Did not pass tests

EVALUATION OF ELASTOMERIC COMPOSITE ROOFING PRODUCT AND INDOOR FUGITIVE EMISSIONS

Prepared for:

Mr. Jim Rosenbaum
Renewed Materials Industries, Inc.
621 West Division Street
Muenster, Texas 76252

Prepared by:

Southwestern Laboratories, Inc.
Research and Development Division
222 Cavalcade Street
Houston, Texas 77009

SWL Report No. 261393-36411
SWL Client No. 12-7416-01

October 14, 1993

SWL

RESEARCH AND DEVELOPMENT

October 14, 1993

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SWL Report No. 261393-36411
SWL Client No. 12-7416-01

Mr. Jim Rosenbaum
Renewed Materials Industries, Inc.
621 West Division Street
Muenster, Texas 76252

Re: Evaluation of Elastomeric Composite Roofing Product and Indoor Fugitive Emissions

Dear Mr. Rosenbaum:

Attached are results for the above referenced project. A composite material is manufactured by Renewed Materials Industries from waste tires and various recycled plastics. The composite material is to be sold as a roofing material.

Tests evaluated physical properties for Material Safety Data Sheets (MSDS), fire ratings according to the Monsanto Method for Estimating Flame Spread Rating, and a laboratory controlled burn to trap and evaluate combustion smoke for toxic materials.

The results of the Indoor Fugitive Emissions Test are included in the separately bound report, SWL Project No. 54-9303-353.

Southwestern Laboratories Inc. (SWL) is pleased to provide these services to you. Please call if there are any questions.

Respectfully,
SOUTHWESTERN LABORATORIES, INC.

A. Beryl Gainer

A. Beryl Gainer, Ph. D.
Senior Consultant
Waste & Chemicals Research

J B Woodson
Reviewed by:

Attachment

ABG/pf

cc: J. B. Woodson

Evaluation of Elastomeric Roofing Product and Indoor Fugitive Emissions
SWL Report No. 261393-36411

1.0 INTRODUCTION

On 11/16/92 and 1/21/93, SWL Proposals C92-072A and C93-022 were submitted to Renewed Materials Industries (RMI) on the above referenced project. On 3/26/93 RMI authorized work to evaluate a new elastomeric composite product. Physical and chemical test results are reported below. Attached is a separately found report of an air emissions test program of the Wood Substitute Extruder vent located at the Muenster, Texas, facility by J. B. Johnston and P. W. Yokley of SWL.

2.0 LABORATORY INVESTIGATION

Material Safety Data Sheet Physical Properties

Shown below are tests required for a material safety data sheet (MSDS) for the elastomeric roofing product.

ASTM Test Performed	Result
D-92 Cleveland Open Cup Flash Point, °F	400
C-661 Durometer Hardness	45
Density, grams/cubic centimeter	1.082
E-96 Water Vapor Transmission, perms	0.0005
G-53 500 Hour Accelerated Weathering	No Degradation
B-117 Salt Spray Fog Test	2 Rusty Spots
E-681-9.7 Lower Flammability, grams	3.96
E-681-9.7 Upper Flammability, grams	21.22
E-84 Flame Spread Monsanto Fire Test	97.5
E-84 Smoke Rating Monsanto Fire Test	156.4
Toxic Smoke Test (EPA Method)	Attached

3.0 DETAILS OF UEL-LEL, FLAME TUNNEL AND TOXIC SMOKE TESTS

FLAMMABILITY LIMITS

I. SAMPLE IDENTIFICATION

Roofing Material (Waste Tires & Recycled Plastic)

II. SCOPE OF TESTING

The purpose of this testing was to determine the temperature at which the smallest weighed amount of material would produce ignition. The test was performed by placing a weighed sample in the apparatus and elevating the temperature to 400°F and testing with a spark.

III. RESULTS

This sample flammability was not reached until the temperature was in excess of 400°F. The Lower Flammability Limit was the least amount of sample to produce ignition at 440°F.

FIRE HAZARD EVALUATION USING THE MONSANTO TWO-FOOT FLAME TUNNEL AND SMOKE CHAMBER

I. SAMPLE IDENTIFICATION

Three (3) Pieces Roofing Material (Waste Tires & Recycled Plastic)

II. SCOPE OF TESTING

The purpose of this testing was to determine the protection a material affords its substrate and the comparative burning characteristics of coatings. The testing was accomplished using equipment and procedures to evaluate the flame spread over the surface of the material under controlled conditions. This establishes a basis for comparing surface-burning characteristics of different coatings without specific consideration of all the end-use parameters that might affect these characteristics under actual fire conditions.

In addition to the predicted flame spread rate, the afterflame time, afterglow time, smoldering and smoke developed rate may be measured. However, a relationship should not be presumed among these measurements.

