000 ft <sup>3</sup> /hr) <sup>d</sup>	35.7		34.4		34.1		34.7	
<u>Total Organic Results<sup>e</sup></u>								
parts/million, C <sub>1</sub>	1,027	1,536	1,389	1,286	1,524	1,030	1,313	1,284
gr/DSCF, C <sub>1</sub>	0.22	0.33	0.30	0.28	0.33	0.22	0.28	0.28
lbs/hour, C <sub>1</sub>	23.8	43.6	31.1	42.0	35.8	30.9	30.2	38.8
lbs/1000 ft <sup>3</sup> , C <sub>1</sub>	0.67	1.22	0.90	1.22	1.05	0.91	0.87	1.12
System Collection Efficiency (%)	<0		<0		13.7		<0	

<sup>a</sup> Standard conditions: 29.92 inches Hg at 68°F.<sup>b</sup> Outlet volumetric flows (DSCFM) suspected to be slightly biased high due to possible wind interference.<sup>c</sup> Actual measured moisture adjusted to saturated conditions using psychometric equation (controlled emissions only).<sup>d</sup> 1000 square feet veneer per hour on 3/8 inch basis; includes trim factor; does not account for redry material.<sup>e</sup> Emission results calculated and reported as C<sub>1</sub>. Does not include front half results from Method 5X collector, and cannot be compared with Method 5X mass determinations.

TABLE 2-5b (Metric Units)

SUMMARY OF METHOD 25 TOTAL ORGANIC COLLECTION  
EFFICIENCY FOR GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 6-9-81		Run 2 6-10-81		Run 3 6-11-81		Average	
Emission Description:	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled
Stack Gas Flow Rate (NM <sup>3</sup> /Min) <sup>a, b</sup>	351.2	430.2	339.8	495.6	356.8	456.0	348.3	461.6
Stack Temperature (°C)	150.6	74.4	156.7	74.4	153.9	75.6	154	74.8
Percent Moisture by Volume <sup>c</sup>	31.9	37.4 <sup>f</sup>	34.0	37.4 <sup>f</sup>	31.8	39.3 <sup>f</sup>	32.6	38.0 <sup>f</sup>
Scrubber Pressure Drop (mm H <sub>2</sub> O)	360.7		381.0		353.1		365.8	
Production Rate (1000 meters <sup>2</sup> /hr) <sup>d</sup>	3.32		3.20		3.17		3.22	
<u>Total Organic Results<sup>e</sup></u>								
parts/million, C <sub>1</sub>	1,027	1,536	1,389	1,286	1,524	1,030	1,313	1,284
g/DSCP, C <sub>1</sub>	0.50	0.76	0.69	0.64	0.76	0.50	0.62	0.63
kg/hour, C <sub>1</sub>	10.6	19.5	14.0	19.1	16.2	14.0	13.6	17.5
kg/1000 m <sup>2</sup> , C <sub>1</sub>	3.20	5.87	4.37	5.95	5.10	4.42	4.22	5.41
System Collection Efficiency (%)	<0		<0		13.6		<0	

<sup>a</sup> Standard conditions: 760 mm Hg at 20°C.<sup>b</sup> Outlet volumetric flows (NM<sup>3</sup>/min) suspected to be slightly biased high due to possible wind interference.<sup>c</sup> Actual measured moisture adjusted to saturated conditions using psychometric equation (controlled emissions only).<sup>d</sup> 1000 square meters veneer per hour on 9.5-mm basis; includes trim factor; does not account for redry material.<sup>e</sup> Emission results calculated and reported as C<sub>1</sub>. Does not include front half results from Method 5X collector, and cannot be compared with Method 5X mass determinations.<sup>f</sup> Theoretical moisture content at saturation.



### 2.3.1 Scrubber Inlet

A summary of Method 25 condensible and noncondensable organics data collected at the scrubber inlet is presented in Tables 2-6 and 2-8. Table 2-6 shows relevant emission data and presents total organic emissions calculated by TRC, PCS, and NCASI as concentration, mass emission rate, and emission rate per unit production. Table 2-8 presents a breakdown of the total organic emissions into condensible and noncondensable organics as analyzed by the three laboratories. In addition, individual sample train analyses results are shown. The relative standard deviation between the paired sample trains is also presented.

Emissions of carbon ( $C_1$ ) from the scrubber as analyzed by TRC, PCS and NCASI showed good overall correlation. The precision of the test data between paired samples (relative standard deviation-RSD) was excellent overall, averaging 19.8 percent RSD for the three laboratories involved.

### 2.3.2 Scrubber Outlet

A summary of Method 25 condensible and noncondensable organics data collected at the scrubber outlet is presented in Tables 2-7 and 2-9. Table 2-7 shows relevant emission data and presents total organic emissions calculated by TRC, PCS and NCASI as concentration, mass emission rate, and emission rate per unit production. Table 2-9 presents a breakdown of the total organic emissions into condensible and noncondensable organics as analyzed by the three laboratories. In addition, individual sample train analyses results are shown. The relative standard deviation between paired sample trains is also presented.

Emissions of carbon ( $C_1$ ) from the scrubber as measured by TRC and NCASI showed good correlation. The average emissions calculated by TRC were slightly greater than those calculated by NCASI and PCS. There is no apparent

TABLE 2-6

SUMMARY METHOD 25 INDIVIDUAL TOTAL ORGANIC MEASUREMENTS  
FOR GASES ENTERING THE GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant Springfield, Oregon

Run Number Date	Run 1 6/9/81			Run 2 6/10/81			Run 3 6/11/81			Average		
Stack Gas Flow Rate (DSCFM) <sup>a</sup>	12,400			12,000			12,600			12,300		
Stack Temperature (°F)	303			314			309			309		
Percent Moisture by Volume	31.9			34.0			31.8			32.6		
Production Rate (1000 ft <sup>3</sup> /hr) <sup>b</sup>	35.7			34.4			34.1			34.7		
Laboratory Performing Analysis	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>
<u>Total Organic Results<sup>c</sup></u>												
parts/million, C <sub>1</sub>	1016	855	1210	1482	1392	1295	2137	1101	1334	1545	1116	1280
g/DSCF, C <sub>1</sub>	0.22	0.19	0.26	0.32	0.30	0.28	0.47	0.24	0.29	0.34	0.24	0.28
lbs/hour, C <sub>1</sub>	23.7	19.8	28.1	33.3	31.2	29.1	50.4	25.9	31.4	35.8	25.6	29.5
lbs/1000 ft <sup>3</sup> , C <sub>1</sub>	0.66	0.55	0.78	0.97	0.91	0.84	1.48	0.76	0.92	1.03	0.74	0.85

<sup>a</sup> Standard Conditions: 29.92 inches Hg at 68°F, NCASI uses 0°C.

<sup>b</sup> 1000 square feet veneer per hour on 3/8 inch basis; includes trim factor; does not account for redry material.

<sup>c</sup> Emission results calculated and reported as C<sub>1</sub>. Does not include front half results from Method 5X collection, cannot be compared with Method 5X mass determination.

TABLE 2-7

SUMMARY OF METHOD 25 INDIVIDUAL TOTAL ORGANIC MEASUREMENTS  
FOR GASES EXITING THE GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run Number Date	Run 1 10/9/81			Run 2 10/10/81			Run 3 10/11/81			Average		
Stack Gas Flow Rate (DSCFM) <sup>a, b</sup>	15,200			17,500			16,100			16,300		
Stack Temperature <sup>c</sup> F	166			166			168			167		
Percent Moisture by Volume <sup>c</sup>	37.4			37.4			39.3			38.0		
Production Rate (1000 ft <sup>3</sup> /hr) <sup>d</sup>	35.7			34.4			34.1			34.7		
Laboratory Performing Analysis	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>	<u>TRC</u>	<u>PCS</u>	<u>NCASI</u>
<u>Total Organic Results<sup>e</sup></u>												
parts/million, C <sub>1</sub>	1762	1538	1306	1694	941.6	1221	1264	903	923	1573	1127	1150
gr/DSCF, C <sub>1</sub>	0.38	0.33	0.28	0.37	0.20	0.27	0.28	0.20	0.20	0.34	0.25	0.25
lbs/hour, C <sub>1</sub>	50.1	43.7	37.2	55.5	30.8	40.0	38.1	27.2	27.8	48.0	34.2	35.1
lbs/1000 ft <sup>3</sup> , C <sub>1</sub>	1.40	1.22	1.04	1.61	0.90	1.16	1.12	0.80	0.82	1.38	0.99	1.01

<sup>a</sup> Standard Conditions: 29.92 inches Hg at 68°F, NCASI uses 0°C.

<sup>b</sup> Outlet flows suspected to be slightly biased high due to wind interference.

<sup>c</sup> Theoretical moisture content at saturation. (See Section 5.)

<sup>d</sup> 1000 square feet veneer per hour on 3/8 inch basis; includes trim factor; does not account for redry material

<sup>e</sup> Emission results calculated and reported as C<sub>1</sub>. Does not include front half results from Method 5X collector, and cannot be compared with Method 5X mass determinations.

TABLE 2-8

SUMMARY OF METHOD 25 INDIVIDUAL TOTAL ORGANIC TRAP, TANK MEASUREMENTS  
FOR GASES ENTERING THE GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

	Stack Gas Flow Rate DSCFM <sup>a</sup>	Sample I.D. No.	Lab	Condensible Catch		NonCondensible Catch (ppm)	Total Catch (ppm)	Pair Average (ppm)	Emission Rate (lbs/hr)	Relation Standard Deviation
				H <sub>2</sub> O	CO <sub>2</sub>					
				Ice Trap (ppm)	Ice Trap (ppm)					
Run 1										
June 9	12,400	1-A	TRC	477	300	409	1186	1016	23.7	4.22
		1-B	TRC	245	601	n.d.	846			
		1-C	PCS	509.7	267.7	25.0	802.4	855	19.8	11.6
		1-D	PCS	720.1	164.1	22.5	906.7			
		9-1	NCASI	N.A. <sup>b</sup>	1231.4	60.9	1292	1210	28.1	4.0
		9-2	NCASI	N.A. <sup>b</sup>	1045.6	82.3	1128			
		Average		488	601.6	100	1027	1027	23.8	6.6
Run 2										
June 10	12,000	2-A	TRC	483	163	804	1450	1482	33.3	32.2
		2-B	TRC	489	212	814	1515			
		2-C	PCS	539	352.2	433	1324	1392	31.2	14.6
		2-D	PCS	549.7	367.9	541.8	1459			
		10-1	NCASI	N.A. <sup>b</sup>	1531.1	63.3	1594	1295	29.1	3.06
		10-2	NCASI	N.A. <sup>b</sup>	863.2	132.0	995			
		Average		515	582	465	1389	1389	31.1	16.6
Run 3										
June 11	12,600	3-A	TRC	545	469	1102	2116	2137	50.4	70.3
		3-B	TRC	940	433	786	2159			
		3-C	PCS	469.0	550.8	159.2	1206	1101	25.9	7.4
		3-D	PCS	576.7	315.9	102.6	995.2			
		11-1	NCASI	N.A. <sup>b</sup>	1143.1	161.1	1304	1334	31.4	31.2
		11-2	NCASI	N.A. <sup>b</sup>	1155.2	209.4	1365			
		Average		639	678	420	1524	1524	35.8	36.3
Overall Average	12,300			547	621	328	1314	1314	30.2	19.8

<sup>a</sup> Standard Conditions: 29.92 inches Hg at 68°F; NCASI uses 0°C.<sup>b</sup> NCASI does not use an H<sub>2</sub>O ice trap in their train.