III. SIGNIFICANCE

A number of laboratory procedures are used in evaluating the effectiveness of fire-retardant and fire-resistant treatment and coatings. In general, these methods measure the three stages of fire development: (1) ignition, (2) flame spread (rate of growth of the fire), and (3) conflagration extent. While all three are of extreme importance, flame spread has been recognized as the main factor associated with testing fire-retardant coatings. The Two-Foot Tunnel apparatus as produced by the Monsanto Company has been designed specifically to predict the performance by the ASTM E-84 (Steiner Tunnel) equipment. Flame spread ratings based upon ASTM E-84 have acquired common acceptance by regulatory agencies, but such large scale tests are seldom practical during the development or modification of a fire-retardant coating.

This method provides the relative flame spread in comparison with standard materials. Results from the two-foot tunnel test have been shown to correlate to a predicted approximate ASTM E-84 result, according to the following equation:

$$y = 4.8 + 0.92x$$

where x is the result obtained from the Monsanto test apparatus and y is the predicted result from ASTM E-84.

Degree of the density of the smoke, particulate matter, and other effluent given off by the test specimen are continuously recorded during the flame spread test and rated as a percentage of the degree of smoke density of red oak. Comparative smoke density determinations are made by use of the Monsanto Smoke Chamber which was developed as an approximation of the smoke density equipment utilized in the ASTM E-84 equipment. No direct correlation data is available between smoke density results obtained by the Monsanto Chamber and those obtained by ASTM E-84.

IV. TEST EQUIVALENT

The Monsanto Two-Foot Flame Tunnel and Smoke Chamber consists of a 24 x 4 inch angle-iron flame inclined 28° from the horizontal. The sides and fire-end of the tunnel are covered with 1/4" asbestos-cement board which is attached to the inside of the frame. The open end, flue end, and cutout sides allow a natural draft through the tunnel. Heat, gases, and smoke rise by convection flow. The sample hold is notched along the bottom, or supporting lip angle at one inch intervals to assist in measurement of the flame advance. An observation window, a two-inch wide strip of 1/8" polished vycor plate, is located just below the sample holder and extending the full length of the tunnel. The glass is calibrated every inch from 4 to 22. The burner, using local commercial gas fuel, is place 2 1/4" horizontally from the interior of the fire-end of the tunnel. A thermocouple, ignition transformer, time and regulating valve are part of the assembly.

The Smoke Chamber is equipped with a light source, photoelectric cell, milliampere recorder, necessary stacks, vents and accessories. Test results are shown below:

Flame Propagation Rate E-84 (Monsanto Fire Test)
March 30, 1993

Test and Calibration Data

The tunnel is calibrated prior to each day's operation by determining the difference in flame length of standard preconditioned mineral board and red oak boards.

	Calibration Panels			Samples		
	Data	Red Oak	Mineral Board	No. 1	No. 2	No. 3
Flame Length (L) (Average of 3 highest consecutive flame front readings)		18.0	8.5	18.2	18.0	18.1
Flame Spread (FS) (Flame length of test panel minus flame length of mineral board calibration pane)				9.7	9.5	9.6
Flame Spread Constant (K) $\frac{(100)}{L0 - La}$	$\frac{(100)}{(18.0 - 8.5)}$		=	$\frac{(100)}{}$	= 10.5	

EVALUATION OF TEST DATA

Determination	No. 1	No. 2	No. 3	Average
Monsanto Flame Spread Rating (FS x K)	101.9	99.8	100.8	100.8
Flame Spread-Predicted E-84 Value by use of Monsanto Formula	98.5	96.6	97.5	97.5
Afterflaming	None	None	None	
Afterglow	None	None	None	
Smoldering	None	None	None	
Smoke Developed Rating Reported as a Percentage of Smoke Developed by the Red Oak Calibration Panel	160.7	158.7	149.8	156.4

TOXIC SMOKE TEST (MODIFIED EPA METHOD)

I. INTRODUCTION

A laboratory scale research project was jointly performed by personnel of Southwestern Laboratories, Inc. (SWL), Center for construction Materials Technology (CCMT) and Environmental Analytical Services (EAS) Divisions. Testing was performed to determine both a qualitative and quantitative analysis of the emissions given off from the ignition and subsequent combustion of a roofing material. The roofing material was comprised primarily of recycled plastics and vehicle tires. It was decided that a test program to determine both the volatile (boiling point <100°C) and semivolatile (boiling point >100°C) organic constituents present in the emission would be undertaken. Samples were extracted from sampling ports which were located in a flexible metal duct positioned directly above the ignited material. The project was conducted within the confines of a laboratory hood which pulled the emission through the flexible duct before exhausting it to the atmosphere.