TABLE 2-9

SUMMARY OF METHOD 25 INDIVIDUAL TOTAL ORGANIC TRAP, TANK MEASUREMENTS  
FOR GASES EXITING THE GEORGIA-PACIFIC SCRUBBER SYSTEM

Georgia-Pacific Plywood Plant, Springfield, Oregon

Run	Stack Gas Flow Rate DSCFM <sup>a</sup>	Sample I.D. No.	Lab	Condensible Catch		Non-Condensable Catch (ppm)	Total Catch (ppm)	Pair Average (ppm)	Emission Rate (lbs/hr)	Relation Standard Deviation
				H <sub>2</sub> O Ice Trap (ppm)	CO <sub>2</sub> Ice Trap (ppm)					
Run 1										
June 9	15,200	1-A	TRC	815	278	546	1639	1762	50.1	10
		1-B	TRC	758	740	388	1886			
		1-C	PCS	1180.2	405.6	323.3	1909	1538	43.7	2.9
		1-D	PCS	905.0	116.6	145.5	1167			
		9-1	NCASI	N/A <sup>b</sup>	1242.9	49.2	1292	1307	37.2	63
		9-2	NCASI	N/A <sup>b</sup>	1276.3	44.9	1321			
		Average		915	676.6	249	1536	1536	43.6	25.3
Run 2	17,500	2-A	TRC	465	332	687	1484	1694	55.5	5.7
June 10		2-B	TRC	792	303	810	1905			
		2-C	PCS	579.9	117.5	316.8	1032	941.6	30.8	7.3
		2-D	PCS	571.0	102.4	177.5	850.9			
		10-1	NCASI	N/A <sup>b</sup>	1270.2	23.6	1294	1221	40.0	11.8
		10-2	NCASI	N/A <sup>b</sup>	1039.9	108.5	1148			
		Average		606	527	354	1286	1286	42.0	8.3
Run 3	16,000	3-C	TRC	831	196	443	1470	1264	38.1	4.3
June 11		3-D	TRC	441	193	424	1058			
		3-A	PCS	534.6	176.8	0	711.4	903	27.2	3.3
		3-B	PCS	414.3	641.1	39.0	1094			
		11-1	NCASI	N/A <sup>b</sup>	949.4	68.6	1018	923	27.8	6.9
		11-2	NCASI	N/A <sup>b</sup>	743.4	85.2	828.6			
		Average		555	483	177	1030	1030	30.9	4.8
Overall Average	16,300			692	562	260	1284	1284	38.8	12.8

<sup>a</sup> Standard conditions: 29.92 inches Hg at 68°F; NCASI uses 0°C.

<sup>b</sup> NCASI does not use an H<sub>2</sub>O ice trap in their train.

explanation for this difference. The precision of the test data between paired samples (relative standard deviation) was excellent overall, averaging 12.8 percent RSD for the three laboratories involved.

#### 2.4 Visible Emissions

Visible emissions observations were not conducted during this sampling program as planned. Overcast skies prevented an accurate determination of the scrubber outlet plume opacity. Further details of the decision to abort this phase of the test program are presented in Sections 1.4 and 5.7.

#### 2.5 Scrubber Operational Summary

A summary of operational parameters of the G-P scrubber system during the test program is presented in Table 2-10. Pressure drop measurements ( $\Delta P$ ) across the scrubber system are presented as well as scrubber solution analysis data.

Scrubber solution samples were taken from the recirculating tank every 30 minutes and then composited into one sample per test. Sample analyses for total organic carbon (TOC) ranged from 3,010 mg/l for test 1 to 2,860 mg/l for test 3, averaging 2,956 mg/l for the three tests.

Pressure drop ( $\Delta P$ ) measurements across the scrubber were made at 30 minute intervals during the test program. The  $\Delta P$  gradually increased during tests 1 and 2, and averaged 14.2 and 15.0 inches water, respectively. During test 3, however, the  $\Delta P$  peaked shortly after the start of testing and then gradually declined for the rest of the test, averaging 13.9 inches water. The three test average  $\Delta P$  was 14.4 inches water.

TABLE 2-10

## GEORGIA-PACIFIC SCRUBBER SYSTEM OPERATIONAL DATA SUMMARY

Georgia-Pacific Plywood Plant, Springfield, Oregon  
June 1981

Run Number	Date	Pressure Drop Measurements		Scrubber Solution	
		Time	$\Delta P$ (in. H <sub>2</sub> O)	Volume Collected (ml)	TOC (mg/l)
1	June 9	1400	12.5	800	3010
		1430	13.0		
		1500	14.0		
		1530	14.8		
		1600	14.5		
		1630	14.7		
		1700	15.1		
		<u>1730</u>	<u>15.2</u>		
		Average	14.2		
2	June 10	1300	14.7	700	3000
		1400	14.8		
		1430	15.0		
		1500	14.8		
		1530	15.2		
		1600	15.4		
		<u>1630</u>	<u>15.3</u>		
		Average	15.0		
3	June 11	1145	13.8	700	2860
		1215	14.5		
		1245	14.0		
		1315	13.9		
		1345	13.8		
		1415	14.2		
		<u>1445</u>	<u>12.9</u>		
		Average	13.9		

## 2.6 Summary of Fugitive Emissions (Provided by RTI)

The temperature and pressure changes that a veneer dryer is subjected to make it very difficult for a dryer to be completely air tight. Door seals and skins, green and dry end baffles, and abort stacks will with time all eventually develop leaks. Door seals and dryer skins most readily develop them. At Springfield all the dryers had fugitive emissions. The three older dryers leaked more from around the elephant ears than from individual door seals. The jet dryer also experienced door leaks with quality checks showing varying amounts from one day to another. It was impossible to estimate volume of fugitive gases from any fugitive source.

At the abort stacks there were also fugitive emissions. Very little was seen from the jet dryer abort stacks, while opacities (unofficially) up to 30 percent were seen from the other three dryer abort stacks. Cooling section air volumes are large. No bluish haze was seen coming from cooling section exhausts from the three longitudinal dryers. However, the jet dryer cooling stacks showed some bluish opacity.

All of the fugitive emissions evaluations were purely qualitative and visual. Tables 2-11a, 2-11b and 2-11c contain fugitive emission data.

## 2.7 Ambient Air Measurements

A summary of ambient temperature and relative humidity measurements by RTI and DGA is presented along with process information in Table 3-1. Ambient temperatures ranged from 54° to 75°F, while relative humidity ranged from 36 percent to 76 percent during the test program.



TABLE 2-11a

## FUGITIVE EMISSION SUMMARY

Georgia-Pacific Plywood Plant, Springfield, Oregon

(Provided by RTI)

June 9, 1981

Dryer #/Time	Abort Stacks				Overall <sup>1</sup>	Inside			
	Green End	Dry End	Cooling			Time	Door Seals	Elephant Ears	Above Dryers
1	2:10	L	L	N	L 100 cfm	2:10	2M	1M	M
	2:45	H 25%	M 30%	N	M 200 cfm	3:25	2L, 2T	1M, 1L	M
	3:40	H 30%	H 20%	N	M 200 cfm	4:15	4M	1M, 2H	H
	4:50	M	H 30%	N	H 250 cfm	5:05	1L	4M, 1H	H
	5:30	H	H 30%	N	H 300 cfm	5:40	3L	2M	M
2	1:50	M	L	N	M 150 cfm	2:05	1L	1L	L
	2:45	H	L	N	M 200 cfm	3:25	N	N	L
	3:45	H	M	N	M 200 cfm	4:15	N	1M	M
	4:50	L	M 10%	N	M 150 cfm	5:05	N	1L	M
	5:30	H 10%	M 10%	N	M 150 cfm	5:40	N	1L	H
3	2:00	H 10%	H 20%	N	H 250 cfm	2:05	N	N	H
	2:45	H 30%	M 30%	N	H 250 cfm	3:15	N	N	H
	3:45	H 30%	M 30%	N	H 250 cfm	4:13	N	N	H
	4:45	H 10%	L	N	M 150 cfm	5:00	N	N	H
	5:30	H 20%	H 30%	N	H 300 cfm	5:40	N	N	H
4	1:45	N	N	N	5%	2:00	1M, 1L	NA	L
	2:45	N	N	N	10%	3:18	1L	NA	L
	3:40	N	N	N	10%	4:12	1H, 1L	NA	L
	4:40	N	N	N	10%	5:00	1H, 1L	NA	L
	5:27	N	N	N	15%	5:40	2M	NA	M

Building	1	2	3	4	5	6	KEY	
Fans							N = None	cfm estimates
(Opacity)							T = Trace	are gross
							VL = Very Light	estimates
2:00	5%	5%	-	5%	-	not	L = Light	
2:45	5%	10%	-	5%	-	observed	M = Moderate	% opacity
3:45	5%	10%	-	5%	-	"	H = Heavy	on blue
4:45	5%	5%	-	5%	-	"	VH = Very Heavy	plumes
5:30	5%	5%	-	10%	5%	"		

TABLE 2-11b

## FUGITIVE EMISSION SUMMARY

Georgia-Pacific Plywood Plant, Springfield, Oregon  
(Provided by RTI)  
June 10, 1981)

Abort Stacks						Inside Appearance					Comments
Dryer #/Time	Green	End	Dry	End	Cooling	Overall <sup>1</sup>	Time	Door Seals	Elephant Ears	Top	
1	12:20	S 10%	M 20		N	M 150 cfm	12:10	1 VL	N	L	M @ mid fans
	1:15	H	M		N	M 150 cfm	1:25	2 VL	N	L	
	2:20	H	H 20		N	H 250 cfm	2:07	2 VL	N	L	
	2:45	M 10	H 20		N	M 150 cfm	2:40	1 S, 1 L	1 L	M	
	3:45	M 15	H 30		N	M 200 cfm	3:40	2 L	1 L	M	
	4:15	L 10	H 30		N	H 250 cfm	4:05	2 L	1 L	L	
	4:45	L 10	M 20		N	M 200 cfm	4:38	2 L	1 L	M	
2	12:17	H	M		N	M 300 cfm	12:08	2 M	1 S	L	Mod. around mid fans
	1:15	H	S		N	M 150 cfm	1:25	2 VL	1 S	M	
	2:15	H	M 10%		N	M 200 cfm	2:06	N	1 M	M	
	2:50	L 10%	M 10%		N	L 150 cfm	2:40	N	1 L	H	
	3:45	L	M 10		N	L 150 cfm	3:40	N	1 L	M	
	4:15	L 5%	M 10		N	L 100 cfm	4:05	N	1 L	L	
	4:45	L 10	M 10		N	L 150 cfm	4:35	N	1 L	L	
3	12:15	M 20%	M 20%		N	M 200 cfm	12:05	N	N	M	H at dry end None at Green
	1:15	L	L		N	50 cfm	1:20	N	N	M	
	2:15	M 10%	M 10%		N	M 100 cfm	2:05	N	N	H	Large leakage around exhaust dry end stk.
	2:50	H 20%	M 20		N	H 250 cfm	2:40	N	N	H	
	3:50	M 10	H 20		N	H 250 cfm	3:35	N	N	H	
	4:15	H 20	H 20		N	H 250 cfm	4:05	N	N	M	
	4:40	H 20	H 20		N	H 250 cfm	4:33	N	N	H	
4	12:13	N	N	10-15	Bad at Dry End		12:03	1 L, 1 M	NA	M	Cooling stks. from this dryer and roof vents are the major roof-ton emitters.
	1:12	N	N	5	"		1:20	2 M	NA	M	
	2:15	N	N	10%	"		2:03	1 L	NA	L	
	2:48	N	N	10-15	"		2:38	1 L	NA	L	
	3:50	N	N	N	"		3:35	1 L	NA	L	
	4:15	N	N	5-10	"		4:00	1 M	NA	M	
	4:40	N	N	5	"		4:33	1 M, TR	NA	L	
	907	908	909		910	911	912				
Roof Vents								KEY			
12:20	5	5	N	5	5	5		N = None cfm estimates			
1:15	5	-	-	-	5	-		T = Trace are gross			
2:15	5	5	-	5	-	-		VL = Very Light estimates			
2:45	5	5	-	5	-	5		L = Light			
3:45	5	5	-	5	-	-		M = Moderate % opacity			
4:15	5	5	-	5	-	-		H = Heavy on blue			
4:40	5	-	-	-	5	-		VH = Very Heavy plumes			

TABLE 2-11c

## FUGITIVE EMISSION SUMMARY

Georgia-Pacific Plywood Plant, Springfield, Oregon  
(Provided by RTI)  
June 11, 1981)