Sampling was performed by Messrs. John Johnston and Wes Bear of SWL's EAS Division. The test program was conducted on April 6, 1993.

II. RESULTS

Results of the individual runs were calculated in accordance with Environmental Agency (EPA) procedures and are contained on the following pages.

III. PROCEDURE

Sampling equipment and procedures were in conformity with Methods 0010 and 0030 as contained in EPA Document SW 846, "Test Methods for Evaluating Solid Waste," Volume 2, Chapter 10. A schematic of the apparatus is shown on the following page.

Sample and Velocity Traverse - Method 1

The exhaust duct was circular in shape with a seven (7) inch diameter. Two (2) three inch diameter sampling ports were provided. Upstream distance from the nearest flow disturbance (duct outlet) to the sample ports (Distance A) was thirty (30) inches (4.3 stack diameters). Downstream distance from the nearest flow disturbance (duct inlet) to the sampling ports (Distance B) was nine (9) inches (1.3 stack diameter). It was determined that a twelve (12) point traverse for velocity measurements would be appropriate, as only one port was accessible for MM5 sampling.

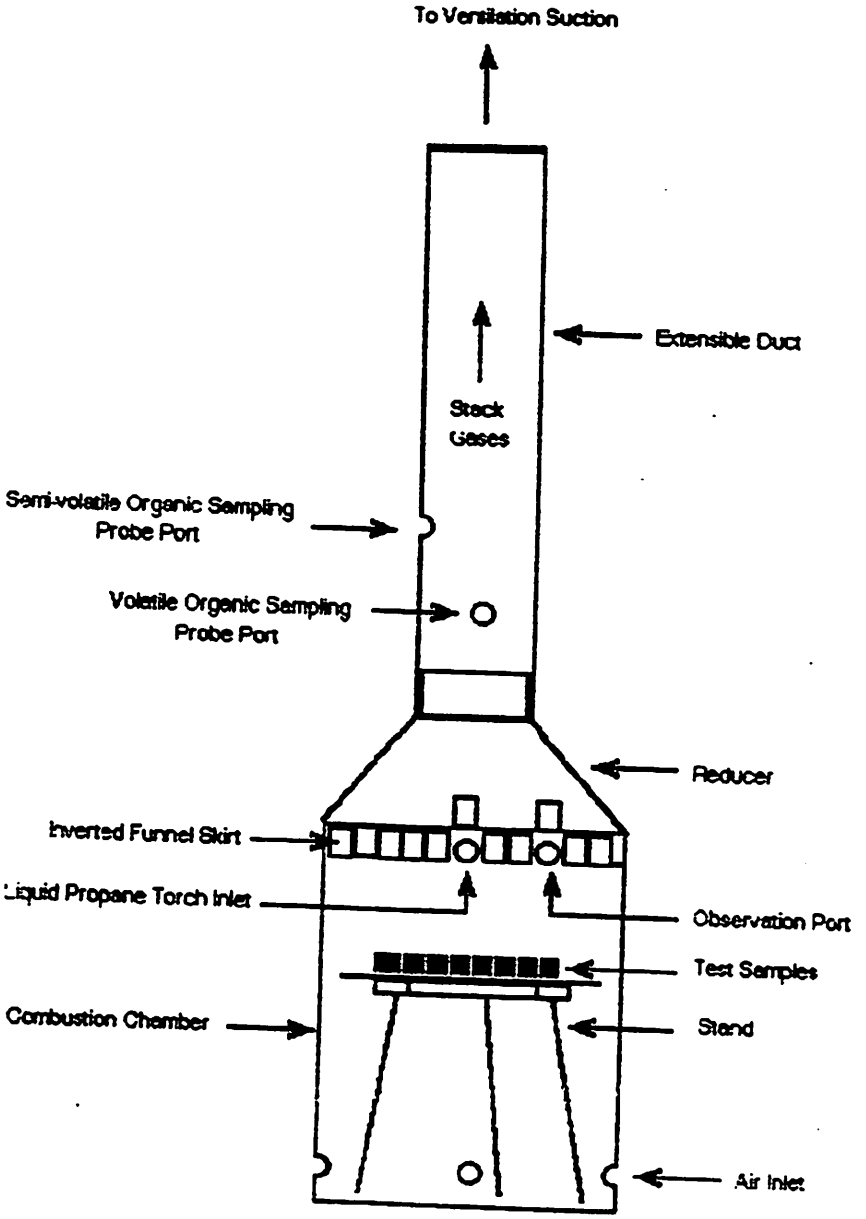
To Ventilation Suction
Extensible Duct
Stack Gases
Semi-volatile Organic Sampling Probe Port
Volatile Organic Sampling Probe Port
Reducer
Inverted Funnel Skirt
Liquid Propane Torch Inlet
Observation Port
Test Samples
Combustion Chamber
Stand
Air Inlet

Figure 1

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

Stack gas velocity was measured with an "S" type pitot tube constructed in accordance with "proper pitot tube sampling nozzle configuration," as specified in the Environmental Protection Agency, "Standards of Performance for Stationary Sources, Revision to Reference Method 1-8 (FR Thursday, August 18, 1977, Part II)." The pitot tube coefficient was determined by a wind tunnel calibration. Temperature measurements were determined by means of a calibrated digital thermometer with a Type "K" thermocouple. A preliminary velocity/temperature traverse was performed in order to calculate isokinetic nomograph settings for semivolatile organic compound sampling. Actual flue gas flow rate data was obtained simultaneously with the emissions sampling run.

Gas Analysis and Molecular Weight Determination - Method 3

A grab stack gas sample taken during the sampling run was analyzed for CO_2 and O_2 by use of a standard Fyrite analyzer. N_2 was determined by difference. Analysis was performed immediately after sampling. Data were utilized in calculating stack gas molecular weight, which was used in stack velocity determinations.

Determination of Moisture Content in Stack Gases - Method 4

Stack gas moisture content was assumed to be two (2) percent. This data was used to calculate isokinetic nomograph settings for semivolatile organic compound sampling.

Actual moisture content of the stack gas was determined by volumetric and gravimetric analysis of the impinger catch from the sample run. Data were used in flue gas exhaust rate calculations.

Determination of Volatile Organic Compound Emissions
- EPA Method 0030 (VOST)

Sampling to determine the concentration and emission rate of volatile organic compounds being emitted from the exhaust stack was performed. One (1) primary run and two (2) backup runs were performed. The backup samples were taken in case analysis of the primary sample indicated breakthrough or over-loading of the sorbent cartridges.

Samples were obtained according to procedure described in EPA Method 0030, as contained in EPA document SW 846, "Test Methods for Evaluating Solid Waste," Volume 2, Chapter 10. This method is commonly referred to as the Volatile Organic Sampling Train or VOST. The primary tube consisted of a one liter sample (4 minutes at a rate of 0.25 liters per minute). The backup tubes consisted of a second one liter sample as well as a five liter sample (20 minutes at a rate of 0.25 liters per minute).

The sampling system consisted of, in the following order, a heated glass-lined probe with a precleaned glass wood plug to remove particulates, a glass twin valve for purging/sampling, a chilled coil condenser to cool the gas stream and condense any water vapor present, a tenax cartridge, a glass condensation trap to collect condensed water vapor, a chilled straight condenser, a tenax/charcoal cartridge which served as a backup for highly volatile, low volume breakthrough compounds, a silica gel tube for residual moisture removal and a flow/temperature control console. Sample temperatures were monitored at the probe outlet, the inlets to both the coil and straight tube condensers and the console dry gas meter. The probe was purged with stack gas prior to sampling and leak checks of the sampling system were performed prior to and following each run to ensure the collection of valid data. At the end of each run, the sorbent cartridges were sealed with stainless steel fittings, and placed into their original glass culture tubes containing charcoal beads and glass wool. The transport tube was then sealed with teflon tape. Due to the low moisture content of the stack gas, as well as the short duration sample, no condensate was collected in the condensation trap. All samples were immediately placed into chilled ice chests to preserve the samples.

Determination of Semivolatile Organic Compounds Emissions - EPA Method 0010

Sampling to determine the concentration and emission rate of semivolatile organic compounds being emitted from the exhaust stack was performed. One (1) sixty (60) minute stenotic run was performed.

The sampling was obtained according to procedures described in EPA Method 0010, as contained in the above referenced EPA document SW 846. This method is commonly referred to as the Modified Method 5, or MM5, procedure for determining semivolatile organic constituents.

The sampling system was similar to a traditional EPA Method 5 train with few exceptions. The primary difference was the insertion of both a chilled coil condenser to condition the gas sample and a porous polymeric XAD resin trap to adsorb semivolatile organic species just prior to an empty first impinger which itself contained shortened stem and served as a water knockout. Impingers two and three each contained 100 ml of deionized water, the fourth impinger was empty and the fifth impinger contained a known weight of silica gel. A stainless steel nozzle, heated glass-lined probe, and a heated quartz fiber filter with a teflon filter support were placed in line prior to the chilled condenser coil.

Prior to and following the sample run, leak checks of the sampling system and pitot types were performed. After the run, the filer was placed into a glass petri dish, the final volumes of the impinger solutions were recorded, and the solutions were poured into a one liter amber glass container. The nozzle, probe liner, filter housing, condenser coil, impingers, and all connecting glassware were rinsed in triplicate with a 1:1 methanol/methylene chloride solution into the same container as that used for the impinger solution. The bottle was sealed with a teflon-lined cap. The glass petri was

sealed at each end with ground glass fittings, wrapped with teflon tape and secured with stainless steel clamps. The filter, liquid, and XAD resin trap were immediately placed into a refrigerated compartment to preserve the samples.