Dryer/Time	Abort Stacks				Overall <sup>1</sup>	Inside Appearance				Comments
	Green End	Dry End	Cooling			Time	Door Seals	Elephant Ears	Top	
1 10:50	H	H	N		300 H	10:42	3 L	1 L	L	M @ top center fans
11:46	H	H 20	N		300 H	11:32	3 L	1 L	M	
12:20	M 5	H 10	N		250 H	12:08	2 L	1 M	M	
12:55	M 5	H 10	N		250 H	12:45	2 VL	1 M	L	
1:06	M 5	H 30	N		300 H	1:26	2 VL	1 L	M	
2:28	M 10	H 20	N		250 H	2:17	2 L	1 L	H	
						2:47	1 L	1 L	M	
2 11:10	H	M	N		350 H	10:39	N	1 L	L	M @ center fans at top
11:45	H	M 10	N		300 H	11:30	N	1 L	L	
12:20	H	M 10	N		250 H	12:07	N	1 L	M	
12:55	H	L	N		150 M	12:45	N	1 L	L	
1:46	H	M 10	N		300 H	1:26	N	1 L	L	
2:28	M 10	M 10	N		200 M	2:16	N	1 L	M	
						2:47	N	1 L	M	
3 11:10	H 30	H 20	N		350 H	10:38	N	N	H	Stack leaks & middle fans high emissions
11:45	H	H 20	N		350 H	11:30	N	N	H	
12:20	H	H 20	N		350 H	12:06	N	N	H	
12:55	H 10	H 20	N		350 H	12:43	N	N	H	
1:48	H 10	H 20	N		300 H	1:27	N	N	M	
2:27	M 20	H 20	N		250 H	2:15	N	N	H	
						2:48	N	N		
4 11:10	N	N	10%			10:37	2 VL, 3 T	NA	L	
11:45	N	N	5-10			11:28	2 VL	NA	L	
12:17	N	N	0-5			12:06	N	NA	VL	
12:55	N	N	5-10			12:43	N	NA	VL	
1:48	N	N	5			1:27	N	NA	VL	
2:26	N	N	5-10			2:14	N	NA	VL	
						2:47	N	NA	VL	
	907	908	909	910	911	912	KEY			
Roof Vents										
11:10	5	-	-	5	5	-	N = None			
11:45	-	5	-	-	-	5	T = Trace			
12:19	5	-	5	-	-	-	VL = Very Light			
12:55	10	5	-	5	-	-	L = Light			
1:48	5	10	-	5	-	-	M = Moderate			
2:27	10	5	-	5	-	5	H = Heavy			
							VH = Very Heavy			
							cfm estimates are gross estimates			
							% = opacity on blue plumes			

## 2.8 Clean-Up Evaluation

Results of the clean-up evaluations performed on both Method 5X sampling trains are presented in Table 2-12. Clean-up evaluation rationale and procedures are presented in Section 1.4.6 and Section 6.1. Front half total residue collected was 55.5 mg and 12.1 mg for the inlet and outlet sampling trains, respectively. Back half total residue collected was 39.8 mg and 164.2 mg, respectively. Total residue collected during the clean-up evaluation was 96.3 mg and 176.3 mg for the inlet and outlet trains, respectively.

The high blank value of the inlet probe wash is probably due to the fact that the probe was not acid washed before the evaluation. The high value detected as impinger residue was probably due to a large amount of chromium residue (2.50 mg/l) remaining from the pretest chromic acid wash of the glassware. Further analysis for chromium was performed on the actual test impinger solutions with only a trace amount being detected in test 1 samples. Therefore, it is believed no test sample interference resulted from chromium contamination. Chromium analytical data are presented in Appendix G.

## 2.9 Possible Test Interferences

A possibility exists that components and reagents used in the Method 5X sampling train may cause interferences with the Method 25 samples drawn from the Method 5X train. At the time of this report, a study is being performed by TRC to quantify the possible interfering effects of acetone, silicone vacuum grease, and silicone rubber sealant (RTV) on the Method 25 procedures.

The scrubber outlet Method 5X filtration temperature could not be maintained in the planned  $350 \pm 25^{\circ}\text{F}$  range due to insufficient heater capacity. Temperatures ranged from  $310^{\circ}$  to  $340^{\circ}\text{F}$ . Although not a factor in the

TABLE 2-12

## METHOD 5X CLEAN-UP EVALUATION RESULTS, JUNE 8, 1981

Georgia-Pacific Plywood Plant, Springfield, Oregon

Train Component	Sample Fraction	Residue Weight (g)	
		Inlet	Outlet
Front Half	Probe Wash (DD H <sub>2</sub> O)	0.0337*	0.0116
	Probe Wash (acetone)	0.0448	0.0113
	Front Filter	<u>NA†</u>	<u>NA†</u>
	Front Half Total	0.0785	0.0229
Back Half	Impinger Water		
	Organic Extraction	0.0014	0.0019
	Evaporation	0.0230	0.1360**
	Acetone Rinse	0.0151	0.0260
	Back-up Filter	<u>NA†</u>	<u>NA†</u>
	Back Half Total	0.0395	0.1639
	Total Sample	0.1180	0.1868

\* Probe not acid washed prior to test program.

\*\* Upon further analysis, it was discovered that Sample 5X-0-0-4 contained 2.50 mg/liter chromium, indicating residue remaining from the chromic acid cleaning solution used in the pretest preparation of the glassware.

† Filters not inserted into trains.

Method 5X sample collection, this may have resulted in a slight low bias for the Method 25 samples. Organic materials which would have passed through the filter at  $350 \pm 25^{\circ}\text{F}$  may instead have condensed and been collected on the lower temperature filter.

### 3.0 PROCESS DESCRIPTION AND OPERATIONS (Provided by RTI)

This section describes the plywood manufacturing process, specifically the veneer drying process and its emission control, a G-P scrubber system. Production monitoring as well as process operational conditions during the test program are also discussed.

#### 3.1 Process Equipment

The veneer drying operation begins after the veneer has been peeled from the log at the lathe operation. The veneer then proceeds to the drying operation. Here, the veneer is continuously hand-fed onto the dryer feed conveyor and into the dryer. The purpose of the operation is to thermally drive the moisture out of the veneer in preparation for the layup and laminating operations which follow. During the drying operation, organic compounds are also driven out of the veneer.

The G-P Springfield plant has four veneer dryers. Each is a steam heated, multideck unit, with the number of drying zones varying between dryers. Dryers 1, 2 and 3 are longitudinal dryers, with 22, 18 and 18 zones, respectively. Dryer 4, a new unit, is a 22 zone jet dryer. Each dryer has two exhausts from the heated zones, except dryer 4 which has three exhausts. Atop each exhaust is an abort damper for emergency use only. These are a source of fugitive emissions. The eight exhausts are ducted to a common manifold which carries the exhaust to the Georgia-Pacific scrubber system.

#### 3.2 Emission Control Equipment

The Georgia-Pacific scrubber system shown in Figure 1-1 includes a wet spray zone, six wet cyclones, a packed tower, and a mesh pad entrainment separator. As dryer exhaust gases pass through the 35.25-inch inside diameter

duct, six nozzles inject water countercurrently into the gas stream to saturate and cool the gas stream, thereby condensing the organics. Solids are separated and agglomerated droplets are collected in the six wet cyclones which follow. The remaining moisture laden gases are drawn through an induced draft fan and forced through a packed tower and a mesh pad to rid the effluent of aerosols. All water within the scrubber system is recirculated. The gas stream, at approximately 165°F and 35 percent moisture by volume, then discharges to the atmosphere through a 9-foot i.d. stack.

### 3.3 Production and Control Equipment Monitoring

All production monitoring data collected by RTI and DGA is presented in Table 3-1. Scrubber operational data, collected by TRC, is presented in Table 2-10.

### 3.4 Process Operating Conditions During Test Program

The operation of each dryer is set according to the size, thickness, and kind of wood being dried. The operation of the three longitudinal dryers does not frequently vary, but it appears that the jet dryer makes more frequent changes. During the testing hours of the first day (June 9) there was a change of production, despite efforts on Georgia-Pacific's part to keep the dryer operation steady state. Dryer 4 changed from drying 1/6-inch sapwood to 1/6-inch heartwood. This was not considered to be a major change worthy of cancelling the test run.

It is normal for small plugups in the feeding and outloading mechanisms to occur and this did happen during the tests. On the third test day (June 11) there was more of this type upset than usual on Dryer 4, but these were considered minor and insufficient cause for cancelling a test.



TABLE 3-1

## SUMMARY OF OPERATING CONDITIONS (Provided by RTI)

Georgia-Pacific Plywood Plant, Springfield, Oregon

	June 8	June 9	June 10	June 11
I Production (ft <sup>2</sup> per hour on 3/8-in. basis)				
Sapwood	19,935	21,604	21,509	19,847
Heartwood	<u>12,090</u>	<u>14,143</u>	<u>12,863</u>	<u>14,221</u>
Total	31,424	35,747	34,372	34,068
II Redry Rate (%)	9.7	9.0	9.6	11.4
III Steam Use (lbs per hour)	No Evaluation	51,430	50,467	51,450
IV Temperatures	No Evaluation	steady 325-375°F	steady 325-375°F	steady 325-375°F
V Fugitives	No Evaluation			
1. abort stacks		150-300 CFM*	150-300 CFM*	150-300 CFM*
2. door leaks		nos. 1&4	nos. 1, 2 & 4 less than on June 9	small leaks
3. above dryers		nos. 1 & 3 had blue haze		noticeable above all dryers
4. cooling stacks		4	4	4
VI Weather	No Evaluation	cloudy, showers, mid 60s	cloudy, small showers, 60°-75°	morning fog, sunny, 54°-66°
		53-74% rel. humidity	36-70% rel. humidity	51-76% rel. humidity

\*Per dryer, except no. 4

Steam usage, dryer temperatures, and drying times were maintained evenly throughout the three days of tests. Process operating conditions are summarized in Table 3-1.

Production figures provided are not the actual square footage of green veneer dried in the steam-heated dryers but rather a figure that accounts for trim and shrinkage. A full green veneer sheet is approximately 54 inches by 101 inches and will eventually be trimmed to 48 inches by 96 inches following shrinkage in the dryer. The amount of shrinkage depends on the original moisture level. As is the case with all western softwoods, Douglas fir sapwood will shrink more than heartwood. An expected shrinkage loss is 5 percent to 7 percent. The production figures reported are, therefore, approximately 85 percent of the actual throughput of the dryers. All veneer has been converted to a 3/8-inch basis.

#### 4.0 DESCRIPTION OF THE SAMPLING LOCATIONS

This section presents a description of each sampling location and a summary of the work performed at each site. Figure 4-1 presents a schematic layout of the veneer dryer exhaust system and identifies all sampling locations.

##### 4.1 Scrubber Inlet

The inlet to the scrubber system was sampled employing EPA Methods 1, 2, 4, 5X and 25 in the 35.25-inch inside diameter insulated duct at sampling ports 45° above the horizontal duct axis. These ports were located 30 feet downstream (>8 diameters) and 24 feet upstream (>2 diameters) from the nearest respective flow disturbances. In accordance with EPA Method 1, sampling was performed at 12 traverse points. Sampling port and traverse point locations are presented in Figure 4-2. Duct static pressure was also measured at this location.

Method 5X tests performed at this location were 60 minutes in duration as were the Method 25 tests performed simultaneously. A total of three Method 5X and 18 Method 25 tests was performed at this location.

##### 4.2 Scrubber Outlet

Sampling ports were located 9 feet upstream (1 diameter) from the top of the 9-foot i.d. stack and approximately 6 feet (2/3 diameter) downstream from the mesh pad entrainment separator. In accordance with EPA Method 1, sampling was performed at 48 traverse points. Sampling port and traverse point locations are presented in Figure 4-3.