IV. SAMPLE RECOVERY

Volatile Organic Compounds

VOST samples were analyzed using thermal desorption purge-and-trap GC/MS techniques in accordance with procedures described in Method 5040 of the aforementioned EPA SW 846 document. Both the tenax and tenax/charcoal tubes were desorbed simultaneously ("tendem" analysis). The sorbent tubes were thermally desorbed by heating and purging with organic/free helium. The gaseous effluent from the tubes was bubbled through pre-purged organic/free reagent water and trapped on an analytical trap in a purge-and-trap unit. After desorption, the analytical sorbent trap was heated rapidly and the gas flow from the analytical trap was directed to the head of a wide-bore column under subambient conditions. The volatile organic compounds were calculated from a multi-point calibration curve, using appropriate response factors. The detected VOST compound emissions data are summarized in the results section of this report.

Semivolative Organic Compounds

MM5 samples were analyzed by gas chromatography/mass spectrometry (GC/MS) using fused-silica capillary GC columns as described in Method 8270 of the aforementioned EPA SW 846 document. The samples were prepared as follows:

250 uL of the base/neutral acid (BNA) surrogate spiking solution (B/N at 100 mg/L, Acid at 200 mg/L) were added to each liquid sample. The pH was adjusted to 2 with H_2SO_4 and the sample was extracted by separatory funnel with three 60 ml portions of $MeCl_2$ while filtering the extract through sodium sulfate. The pH was then adjusted to 11 with NaOH and the extraction process repeated. The XAD-3 resin and particulate filter were quantitatively transferred to a soxhlet extraction thimble, spiked with 250 uL of the BNA surrogate spiking solution and then covered with pre-cleaned glass wool. The soxhlet extractor was set to cycle approximately 6 times per hour and the extraction was allowed to proceed overnight. All solvent extracts were combined and then further concentrated to a final volume of 1 ml.

Analyses were performed on a Finnigan INCOS XL GC/MS system consisting of an A200S autosampler, Varian 3400 GC and INCOS XL MS. The system is supported by an INCOS Disk Operating System which includes IDOS II and IDOS IV software.

The detected semivolatile compounds emissions data are contained in the results section of this report.

V. CUSTODY OF SAMPLES

After completion of tests, each sample was placed in the custody of the technician for analysis. It was his assigned responsibility to insure that each sample was recorded and correctly analyzed. Analysis of samples was performed either at Southwestern Laboratories' facilities by Environmental Analytical Services personnel, or at Twin City Testing Corporation, St. Paul, Minnesota. It was the duty of the Department Manager and Project Manager to answer any procedural queries from SWL's Laboratory Technician. Final responsibility rested with the Department Manager.

VI. DISCUSSION

The following was observed during the burning tests:

> The flame front was observed to spread rapidly from the steady burning region to the non-burning region of the test samples. The spread of the flame front was intermittent and was never observed to be able to induce steady burning to other non-burning parts of the test samples.
>
> After ignition (with observable flame), steady burning generally lasted from 15 to 25 minutes. Then, the flame went out and smoldering was observed.

Emissions sampling was undertaken to determine both the type and quantity of volatile and semivolatile organic hydrocarbons given off as a result of the combustion of a recycled material comprised of miscellaneous plastic materials. The scope of work in this test program was limited to identifying only those compounds listed in Title III, Section 301, of the Clean Air Amendments of 1990.

For a detailed summary of both the volatile and semivolatile compounds detected, please refer to the attached tables on the following pages.

VII. RECOMMENDATIONS

Although the SWL EAS air emissions test group has performed many emissions sampling of polyethylene production facilities, synthetic rubber manufacturing facilities and processes which utilize used vehicle tires as an asphalt additive, each using similar sampling and analytical procedures, the interpretation of data was limited in these instances to determining compliance with an applicable permit.

It is our recommendation that further data interpretation concerning such items as product safety, occupational exposure, etc., be achieved by contacting the appropriate governmental agencies as these items were not included in the test program described herein.

SWL
RESEARCH AND DEVELOPMENT

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October 15, 1993

Mr. Jim Rosenbaum
Renewed Materials Industries, Inc.
621 West Division Street
Muenster, Texas 76252

RE: SWL Report No. 261393-36411

Dear Mr. Rosenbaum:

Enclosed please find an additional report that was inadvertently left out of our referenced report federal expressed to you yesterday. We apologize for this oversight.

This separate report for toxic smoke tests should follow Section 3.0: Details of UEL-LEL, Flame Tunnel and Toxic Smoke Tests.

Again, we apologize for this inconvenience to you.

Sincerely,
SOUTHWESTERN LABORATORIES, INC.

A. Beryl Gainer

A. Beryl Gainer, Ph.D.
Senior Consultant
Waste & Chemicals Research

Enclosure

ABG:pf

cc: J. Woodson

SWL
SOUTHWESTERN LABORATORIES, INC.

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May 7, 1993

Mr. Jeffery B. Woodson
SOUTHWESTERN LABORATORIES, INC.
222 Cavalcade
Houston, Texas 77009

Re: Air Emissions Sampling of a
Wood Substitute Material
SwL Project No. 54-9303-019

Gentlemen:

In accordance with your discussion with Phil Yokley, Southwestern Laboratories, Inc. hereby submits our test report covering the emissions test program of CCMT located at Southwestern Laboratories' Houston lab. Testing was conducted April 1 and 2, 1993.

It has been a pleasure working with you and your personnel. Please let us know if you have any questions concerning this report, or if we may be of further service.

Sincerely,

SOUTHWESTERN LABORATORIES, INC.

Johndunn B. Johnston
Project Manager

Phillip W. Yokley
Air Pollution Program Manager
Environmental Analytical Services

JBJ:pm

INTRODUCTION

A laboratory scale research project was jointly performed by personnel of Southwestern Laboratories, Inc. (SwL) Center for Construction Material Technology (CCMT)) and Environmental Analytical Services (EAS) Divisions. Testing was performed to determine both a qualitative and quantitative analysis of the emissions given off from the ignition and subsequent combustion of a wood substitute material. The wood substitute material was comprised primarily of recycled plastics and vehicle tires. It was decided that a test program to determine both the volatile (boiling point $< 100°C$) and semivolatile (boiling point $> 100°C$) organic constituents present in the emission would be undertaken. Samples were extracted from sampling ports which were located in a flexible metal duct positioned directly above the ignited material. The project was conducted within the confines of a laboratory hood which pulled the emission through the flexible duct before exhausting it to the atmosphere.

Sampling was performed by Messrs. John Johnston and Wes Bear of SwL's EAS Division. The test program was conducted on March 2, 1993.

RESULTS

Results of the individual runs were calculated in accordance with Environmental Protection Agency (EPA) procedures and are contained in Tables 2 and 3.

PROCEDURE

Sampling equipment and procedures were in conformity with Methods 0010 and 0030 as contained in EPA Document SW846, "Test Methods for Evaluating Solid Waste", Volume 2, Chapter 10.

Sample and Velocity Traverses - Method 1

The exhaust duct was circular in shape with a seven (7) inch diameter. Two (2) three inch diameter sampling ports were provided. Upstream distance from the nearest flow disturbance (duct outlet) to the sample ports (Distance A) was thirty (30) inches (4.3 stack diameters). Downstream distance from the nearest flow disturbance (duct inlet) to the sampling ports (Distance B) was nine (9) inches (1.3 stack diameters). It was determined that a twelve (12) point traverse for velocity measurements would be appropriate, as only one port was accessible for MM5 sampling.

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

Stack gas velocity was measured with an "S" type pitot tube constructed in accordance with "proper pitot tube sampling nozzle configuration", as specified in the Environmental Protection Agency, "Standards of Performance for New Stationary Sources - Revision to Reference Method 1-8 (FR Thursday, August 18, 1977, Part II)". The pitot tube coefficient was determined by a wind tunnel calibration. Temperature measurements were determined by means of a calibrated digital thermometer with a Type "K" thermocouple. A preliminary velocity/temperature traverse was performed in order to calculate isokinetic nomograph settings for semivolatile organic compound sampling. Actual flue gas flow rate data was obtained simultaneously with the emissions sampling run.

Gas Analysis and Molecular Weight Determination - Method 3

A grab stack gas sample taken during the sampling run was analyzed for CO_2 and O_2 by use of a standard Fyrite analyzer. N_2 was determined by difference. Analysis was performed immediately

after sampling. Data were utilized in calculating stack gas molecular weight, which was used in stack velocity determination.

Determination of Moisture Content in Stack Gases - Method 4

Stack gas moisture content was assumed to be two (2) percent. This data was used to calculate isokinetic nomograph settings for semivolatile organic compound sampling.

Actual moisture content of the stack gas was determined by volumetric and gravimetric analysis of the impinger catch from the sample run. Data were used in flue gas exhaust rate calculations.

Determination of Volatile Organic Compound Emissions - EPA Method 0030 (VOST)

Sampling to determine the concentration and emission rate of volatile organic compounds being emitted from the exhaust stack was performed. One (1) 20-liter run was performed.