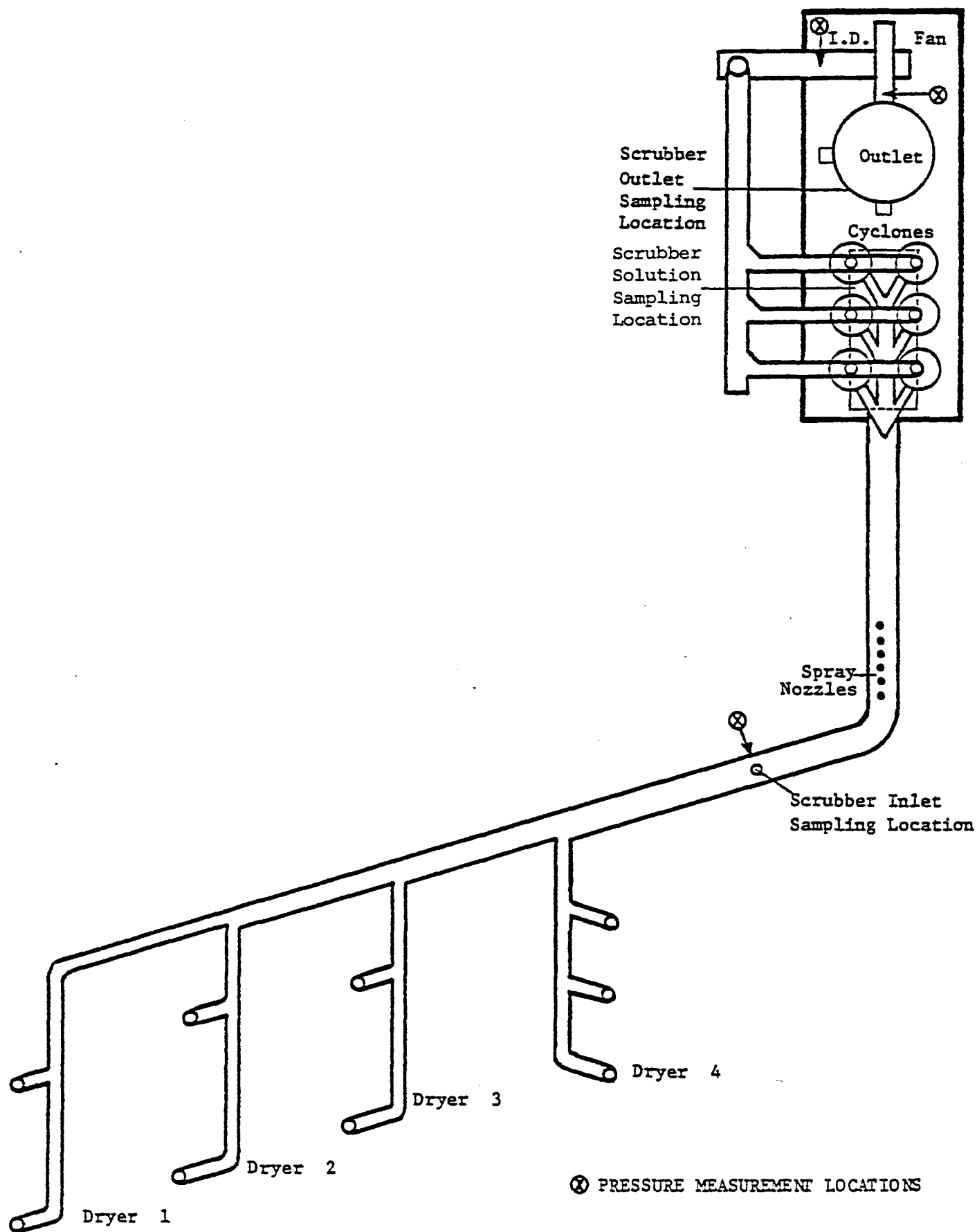
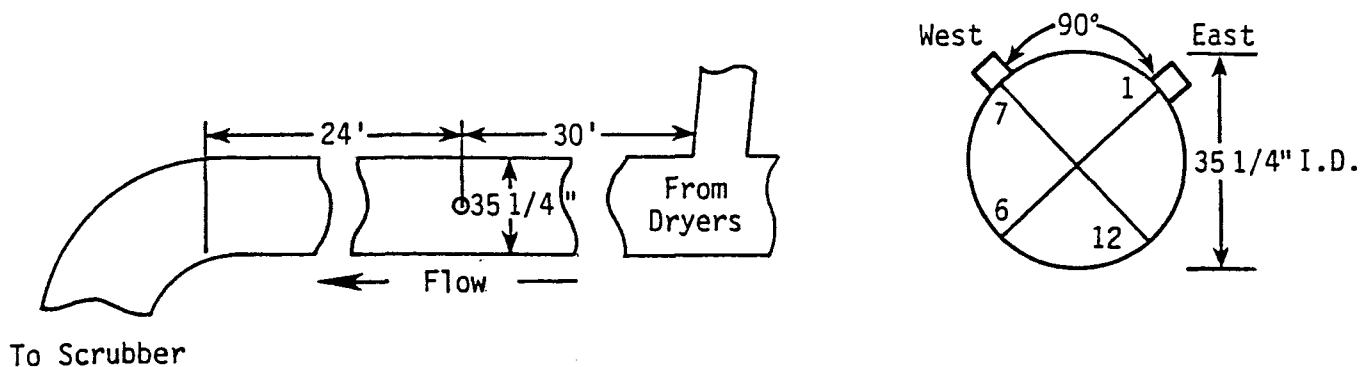
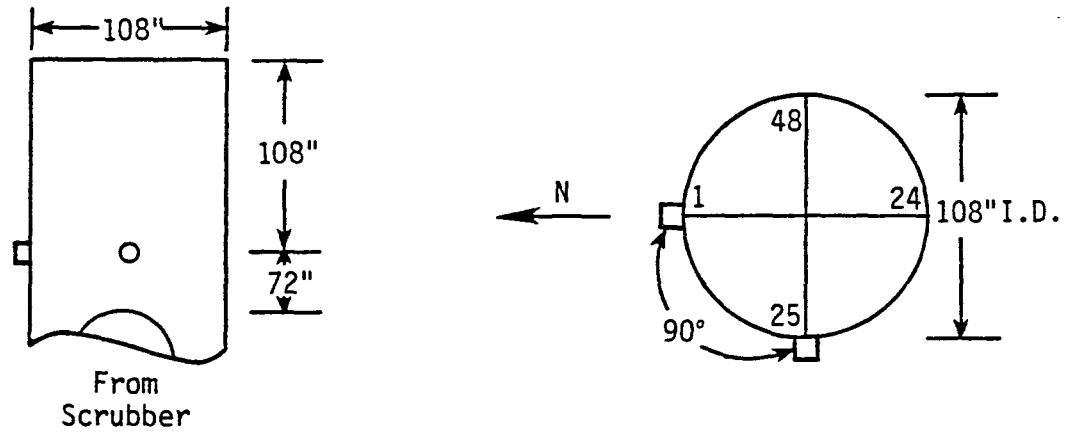


Figure 4-1. Veneer Dryer Exhaust and Scrubber System Sampling Locations  
Georgia-Pacific Plywood Plant  
Springfield, Oregon



Traverse Point Number	Traverse Point Location From Inside Duct Wall (Inches)
1	1.6
2	5.1
3	10.4
4	24.8
5	30.1
6	33.7

Figure 4-2. Scrubber Inlet Sampling Port Configuration and Traverse Point Locations, Georgia-Pacific Plywood Plant Springfield, Oregon



Traverse Point Number	Traverse Point Location From Inside Duct Wall
1	1.2
2	3.5
3	5.9
4	8.5
5	11.3
6	14.3
7	17.4
8	21.0
9	24.8
10	29.4
11	34.9
12	43.0
13	65.0
14	73.1
15	78.6
16	83.2
17	87.0
18	90.6
19	93.7
20	96.7
21	99.5
22	102.1
23	104.5
24	106.8

Figure 4-3. Scrubber Outlet Sampling Port Configuration and Traverse Point Locations Georgia-Pacific Plywood Plant, Springfield Oregon

Method 5X tests performed at this location were 96 minutes in duration. Method 25 sampling began 18 minutes into each Method 5X test and ran for 60 minutes, leaving 18 minutes of Method 5X testing after the completion of the Method 25 tests. A total of three Method 5X and 18 Method 25 tests were performed at this location.

#### 4.3 Scrubber Operational Measurement Locations

Scrubber solution samples were taken from the scrubber recirculation tank during each test. Pressure drop across the scrubber system was calculated from static pressures in the duct measured at the scrubber inlet and at two pressure taps each located 2 feet from the scrubber fan inlet and outlet. These sampling locations are shown in Figure 4-1.

#### 4.4 Fugitive Emissions

Fugitive emissions were observed by RTI and DGA around the veneer dryers and their abort dampers.

## 5.0 SAMPLING AND ANALYTICAL METHODS

This section presents descriptions of sampling and analysis procedures employed during the emission testing conducted at the Georgia-Pacific plywood facility in Springfield, Oregon during the week of June 8, 1981. EPA Methods 1, 2, 4, 5X\*, 9, 22 and 25 were used to measure emissions at the veneer dryer exhaust and from the scrubber outlet. These methods are presented in greater detail in Appendix G.

### 5.1 EPA Reference Methods Used in This Program

The following EPA Reference Methods were used for the testing at the G-P plywood plant. These methods\*\* were taken from CFR 40, July 1, 1980, part 60, "Standards of Performance for New Stationary Sources," Appendix A, pp. 183 ff.; and Federal Register, volume 45, no. 194, Friday, October 3, 1980, pp. 65959 ff.

#### Method 1 - Sample and Velocity Traverses for Stationary Sources

This method specifies the number and location of sampling points within a duct, taking into account duct size and shape and local flow disturbances.

#### Method 2 - Determination of Stack Gas Velocity and Volumetric Flow Rate

This method specifies the measurement of gas velocity and flow rate using an S-type pitot tube, manometer, and temperature sensor. The physical dimensions of the pitot tube and its spatial relationship to the temperature sensor and a sampling probe are also specified.

#### Method 4 - Determination of Moisture Content in Stack Gases

This method specifies the procedures by which the water vapor content of a gas stream can be determined.

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\* Method 5X will be assigned a reference letter designation when the NSS regulation is proposed in the Federal Register. This method was derived from EPA Method 5 and ODEQ Method 7.

\*\* With the exception of the Provisional Method 5X, which has yet to be proposed.



Method 5X - Determination of Particulate and Condensible Organic (Provisional) Emissions from Stationary Sources in the Plywood Industry

This method, based upon EPA Method 5 and ODEQ Method 7, describes procedures for measuring emissions in the context of the following definitions. Particulate matter is material which condenses at or above filtration temperature and is collected by the front half of the sampling train. Condensible organic matter is that material which remains after extraction, filtration, and evaporation of the impinger portion of the train.

Method 9 - Visual Determination of the Opacity of Emissions From Stationary Sources

This method specifies the procedures by which opacity of emissions are measured.

Method 22 - Visual Determination of Fugitive Emissions from Material Processing Sources

This method specifies the procedures for visual determination of the presence and total time of occurrence of fugitive process emissions.

Method 25 - Determination of Total Gaseous Nonmethane Organic Emissions as Carbon

This method describes procedures for the sampling and analysis of gaseous nonmethane organic emissions. An emission sample is drawn through a condensate trap and into an evacuated tank. Trap and tank contents are oxidized to carbon dioxide, reduced to methane, and analyzed by a flame ionization detector.

## 5.2 Preliminary Measurements

Before the start of emission sampling, each location was tested according to EPA Methods 1, 2 and 4 to determine the preliminary stack gas velocity and moisture content within the ducts.

## 5.3 Measurements for Particulate, Condensible and Noncondensable Emissions

### 5.3.1 EPA Method 5X (Provisional) - Particulate and Condensible Organic Compounds

This section presents a summary of procedures followed by TRC during particulate and condensible organic sample collection, recovery and preparation, analysis, and data reduction. Deviations from the specified method are

explained in this section. Further details of this method are presented in Appendix G.

#### 5.3.1.1 Method 5X - Sample Collection

The sampling train was a modified EPA Method 5X train as shown in Figure 5-1. This train was designed and built by TRC. A slipstream was drawn from behind the heated Method 5X filter to quadruplicate TRC and duplicate NCASI Method 25 sampling trains. Vacuum grease was used in the assembly of the Method 5X train ahead of the Teflon sample line-impinger train connection for test 1. This may have caused contamination of the total organic compound samples for test 1. No vacuum grease was used at those locations during tests 2 and 3. A minimum amount of grease was used in the impinger train. Leak checks were performed on the complete sampling train (modified 5X train attached to the six Method 25 trains) before and after each test. Field data were recorded on standard EPA Method 5 data sheets which are presented in Appendix C.