Samples were obtained according to procedures described in EPA method 0030, as contained in EPA document SW 846, "Test Methods for Evaluating Solid Waste", Volume 2, Chapter 10. This method is commonly referred to as the Volatile Organic Sampling Train or VOST. The tenek tubes consisted of a twenty liter sample (20 minutes at a rate of 1.0 liters per minute).

The sampling system consisted of, in the following order, a heated glass-lined probe with a precleaned glass wool plug to remove particulates, a glass twin valve for purging/sampling, a chilled coil condenser to cool the gas stream and condense any water vapor present, a tenax cartridge, a glass condensation trap to collect condensed water vapor, a chilled straight condenser, a tenax/charcoal cartridge which served as a backup for highly volatile, low volume breakthrough compounds, a silica

gel tube for residual moisture removal and a flow/temperature control console. Sample temperatures were monitored at the probe outlet, the inlets to both the coil and straight tube condensers and the console dry gas meter. The probe was purged with stack gas prior to sampling and leak checks of the sampling system were performed prior to and following each run to ensure the collection of valid data. At the end of each run, the sorbent cartridges were sealed with stainless steel fittings, and placed into their original glass culture tubes containing charcoal beads and glass wool. The transport tube was then sealed with teflon tape. Due to the low moisture content of the stack gas as well as the short duration sample, no condensate was collected in the condensation trap. All samples were immediately placed into chilled ice chests to preserve the samples.

Determination of Semivolatile Organic Compounds Emissions - EPA Method 0010

Sampling to determine the concentration and emission rate of semivolatile organic compounds being emitted from the exhaust stack was performed. One (1) sixty (60) minute isokinetic run was performed.

The sample was obtained according to procedures described in EPA method 0010, as contained in the above referenced EPA document SW846. This method is commonly referred to as the Modified Method 5, or MM5, procedure for determining semivolatile organic constituents.

The sampling system was similar to a traditional EPA Method 5 train with few exceptions. The primary difference was the insertion of both a chilled coil condenser to condition the gas sample and a porous polymeric XAD resin trap to adsorb semivolatile organic species just prior to an empty first impinger which itself contained shortened stem and served as a water knockout. Impingers two and

three each contained 100 ml of deionized water, the fourth impinger was empty and the fifth impinger contained a known weight of silica gel. A stainless steel nozzle, heated glass-lined probe, and a heated quartz fiber filter with a teflon filter support were placed in line prior to the chilled condenser coil.

Prior to and following the sample run, leak checks of the sampling system and pitot tubes were performed. After the run the filter was placed into a glass petri dish, the final volumes of the impinger solutions were recorded, and the solutions were poured into a one liter amber glass container. The nozzle, probe liner, filter housing, condenser coil, impingers, and all connecting glassware were rinsed in triplicate with a 1:1 methanol/methylene chloride solution into the same container as that used for the impinger solution. The bottle was sealed with a teflon-lined cap. The glass petri dish and the sample bottle were then sealed with teflon tape. The XAD resin trap was sealed at each end with ground glass fittings, wrapped with teflon tape and secured with stainless steel clamps. The filter, liquid, and XAD resin trap were immediately placed into a refrigerated compartment to preserve the samples.

SAMPLE RECOVERY

Volatile Organic Compounds

VOST samples were analyzed using thermal desorption purge-and-trap GC/MS techniques in accordance with procedures described in Method 5040 of the aforementioned EPA SW 846 document. Both the tenax and tenax/charcoal tubes were desorbed simultaneously ("tandem" analysis). The sorbent tubes were thermally desorbed by heating and purging with organic-free helium. The gaseous effluent from the tubes was bubbled through pre-purged organic-free reagent water and trapped on an analytical

sorbent trap in a purge-and-trap unit. After desorption, the analytical sorbent trap was heated rapidly and the gas flow from the analytical trap was directed to the head of a wide-bore column under subambient conditions. The volatile organic compounds were calculated from a multi-point calibration curve, using appropriate response factors. The detected VOST compound emissions data are summarized in the results section of this report.

Semivolatile Organic Compounds

MM5 samples were analyzed by gas chromatography/mass spectrometry (GC/MS) using fused-silica capillary GC columns as described in Method 8270 of the aforementioned EPA SW 846 document. The samples were prepared as follows:

250μL of the base/neutral acid (BNA) surrogate spiking solution (B/N at 100 mg/L, Acid at 200 mg/L) were added to each liquid sample. The pH was adjusted to 2 with H_2SO_4 and the same was extracted by separatory funnel with three 60 ml portions of $MeCL_2$ while filtering the extract through sodium sulfate. The pH was then adjusted to 11 with NaOH and the extraction process repeated. The XAD-2 resin and particulate filter were quantitatively transferred to a soxhlet extraction thimble, spiked with 250μL of the BNA surrogate spiking solution and then covered with pre-cleaned glass wool. The soxhlet extractor was set to cycle approximately 6 times per hour and the extraction was allowed to proceed overnight. All solvent extracts were combined and then further concentrated to a final volume of 1 ml.