The Method 5X sampling train is essentially the same as that described by EPA Method 5 with the following modifications. A flexible Teflon sample line was used to connect the outlet of the 4-1/2 inch glass-fiber Gelman Spectrograde no. 64948 filter to the impinger train. Since the filter was at a higher elevation than the impinger train, condensation in the sample line ran into the first impinger and not back into the filter. The Method 5X impinger train consisted of four impingers and a 2-1/2 inch glass-fiber filter. The first impinger was a modified Greenburg-Smith (impingement plate removed) charged with 100 ml of deionized distilled (D.D.) water. The second impinger was a regular Greenburg-Smith unit also charged with 100 ml D.D. water. The third was another modified Greenburg-Smith and was empty. The fourth was

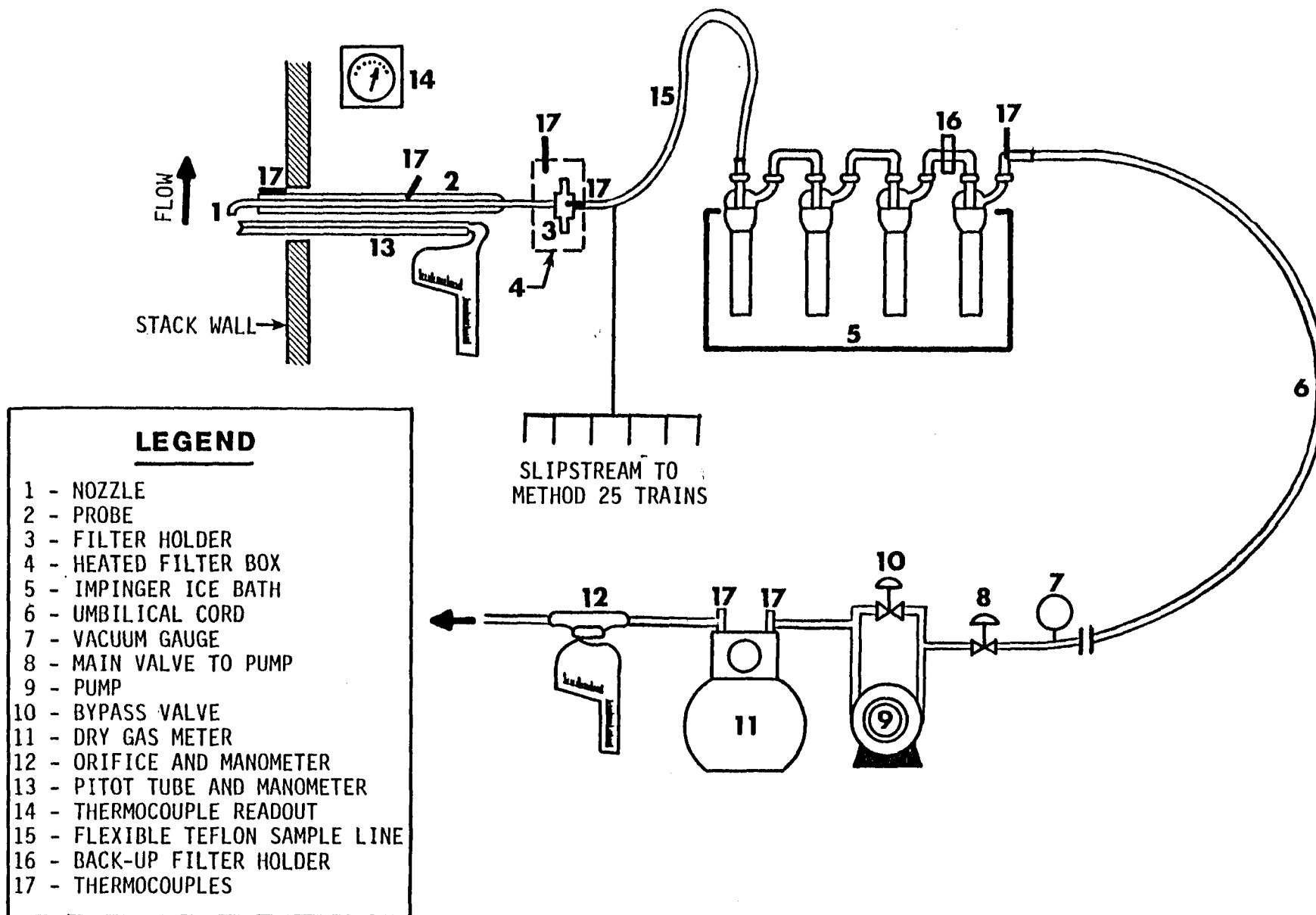


Figure 5-1. Modified EPA particulate and condensible organics sampling train.  
(August 18, 1977 Federal Register)

also a modified Greenburg-Smith type and was charged with 200 grams of silica gel. A 2-1/2 inch glass-fiber filter (similar to the 4-1/2 inch filter) was inserted between the third and fourth impinger to collect any organic material condensed but not collected in the impingers.

Prior to initial field use, all glassware was washed with a chromic acid solution and rinsed with D.D. water and acetone according to Method 5X.

Sampling train operations were identical to those of EPA Method 5, with several exceptions. In order to prevent condensation of organic materials in the probe and on the 4-1/2 inch glass-fiber filter, the stainless steel probe and the filter were heated to  $350^{\circ} \pm 25^{\circ}\text{F}$ . Thermocouples were inserted into the probe and the filter outlet gas stream to ensure that proper temperatures were maintained. These temperatures were noted on the field data sheet during routine data recording intervals.

During sampling at the scrubber outlet it was sometimes impossible to maintain probe and filter outlet temperatures in the range of  $350^{\circ} \pm 25^{\circ}\text{F}$  because of insufficient heater capacity. Probe and filter outlet temperatures ranged between  $310^{\circ}$  to  $340^{\circ}\text{F}$  at the scrubber outlet throughout the test program and averaged about  $320^{\circ}\text{F}$ . Filter box temperatures were maintained at  $350^{\circ} \pm 25^{\circ}\text{F}$  with no problems.

Impinger outlet temperatures were monitored and maintained below  $68^{\circ}\text{F}$  throughout the test program. These temperatures were not, however, recorded on the scrubber outlet field data sheets.

Velocity pressure at the scrubber outlet was extremely low as measured by the S-type pitot tube, hovering near the lower detection limit of EPA Method 2. In addition, wind gusting across the top of the stack sometimes caused turbulence within the 9-foot i.d. duct, creating the illusion of negative flows. If this phenomenon was more than momentary, sampling was halted until flows again appeared positive, and then restarted.

A 2 1/2-inch filter was used in the front half of the inlet sampling train for tests 1 and 2, and the outlet sampling train for test 2. This was done because the 4 1/2-inch filter assembly would not pass the leak check. During outlet test 3, the filter assembly was broken in the process of changing sampling ports. The filter was recovered and replaced with another filter assembly to complete the test.

#### 5.3.1.2 Method 5X - Sample Recovery and Preparation

Sample recovery was performed in an improvised laboratory on site. Because this area had a clean, wind-free environment and was well lighted, it was suited for sample recovery and preparation for shipment.

Sample recovery was performed in accordance with EPA Methods 5 and 5X as presented in Appendix G. At the conclusion of each test run, separate sample fractions were collected from each Method 5X sampling train by a three-person clean-up crew. The liquid samples were placed in glass sample jars with Teflon-lined lids, and the filters were placed in inert petri dishes and sealed. The sample fractions collected were as follows:

- Container 1 - 4-1/2 inch glass-fiber filter (2-1/2 inch filters were used during test I-1, I-2, and O-2).
- Container 2 - D.D. H<sub>2</sub>O wash of nozzle, probe and front half of the 4-1/2 inch filter holder.
- Container 3 - Acetone wash of nozzle, probe and front half of the 4-1/2 inch filter holder.
- Container 4 - Exposed impinger solution from impingers 1, 2 and 3 and D.D. H<sub>2</sub>O wash of impingers, connectors, Teflon sample line, back half of 4-1/2 inch filter holder and front half of 2-1/2 inch filter holder.
- Container 5 - Acetone wash of first three impingers, connectors, Teflon sample line, back half of 4-1/2 inch filter holder, and front half of 2-1/2 inch filter holder.
- Container 6 - 2-1/2 inch glass-fiber filter.

The probe and nozzle were brushed and rinsed three times with D.D.  $H_2O$ , which was deposited in container 2. The front half of the 4-1/2 inch filter holder was also rinsed with D.D.  $H_2O$ , which was deposited in container 2. The probe, nozzle and front half of the 4-1/2 inch filter holder were brushed and rinsed with acetone in the same manner and deposited in container 3.

The Teflon sample line was drained into the impinger train. The Teflon sample line was not brushed because the particulate catch in the sample line is generally considered to be insignificant. Impinger contents were weighed to determine moisture catch and deposited in container 4. The Teflon sample line, impingers, connectors and the back half of the 4-1/2 inch filter holder were rinsed three times with D.D.  $H_2O$  into container 4, and then rinsed three times with acetone into container 5.

Prior to tests 2 and 3 both the probe and Teflon sample line were washed with D.D.  $H_2O$  after the acetone wash to remove any acetone residue which might have contaminated the EPA Method 25 samples. These washes were discarded and the components allowed to dry at ambient conditions before being reassembled. A possibility of Method 25 acetone contamination exists for test 1.

Both filters were removed from their holders and deposited into their respective petri dishes, containers 1 and 6. Filter residue on the filter holders was scraped and deposited into the same acetone rinse containers as the front halves of their respective filter holders. The stainless steel and glass filter frits used in the filter holders were not rinsed during sample recovery, because any organic material collected on the frits is generally considered to be insignificant. Glass and/or metal particles could become detached and contaminate sample fractions.

Silica gel samples were weighed immediately at the conclusion of each test and the weights recorded by the clean-up crew. All Method 5X samples

were packed in shock-proof containers and driven to the CH<sub>2</sub>MHill laboratory in Corvallis, Oregon for analysis at the conclusion of the test program.

#### 5.3.1.3 Method 5X - Sample Analysis

With the exception of the silica gel samples, all sample fractions were analyzed by CH<sub>2</sub>MHill. CH<sub>2</sub>MHill was chosen to perform the analytical phase of the Method 5X sampling program because of their extensive experience with Oregon DEQ Method 7, from which EPA Method 5X was derived. All analyses were performed in accordance with EPA Method 5X and as approved by EPA/EMB. The sample fractions were analyzed as follows:

Container 1 - (4-1/2 inch glass-fiber filter) - desiccate and weigh after 24 hours.

Container 2 - (D.D. H<sub>2</sub>O probe rinse) - evaporate, desiccate and weigh after 24 hours.

Container 3 - (acetone probe rinse) - evaporate, desiccate and weigh after 24 hours.

Container 4 - (impinger water solution and D.D. H<sub>2</sub>O rinse) - extract, desiccate and weigh.

Container 5 - (impinger acetone wash) - evaporate, desiccate and weigh.

Container 6 - (2-1/2 inch glass-fiber filter) - desiccate and weigh after 24 hours.

Silica gel samples were weighed on site with a triple-beam balance at the conclusion of each test by the Method 5X sample recovery crew. The weight gain of the silica gel was determined to the nearest 0.5 gram and recorded.

All analytical data were recorded on the data sheets as presented in Appendix H. Sample residue remaining after analysis was retained for 90 days after the end of the field program after which they were discarded according to EPA instructions.

#### 5.3.1.4 Method 5X Data Reduction

All Method 5X data reduction was performed in a manner identical to procedures described by EPA Method 5. (See Appendices B and G.) The only variation from these calculations was as follows. Because of the unacceptable super-isokinetic sampling conditions during tests 1 and 2 at the scrubber inlet and tests 1 and 3 at the scrubber outlet, the particulate mass emission rate (MER) for these runs were calculated by two methods: the concentration method (by which calculations are normally done) and the area ratio method.\* With the former method, the concentration of particulate matter entering the nozzle is calculated and then multiplied by the volumetric flow rate to obtain the mass emission rate:

$$(m/V) \times Q = \text{MER (lbs/hr)} \quad (\text{Eq. 5-1})$$

where    m = amount of particulate sampled (lbs)  
          V = volume of sampled gas (DSCF)  
          Q = volumetric flow rate (DSCF/hr)

If the nozzle sampling velocity is greater than the stack gas velocity (superisokinetic sampling conditions), then the calculated mass flow rate will be less than the true MER. This is because the heavier particles will leave their streamlines (gas streamlines diverted into the nozzle) and will not enter the nozzle, as they would under isokinetic conditions. Since the volume of gas sampled is greater than what would be sampled under isokinetic conditions, the concentration (m/V) will be less than that under isokinetic conditions.

With the area ratio method, the mass of particulate matter collected is divided by the sampling time and then multiplied by the ratio of the stack area to the nozzle area to obtain the mass emission rate:

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\* Brenchley, D.F., C.D. Turley and R.F. Yarmac. Industrial Source Sampling. Ann Arbor Science Publishers, Inc., 1973, p. 173 ff.



$$(m/t) \times (A_s/A_n) = \text{MER (lbs/hr)} \quad (\text{Eq. 5-2})$$

where

- m = amount of particulate sample (lbs)
- t = sampling time (hrs)
- A<sub>s</sub> = area of stack (ft<sup>2</sup>)
- A<sub>n</sub> = area of nozzle (ft<sup>2</sup>)

Again, if the nozzle sampling velocity is greater than the stack gas velocity, then the MER calculated by this method will be somewhat greater than the true MER. The lighter particles follow the diverted streamlines into the nozzle; the amount of particulate matter sampled in time (t) is therefore assumed to be greater than what should be sampled. The volume of sampled gas is not a factor in this calculation. The average of the two calculated MERs was used as an estimate of the true MER.

Gas stream moisture content measured at the scrubber outlet exceeded the saturation values for the duct temperatures measured. Therefore moisture values were recalculated using the following psychometric equation:

$$\% \text{ H}_2\text{O} = \frac{P_v \times 100}{P_B} \quad (\text{Eq. 5-3})$$

where P<sub>v</sub> = vapor pressure of air at a given temperature  
P<sub>B</sub> = barometric pressure

### 5.3.2 EPA Reference Method 25 - Condensible and Noncondensable Organic Compounds

This section presents a summary of procedures followed by TRC during condensible and noncondensable organic sampling equipment preparation, sample collection, field sample recovery, and sample analysis. The TRC Method 25 sampling train is shown in Figure 5-2. Deviations from the method are also

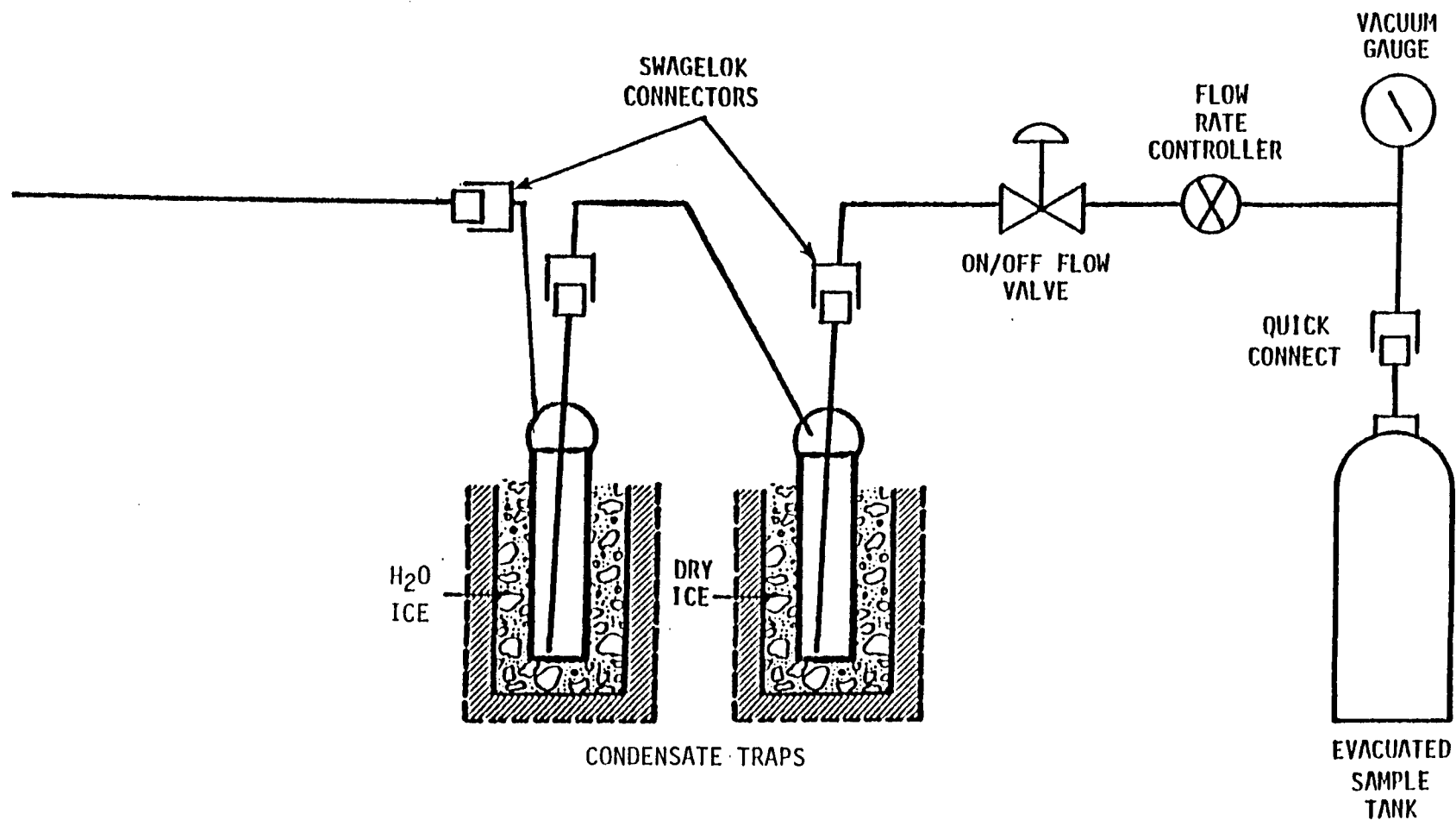


Figure 5-2. Method 25 Sampling Train

explained in this section. Further details of Method 25 are presented in Appendix G. NCASI Method 25 procedures are also presented in Appendix G.

#### 5.3.2.1 Method 25 - Sampling Equipment Preparation

This procedure is based on and supplements EPA Method 25, "Determination of Total Gaseous Nonmethane Organic Emissions as Carbon."\*

##### Condensate Trap

After being checked for any sign of physical damage, each trap was interconnected to a hydrocarbon (HC)-free air cylinder, flowmeters and CO<sub>2</sub> monitor (nondispersive infrared detector (NDIR)) and inserted in the furnace as shown in Figure 5-3. The trap was then purged with the HC-free air at a 100 ml/min flow rate with the furnace operating at a temperature of 600°C. A propane torch was used to heat those portions of the trap and probe assembly that extend outside the furnace. The purge was performed until the CO<sub>2</sub> monitor indicated a concentration of 10 ppm or less.

##### Sample Tank

Each sample tank was connected to a cylinder of HC-free air, a vacuum pump, and a mercury manometer as shown in Figure 5-4. The tank was evacuated to 29 inches Hg vacuum after which the three-way valve was switched and the tank pressurized to 10 inches Hg with HC-free air. This cycle was repeated three times. After the third pressurization, the tank was connected to the TGNMO analyzer and a sample analysis was performed. If a nonmethane organic concentration greater than 10 ppm was measured, the tank was again subjected

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\* Federal Register, volume 45, no. 194, October 3, 1980, pp. 65959-73.

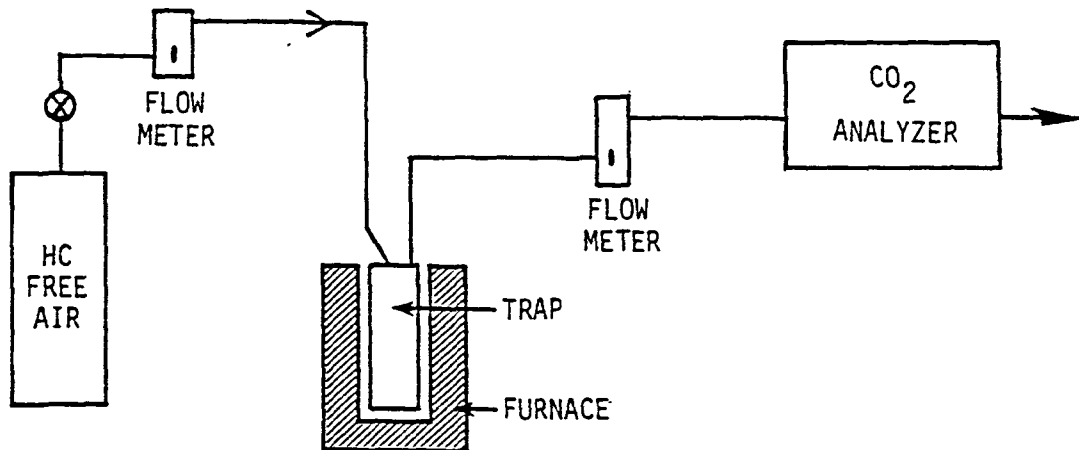


Figure 5-3. Method 25 Trap Preparation

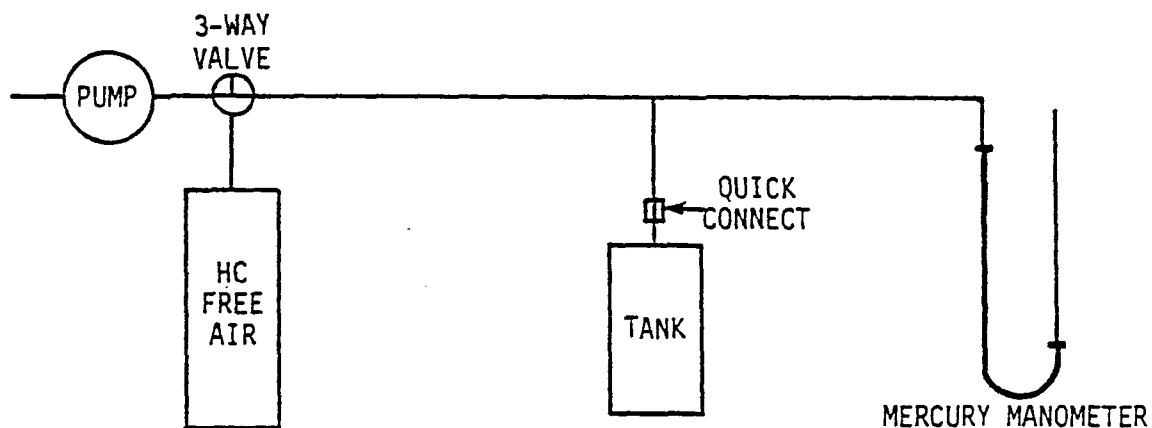


Figure 5-4. Method 25 Tank Purging and Evacuation

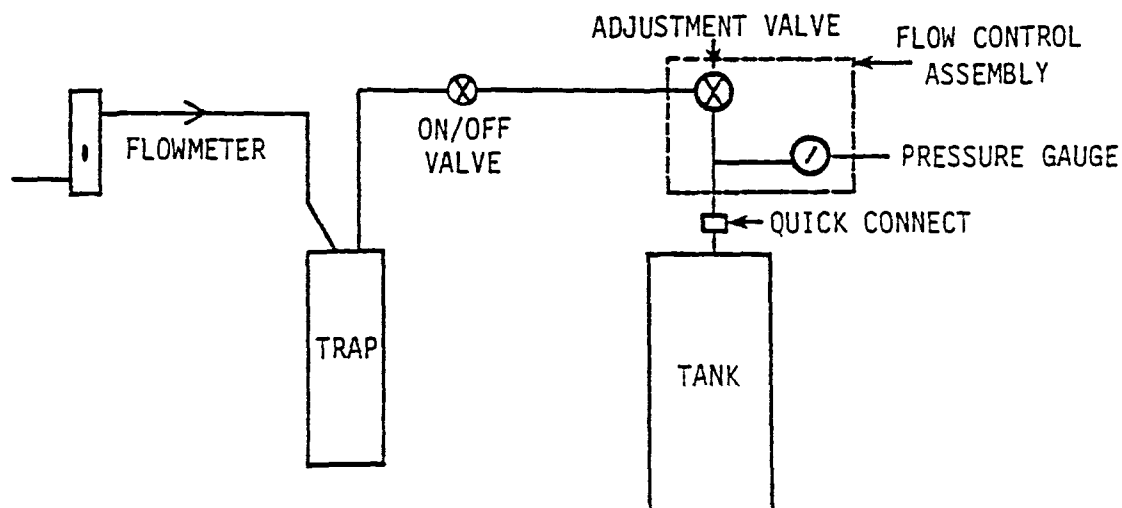


Figure 5-5. Method 25 Flow Control Assembly Adjustment

to the evacuation-pressurization analysis procedure until accepted. Each tank was then evacuated and pressurized with dry nitrogen for shipment to the field.