Analyses were performed on a Finnigan INCOS XL GC/MS system consisting of an A200S autosampler, Varian 3400 GC and INCOS XL MS. The system is supported by an INCOS Disk Operating System which includes IDOS II and IDOS IV software.

The detected semivolatile compounds emissions data are contained in the results section of this report.

CUSTODY OF SAMPLES

After completion of tests, each sample was placed in the custody of the technician for analysis. It was his assigned responsibility to insure that each sample was recorded and correctly analyzed. Analysis of samples was performed either at Southwestern Laboratories' facilities by Environmental Analytical Services personnel, or at Twin City Testing Corporation, St. Paul, Minnesota. It was the duty of the Department Manager and Project Manager to answer any procedural queries from SwL's Laboratory Technician. Final responsibility rested with the Department Manager.

DISCUSSION

Emissions sampling was undertaken to determine both the type and quantity of volatile and semivolatile organic hydrocarbons given off as a result of the combustion of the wood substitute material comprised of vehicle tires and plastic containers. The scope of work in this test program was limited to identifying only those compounds listed in Title III, Section 301, of the Clean Air Amendments of 1990.

For a detailed summary of both the volatile and semivolatile compounds detected, please refer to the attached tables.

Although the air emissions test group has performed emissions sampling of polyethylene production facilities, synthetic rubber manufacturing facilities and one process which actually utilized used vehicle tires as an asphalt additive, each using similar sampling and analytical procedures, the interpretation of data was limited in these instances to determining compliance with an applicable permit.

It is our recommendation that further data interpretation concerning such items as product safety, occupational exposure, etc. be achieved by contacting the appropriate governmental agencies as these items were not included in the test program described herein.

TABLE NO. 1

SUMMARY OF SAMPLING RESULTS - MM5

Houston, Texas

SwL Project No. 54-9303-019

Analyte	Emission Rate (lb/hr)
Naphthalene	89.4×10^{-5}
bis(2-Ethylhexyl)Phthalate	1150.0×10^{-5}

TABLE NO. 2

SUMMARY OF SAMPLING RESULTS - VOST

Houston, Texas
SwL Project No. 54-9303-019

Analyte	Emission Rate (lb/hr)
Methylene Chloride	240.0×10^{-7}
Acetone	565.0×10^{-7}
Carbon Disulfide	134.0×10^{-7}
1,1-Dichloroethene	15.8×10^{-7}
Chloroform	9.68×10^{-7}
1,2-Dichloroethane	7.98×10^{-7}
Methylethyl Ketone (MEK)	39.3×10^{-7}
1,1,1-Trichloroethane	697.0×10^{-7}
Carbon Tetrachloride	9.76×10^{-7}
Vinyl Acetate	137.0×10^{-7}
Bromodichloromethane	5.49×10^{-7}
Trichloroethene	9760.0×10^{-7}
Benzene	4550.0×10^{-7}
4-Methyl-2-Pentanone	111.0×10^{-7}
Tetrachloroethene	5.81×10^{-7}
Toluene	3180.0×10^{-7}
Ethylbenzene	139.0×10^{-7}
Xylene (total)	354.0×10^{-7}
1,3-Butadiene	206.0×10^{-7}
n-Hexane	152.0×10^{-7}
Isoocatane	15.4×10^{-7}
Methyl,t-butyl ether	30.6×10^{-7}

TABLE NO. 3

SUMMARY OF SAMPLING RESULTS - MM5

Houston, Texas

SwL Project No. 54-9303-019

Analyte	Concentration (ug/dscm)
Naphthalene	2870.0
bis(2-Ethylhexyl)Phthalate	36,800.0

TABLE NO. 4

SUMMARY OF SAMPLING RESULTS - VOST

Houston, Texas

SwL Project No. 54-9303-019

Analyte	Concentration (ug/dscm)
Methylene Chloride	77.1
Acetone	181.0
Carbon Disulfide	42.9
1,1-Dichloroethene	5.06
Chloroform	3.11
1,2-Dichloroethane	2.56
Methylethyl Ketone (MEK)	12.6
1,1,1-Trichloroethane	224.0
Carbon Tetrachloride	3.14
Vinyl Acetate	43.9
Bromodichloromethane	1.76
Trichloroethene	3,140.0
Benzene	1,460.0
4-Methyl-2-Pentanone	35.7
Tetrachloroethene	1.87
Toluene	1,020.0
Ethylbenzene	44.7
Xylene (total)	114.0
1,3-Butadiene	66.0
n-Hexane	48.8
Isoocatane	4.96
Methyl,t-butyl ether	9.82