#### Flow Control Assembly

The sampling train was assembled as shown in Figure 5-5 and leak checked. The probe end cap was removed and the probe connected to a flow meter as shown. The sample flow shut-off valve was opened and the flow control valve adjusted to achieve a flow rate of  $50 \pm 5$  ml/minute. The flow control adjustment screw was sealed after the flow rate was achieved. The flow control valve number and calibration data were recorded on forms presented in Appendix E.

#### 5.3.2.2 Method 25 - Sample Collection

The sampling train was a modified EPA Method 25 apparatus. The modification consists of placing an additional condensibles trap, immersed in a water ice bath, ahead of the trap immersed in dry ( $\text{CO}_2$ ) ice. (See Figure 5-2.) The additional trap is intended to remove the high moisture content associated with the process emission streams and prevent freezeup in the dry ice trap which leads to premature sample flow stoppage.\*

The sample tanks were shipped to the site slightly pressurized with dry nitrogen. Immediately prior to each test, tanks were evacuated. The tank vacuum, ambient temperature and barometric pressure were recorded on the field sampling data sheet. (See Appendix C.)

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\* "Method Development for the Plywood/Plywood Veneer Industry," EPA Contract 68-02-3543, Work Assignment 1. TRC - Environmental Consultants, Inc., August 1981.

With the flow shut-off valve in the closed position, the train was checked again after a minimum period of 10 minutes. If the indicated vacuum had not changed, the portion of the sampling train behind the shut-off valve did not leak and was considered acceptable. Assuring that the probe tip was tightly capped, the front part of the sampling train was leak checked by opening the flow shut-off valve. After a short period to allow pressure stabilization (not more than 2 minutes), the indicated gauge vacuum was formed. The tank vacuum as indicated by the vacuum gauge was recorded and assembled as shown in Figure 5-2. The pretest leak check was then performed. After a minimum period of 10 minutes, the indicated vacuum was again noted. The leak check was considered acceptable if no visible change in vacuum occurred. The pretest leak rate (inches Hg/10 minutes) was recorded if observed. At the completion of the leak checks, the sample flow shut-off valve was closed.

After the leak check had been performed, the sample tank number and trap numbers for each sampling train were recorded on the field data sheet with the respective test run number and sampling site. Four TRC and two NCASI sampling trains were connected to each Method 5X sampling train at the insulated outlet of their respective hotbox filters. Immediately prior to sampling, the gauge vacuum and clock time were noted. The flow shut-off valve was opened and sampling begun. TRC gauge vacuum readings were recorded every 5 minutes during the sampling period. At the end of the sampling period, the flow shut-off valve was closed, the time and final gauge vacuum recorded. After the Method 5X sampling was completed, the Method 25 probe lines were disconnected from the Method 5X interface and tightly capped.

A post-test leak check was performed prior to disassembly of the sampling train. After assuring that the probe had been tightly capped, the flow shut-

off valve was opened and the gauge vacuum monitored for a minimum of 10 minutes. The leak check was acceptable if no visible change in tank vacuum occurred. The post-test leak rate (inches Hg/10 minutes) was recorded if observed. At the completion of the leak check, the flow shut-off valve was closed.

#### 5.3.2.3 Method 25 - Field Sample Recovery

After the post-test leak check was completed, the TRC sampling train components were disconnected. Both ends of each condensibles trap were tightly sealed. The traps were then packed in dry ice for sample preservation and shipment to the laboratory.

#### 5.3.2.4 Method 25 - Sample Analysis

Two inlet sampling trains and two outlet sampling trains from each test were analyzed by TRC. The other two inlet sampling trains and two outlet sampling trains from each test were analyzed by Pollution Control Science, Inc., (PCS). NCASI analyzed the samples collected with their equipment. Additional analyses of the PCS analyzed samples were performed at the TRC laboratory. The purpose of this approach was to identify the cause of the poor paired sample data precision obtained during the method development program.

The analyses were performed in general accordance with the method as published (Appendix F). Prior to the nonmethane organic analysis of the tank samples, a preliminary analysis was performed with an FID to determine the relative sample concentrations. The purpose of this analysis was to provide additional information for the resolution of any poor precision. If the pre-

liminary tank sample analyses indicated relatively equal tank concentrations for paired samples, the nonmethane organic analyses should also produce relatively equal values. These data are presented in Appendix F.

#### Preliminary Sample Tank Analysis

The preliminary sample tank analysis was performed using the nonmethane organic analyzer. However, the separation column, oxidation catalyst, and reduction catalyst were bypassed. The sample tank was pressurized to approximately 100 mmHg gauge and then connected to the analyzer. The sample loop was purged and charged with sample gas. The sample was then injected from the loop into the analyzer, bypassing the separation column and catalysts, and introduced directly to the flame ionization detector. The detector response was plotted and scaled by the integrator. The responses for paired sample tanks were compared for relative magnitude on a ppm CH<sub>4</sub> (methane) basis and recorded for reference during the nonmethane organic analysis procedure.

#### TRC Analysis Equipment

The analyzer was fabricated by TRC using the following base components:

Varian Model 2800 gas chromatograph with flame ionization detector; and Hewlett-Packard Model 3390A Reporting Integrator.

These components were interconnected to provide an analyzer scheme very similar to that described in the method. However, TRC has made some changes which improved the ease of operation without affecting analyzer performance. Figure 5-6 is a schematic rendering of the analyzer as assembled. A high-grade, HC-free carrier gas is used which eliminates the necessity for the purification furnace.



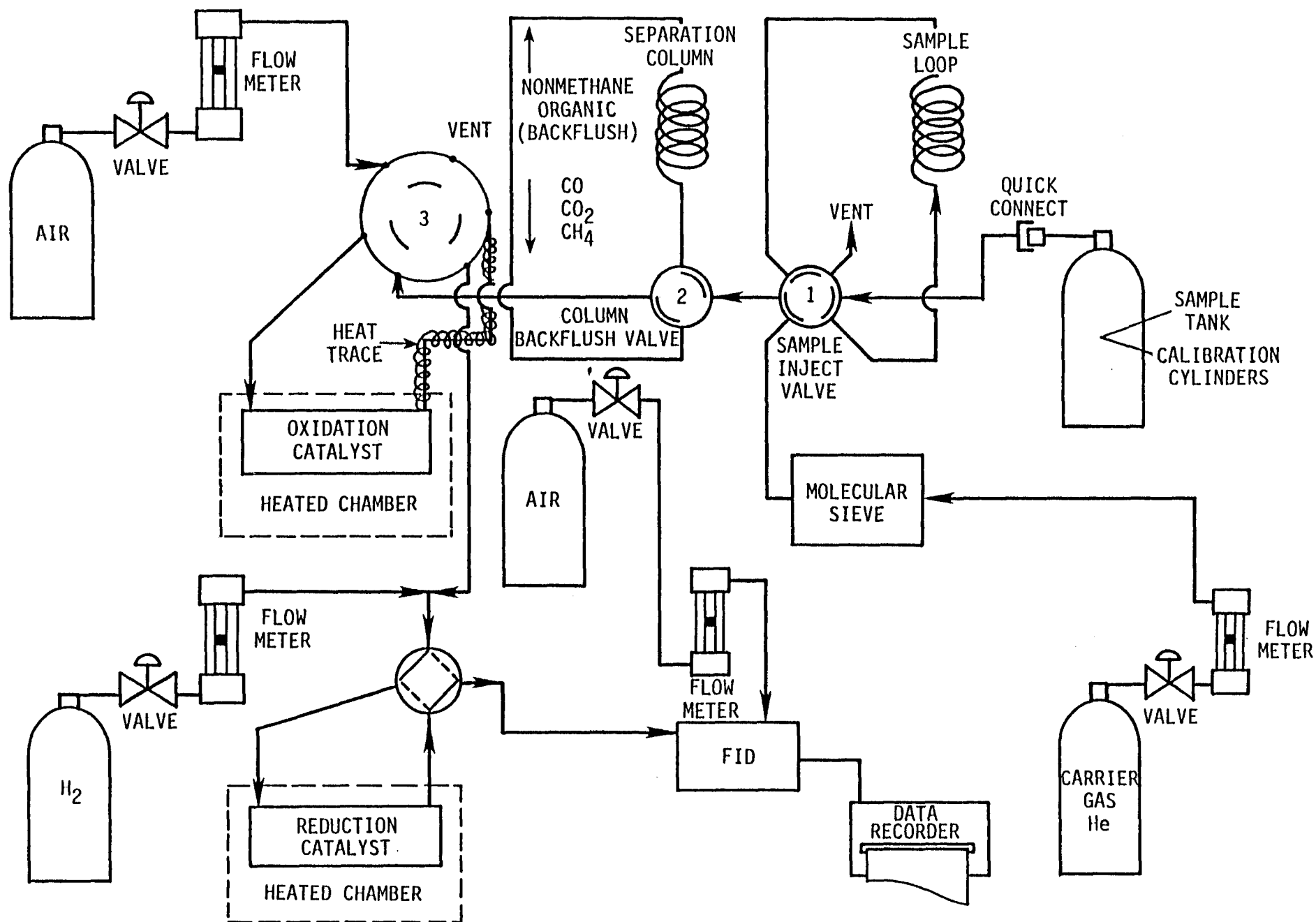


Figure 5-6. TRC Nonmethane Organic Analyzer

A six-port valve (Carle Model 5521) was substituted for the two four-port valves in the oxidation catalyst flow scheme. One four-port valve was used instead of two four-port valves in the reduction catalyst flow scheme. In effect the latter valving modification precluded hydrogen venting within the laboratory.

The exit line from the oxidation furnace to the six-port valve was heat traced to avoid condensation. Additionally, all four switching valves incorporated in the analyzer were enclosed in a heated, insulated compartment thermostatically controlled to maintain a constant 100°C temperature.

The separation column used was prepared by Supelco, Inc. It was a 4-1/2 foot long, 1/8-inch diameter stainless steel tube with two packed sections. The injection side section was 3 feet long and contains 10 percent OV-101 (liquid methyl silicone) on 80/100 mesh Supelcoport. The following section was 1-1/2 feet long packed with 60/80 mesh Poropak Q.

The reduction catalyst was a Byron Instruments unit with integral heater. This was mounted within the Varian gas chromatograph oven to ensure constant temperature operation.

Although not clearly shown in Figure 5-6, a single combustion air source services both the oxidation catalyst and the flame ionization detector. Individual metering valves are used after the flow splitter to regulate the supply to each device.

The condensate recovery and conditioning apparatus equipment was assembled by TRC as shown in Figure 5-7 and was essentially the same as the configuration detailed by the method. The NDIR incorporated was an Anarad AR 400, with a range of 0 to 10,000 ppm CO<sub>2</sub>.

The TRC arrangement did not incorporate the vacuum pump in a direct link with other equipment. Instead it was located remotely. This was done to avoid contamination by the oil mist vented from the vacuum pump.

A tube furnace was used for volatilization of the condensate trap sample. This provides more even, high temperature heating of the trap. A propane torch was used to heat those parts of the trap, including the probe, which remain outside the furnace during the sample recovery procedure. Valves A, B, C and D in Figure 5-7 and their connecting tubing were enclosed in a thermostatically controlled oven maintained at 180°C to prevent condensation. An oxygen rich carrier gas passed through the condensate trap during heating and oxidized the organic compounds to CO<sub>2</sub> and water vapor. The flow exited the trap, passed through a water trap and NDIR, and entered the intermediate collection vessel.

Analyzer Operating Conditions:

<u>Gas</u>	<u>Regulator Pressure (psig)</u>	<u>Flow Rate (cc/min)</u>
Helium	42	25
Air	45	30 FID
		50 Oxidation Catalyst
Hydrogen	20	30

Separation column normal temperature - 0°C  
 Separation column backflush temperature - 100°C  
 Oxidation catalyst temperature - 750°C  
 Reduction catalyst temperature - 100°C (32 VAC)

Condensate Recovery Conditions:

<u>Gas</u>	<u>Regulator Pressure (psig)</u>	<u>Flow Rate (cc/min)</u>
Oxygen	10	150
Air	15	50

Oxidation catalyst temperature - 850°C

Details of the NCASI analyzer and procedures are presented in Appendix H.

Nonmethane Organic Analysis Procedure

The analysis was performed in accordance with the published procedure. (See Appendix H.) However, the condensate trap carbon dioxide purge (Section A.3.2 of the published procedure) was modified. After briefly purging the trap according to the procedure, the valves were switched so that the trap

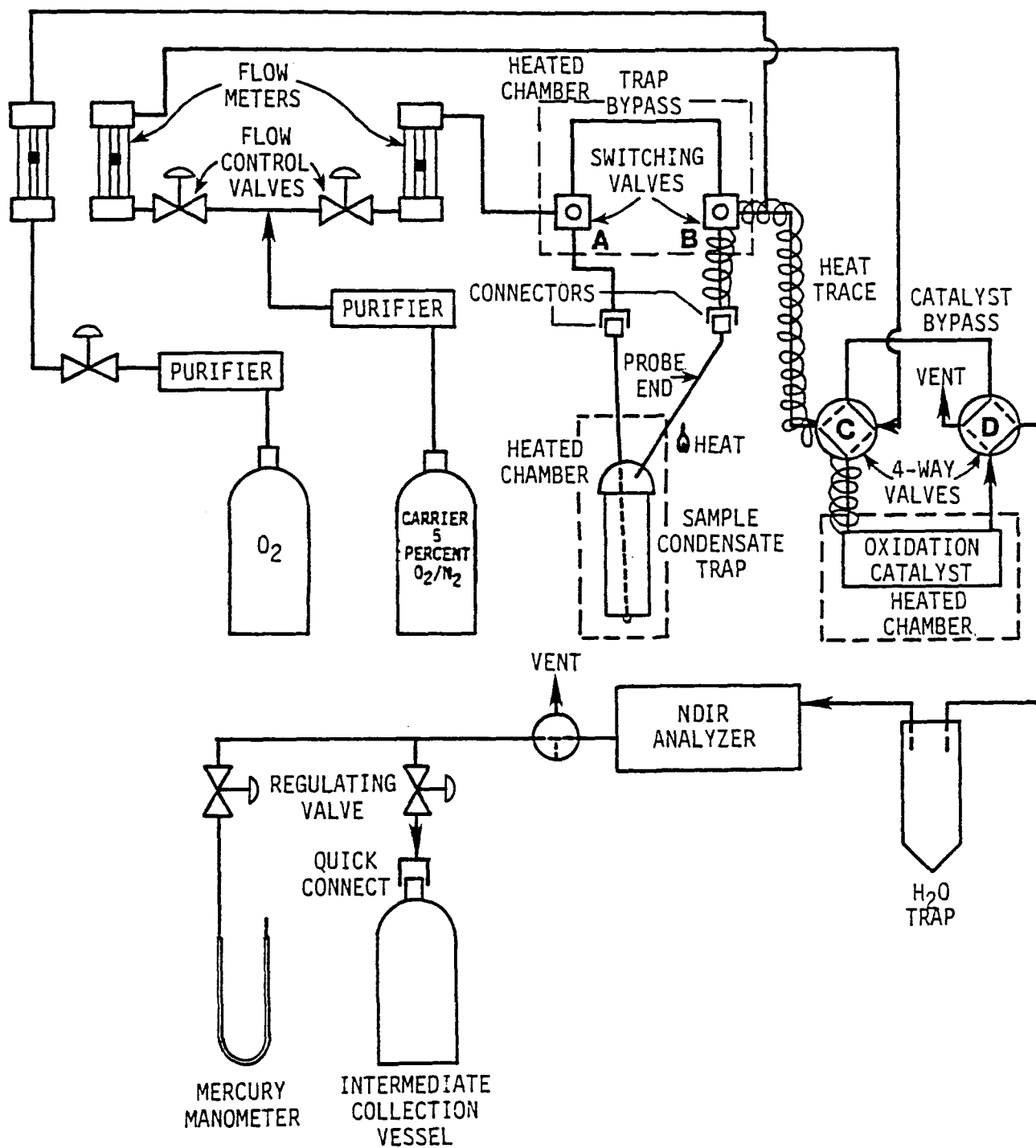


Figure 5-7. TRC Condensate Recovery and Conditioning Apparatus

was bypassed. After the trap had been bypassed, the carrier gas flow continued through the system and into the tank for approximately 5 minutes. It was then vented to the atmosphere through the valve located downstream of the NDIR. (See Figure 5-7.) This time period was sufficient to purge the inter-connecting tubing and NDIR cell volume. Prior to resuming flow through the condensate trap, the valve was switched to introduce again the flow into the sample tank. The trap was removed from the dry ice bath and allowed to warm to room temperature (determined by touch). The trap was placed back into the dry ice bath and the valves switched to resume carrier gas flow through the trap after frosting appeared on external trap surfaces. The procedure was then completed as described. This modification to the procedure was intended to assure the removal of any CO<sub>2</sub> which may be trapped within the ice crystals present in the trap.\*

#### 5.4 Preliminary Moisture Determination

Preliminary moisture tests were performed at the scrubber inlet and outlet prior to emission testing. Testing was performed in accordance with EPA Method 4. Data were recorded on field moisture determination forms as presented in Appendix C.

#### 5.5 Preliminary Velocity Determination

Preliminary velocity measurements were made at the scrubber inlet and outlet prior to emission testing. EPA Methods 1 and 2 were followed in measuring the velocity of the gas stream. Data were recorded on the field data sheets (Traverse Point Location for Circular Ducts and Preliminary Velocity Traverse, Appendix C).

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\* "Investigation of Carbon Dioxide Interference with Method 25." EPA Contract 68-02-2814, Work Assignment 41. Midwest Research Institute, April 15, 1981, p. 7.

## 5.6 Visible Emissions

Scrubber outlet visible emissions were not monitored as planned because of overcast sky background conditions. The controlled emissions were bluish-white which made it impossible to distinguish the emissions from the overcast sky. Overcast skies were present on June 8, 9 and 10. During the last test day, June 11, the sky began to clear and only scattered clouds were present in the afternoon. However, the final test sequence was nearly completed by this time. Consequently, no visible emission observations were recorded.

Although the scrubber outlet stack had an attached steam plume, the Method 9 observations were not cancelled because of this condition. The method provides for attached steam plumes by requiring that observations be made at the point where the condensed water vapor is no longer visible.

## 5.7 Pressure Drop Measurements

The pressure drop across the scrubber system was measured in order to determine if the unit was operating at design conditions and to provide a means of correlating a scrubber operating parameter with collection efficiency. U-tube water manometers were used to measure static pressure at three points at 30-minute intervals during the test period. Measurements were made at the inlet sampling location, just before, and just after the induced draft fan. Pressure drop across the scrubber system was then calculated from the static pressures.

## 5.8 Scrubber Solution Samples

Scrubber solution samples were taken from the holding tank of the recirculating system concurrently with the particulate/condensable organics testing performed at the scrubber outlet. These samples were taken to determine

the relationship between the total organic carbon content of the scrubber solution and the actual measured emissions.

A 100-ml sample was taken approximately every 30 minutes while Method 5X was being performed at the outlet. These samples were taken by dipping a 100 ml graduated cylinder into the holding tank. Sample numbers and collection times were recorded on the Scrubber Solution Sample Collection form. The 100-ml aliquots collected during a test were composited into one sample jar for that test.

The composite samples were placed in shock-proof containers and transported to CH<sub>2</sub>M Hill at the conclusion of the test program. The scrubber solution samples were analyzed for total organic carbon (TOC) following Standard Method 415.1. All analyses were performed within two weeks of sample collection.

### 5.9 Fugitive Emissions

The purpose of these measurements was to visually determine the frequency of occurrence of emissions that are not emitted directly from the process stack or duct. These are generally referred to as fugitive emissions and include such emissions as those: (1) escaping capture by process equipment exhaust hoods; (2) emitted during material transfer; (3) emitted from buildings housing material processing or handling equipment; (4) emitted directly from process equipment.

EPA Method 22 modified guidelines, as presented in Appendix F, were used to determine fugitive emissions from the veneer dryer doors and abort stacks. The method does not require that the opacity of emissions be determined. Instead, the amount of time that any visible emissions occur during the observation period is measured.

Fugitive emissions from the veneer dryers were monitored by RTI and DGA. Observations were recorded periodically throughout the test program.

#### 5.10 Ambient Temperature and Relative Humidity

Outdoor ambient air temperature and relative humidity were measured with a psychrometer at the beginning and end of each test period. Measurements were made by RTI and their subcontractor to determine if a relationship exists between ambient temperature and relative humidity, and the emissions from the veneer dryers. Data was recorded on a form presented in Appendix I.



## 6.0 QUALITY ASSURANCE

The TRC quality assurance 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-600/4-7-027b).

At the beginning of each day, a meeting was held to orient personnel to the activities scheduled for that day and to discuss results from the previous day, and to determine if any special considerations were appropriate for the day's work.

### 6.1 Method 5X

TRC's measurement devices, pitot tubes, dry gas meters, thermocouples, probes and nozzles 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. Samples of these calibration forms are presented in Appendix F.

All Method 5X sampling shall be 100  $\pm$  10 percent isokinetic. Probe and hotbox temperatures were maintained at 350<sup>°</sup>  $\pm$  25<sup>°</sup>F. Deviations from these criteria were reported to the EPA/EMB task manager to decide whether a test run should be repeated or continued.

A single clean-up evaluation test was performed on each initial set (collector train) of glassware prior to collecting field samples. The evaluation tests (Method 5X) were performed in the field clean-up laboratory and were observed by the EPA task manager. Necessary changes or modifications to the clean-up procedures were specified by the EPA task manager prior to collecting field samples. The sets of glassware, including the probes,

were prepared and precleaned before conducting the clean-up evaluation tests. The impingers were precharged as specified in the actual test program. Afterward, the sample collectors, including probes, were cleaned and the blank samples recovered and analyzed as specified in the actual test program. Results are presented in Section 2 of this report.

In summary, the evaluation tests were designed to precondition the sample collectors, to establish blank background values, and to educate the clean-up personnel in specific sample recovery procedures.

Acetone was provided by CH<sub>2</sub>MHill in glass-lined containers. Both the acetone and D.D. water were analyzed by CH<sub>2</sub>MHill prior to field use. Residue data from this preliminary analysis was evaluated by the EPA/EMB task manager with respect to the suitability for use during the test program. These data are presented in Appendix H. In addition, three blank samples of D.D. water, acetone, and both 2-1/2 inch and 4-1/2 inch filters were collected for background analysis. All clean-up evaluation and blank samples were analyzed in conjunction with the actual test samples.

All sample recovery was performed by a three-person clean-up crew. Appropriate sample recovery data were recorded on the sample identification log, sample handling log, chain-of-custody form, and analytical data forms as presented in Appendix D.

Recovered samples were secured in padlocked, shock-proof, steel containers for storage and shipment for analysis.

All preparation and analysis of Method 5X samples were performed by CH<sub>2</sub>MHill, which has extensive experience with Oregon DEQ Method 7, from which Method 5X derives. CH<sub>2</sub>MHill adhered to the standards of quality assurance set forth in the Quality Assurance Handbook for Air Pollution

Measurement Systems, Volume III (EPA-600/4-7-027b) and the Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA-600/4-79-019, March 1979).

## 6.2 Method 25

Method 25 traps were burned out according to the method prior to testing and spot-checked for contamination. All Method 25 tanks were flushed with nitrogen and checked for contamination prior to field use.

Six sampling trains were used to provide a check on data precision. Two trains were analyzed by TRC; two by PCS, and NCASI analyzed the remaining two trains. All tanks and traps have permanently engraved identification numbers.

Analyzers were calibrated over the specified ranges using certified calibration gases. Certification forms are provided in Appendix F.

## 6.3 Method 9

The TRC observer had been certified within the past 6 months to perform visible emission evaluations.