Casting Emission Reduction Program

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US Army Contract DAAE 30-02-C-1095
FY 2002 Tasks

No-Bake Mold Making Baseline

Vendor Product HA International
TECHNISET® 20-665, 23-635, 17-727

Technikon Test #1409-124 EY

Originally Published
29 May 2003
This document has been revised for public distribution.

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VOC Emissions From No-Bake Mixing, Making, and Storage Baseline

1409-124 EY

This report has been reviewed for completeness and accuracy and approved for release by the following:

Research Chemist:	*Original Signed* Carmen Hornsby	Date
Process Engineering Manager:	*Original Signed* Steven Knight	Date
VP Measurement Technologies:	*Original Signed* Clifford Glowacki, CIH	Date
VP Operations:	*Original Signed* George Crandell	Date
President:	*Original Signed* William Walden	Date

The data contained in this report were developed to assess the relative emissions profile of the product or process being evaluated. You may not obtain the same results in your facility. Data was not collected to assess casting quality, cost, or producibility.

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Executive Summary

This report contains the results of Volatile Organic Compound (VOC) and Hazardous Air Pollutant (HAP) emission testing during No-Bake phenolic urethane mold making and storage. All testing was conducted in the Technikon, LLC Production foundry No-Bake mold making facility.

The test was divided into two (2) segments, mold sand mixing/making/curing and mold storage. Sand mixing was performed using a Kloster paddle type sand mixer. The storage emissions represent the VOCs and HAPs released to the environment from the time the mold is made until the mold is used to produce a casting. All components of the mold making process were conducted within an enclosure meeting the criteria for a temporary total enclosure (TTE) as specified in US EPA Method 204.

For Test EY, both the mold mix/make/cure and mold storage test segments consisted of six (6) replicate runs. Samples for selected VOCs and HAPs were collected on sorbent tubes during each run for subsequent laboratory analysis in accordance with US EPA Method 18. All sampling locations were consistent with US EPA Method 1. US EPA Method 25A, Total Gaseous Organic Concentration (TGOC), was used to monitor all segments of the test.

The tables below summarize the results for each of the test segments in lbs/lb of binder and lbs/ton sand respectively.

Test EY Average Emissions Results Comparison – Lb/Lb Binder

Analytes	Mix, Make, Cure	Storage	Total
TGOC as Propane	0.0069	0.0118	0.0187
HC as Hexane	0.0069	0.0129	0.0198
Sum of VOCs	0.0005	0.0018	0.0023
Sum of HAPs	0.0005	0.0018	0.0023
Sum of POMs	0.0003	0.0021	0.0023

Test EY Average Emissions Results Comparison – Lb/Tn Sand

Analytes	Mix, Make, Cure	Storage	Total
TGOC as Propane	0.1781	0.3022	0.4803
HC as Hexane	0.1761	0.3316	0.5077
Sum of VOCs	0.0140	0.0450	0.0590
Sum of HAPs	0.0140	0.0450	0.0590
Sum of POMs	0.0065	0.0533	0.0598

TGOC: measures all carbon-containing organic compounds.

It must be noted that the reference and product testing performed is not suitable for use as emission factors or for purposes other than evaluating the relative emission reductions associated with the use of alternative materials, equipment, or processes. The emissions measurements are unique to the specific castings produced, materials used, and testing methodology associated with these tests, and should not be used as the basis for estimating emissions from actual commercial foundry applications.

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1.0 Introduction

1.1 Background

Technikon LLC is a privately held contract research organization located in McClellan, California, a suburb of Sacramento. Technikon offers emissions research services to industrial and government clients specializing in the metal casting and mobile emissions areas. Technikon operates the Casting Emission Reduction Program (CERP). CERP is a cooperative initiative between the Department of Defense (US Army) and the United States Council for Automotive Research (USCAR). Its purpose is to evaluate alternative casting materials and processes that are designed to reduce air emissions and/or produce more efficient casting processes. Other technical partners directly supporting the project include: the American Foundry Society (AFS); the Casting Industry Suppliers Association (CISA); the US Environmental Protection Agency (US EPA); and the California Air Resources Board (CARB).

1.2 Technikon Objectives

The primary objective of Technikon is to evaluate materials, equipment, and processes used in the production of metal castings. Technikon's facility was designed to evaluate alternate materials and production processes designed to achieve significant air emission reductions, especially for the 1990 Clean Air Act Amendment. The facility has two principal testing arenas: a Pre-Production Foundry designed to measure airborne emissions from individually poured molds, and a Production Foundry designed to measure air emissions in a continuous full scale production process. Each of these testing arenas has been specially designed to facilitate the collection and evaluation of airborne emissions and associated process data.

The Production Foundry provides simultaneous detailed individual emission measurements using methods based on US EPA protocols for the melting, pouring, sand preparation, mold making, and core making processes. The core making area of the Production foundry contains three core blowers, a Georg Fischer for the preparation of automotive block cores, a Redford that is used for the production of step cores, and a second smaller Redford to produce dogbone tensile test specimens.

It must be noted that the results from the reference and product testing performed are not suitable for use as emission factors or for other purposes other than evaluating the <u>relative emission reductions</u> associated with the use of alternative materials, equipment, or manufacturing processes. The emissions measurements are unique to the specific castings produced, materials used, and testing methodology associated with these tests. These measurements <u>should not</u> be used as the basis for estimating emissions from actual commercial foundry applications.

1.3 Report Organization

This report has been designed to document the methodology and results of a specific test plan that was used to evaluate VOC emissions from the No-Bake mold making process. Section 2 of this report includes a summary of the methodologies used for data collection and analysis, emission calculations, QA/QC procedures, and data management and reduction methods. Specific data collected during this test are summarized in Section 3 of this report, with detailed data included in Appendix B of this report. Section 4 of this report contains a discussion of the results.

The raw data for this test series are included in a Data data Binderbinder" that is maintained at the Technikon facility.

1.4 Specific Test Plan and Objectives

This report contains the results of testing performed to provide data on selected VOC emissions from a No-Bake mold making system. Table 1-1 provides a summary of the test plan for the mixing/making/curing, and storage phases. The details of the approved test plans are included in Appendix A. The specific resin was used for a baseline because it is an older generation binder that is still widely used in the industry.

Table 1-1 Test Plan Summary

	Test EY
Type of Process Tested	No Bake Emissions Study
Test Plan Number	1409-124
Binder System	Phenolic Urethane No-Bake HA-International TECHNISET ® 20-665; 23-635; 17-727
Number of Tests	6 at mix/make/cure and 6 at storage
Test Date	2/19/03 > 2/24/03
Emissions Measured	TGOC as Propane, HC as Hexane, Phenol, Naphthalene, 1 & 2-Methylnaphthalene, Formaldehyde
Process Parameters Measured	Sand and Binder Weights; Incoming Sand Temperature; Sand Mixing Time; Temperature; Storage Time & Temperature
Source Parameters Measured	Exhaust Duct Temperature, Pressure, and Volumetric Flow Rate

2.0 Test Methodology

2.1 Description of Process and Testing Equipment

Figure 2-1 is a diagram of the no-bake mold making process and testing equipment.

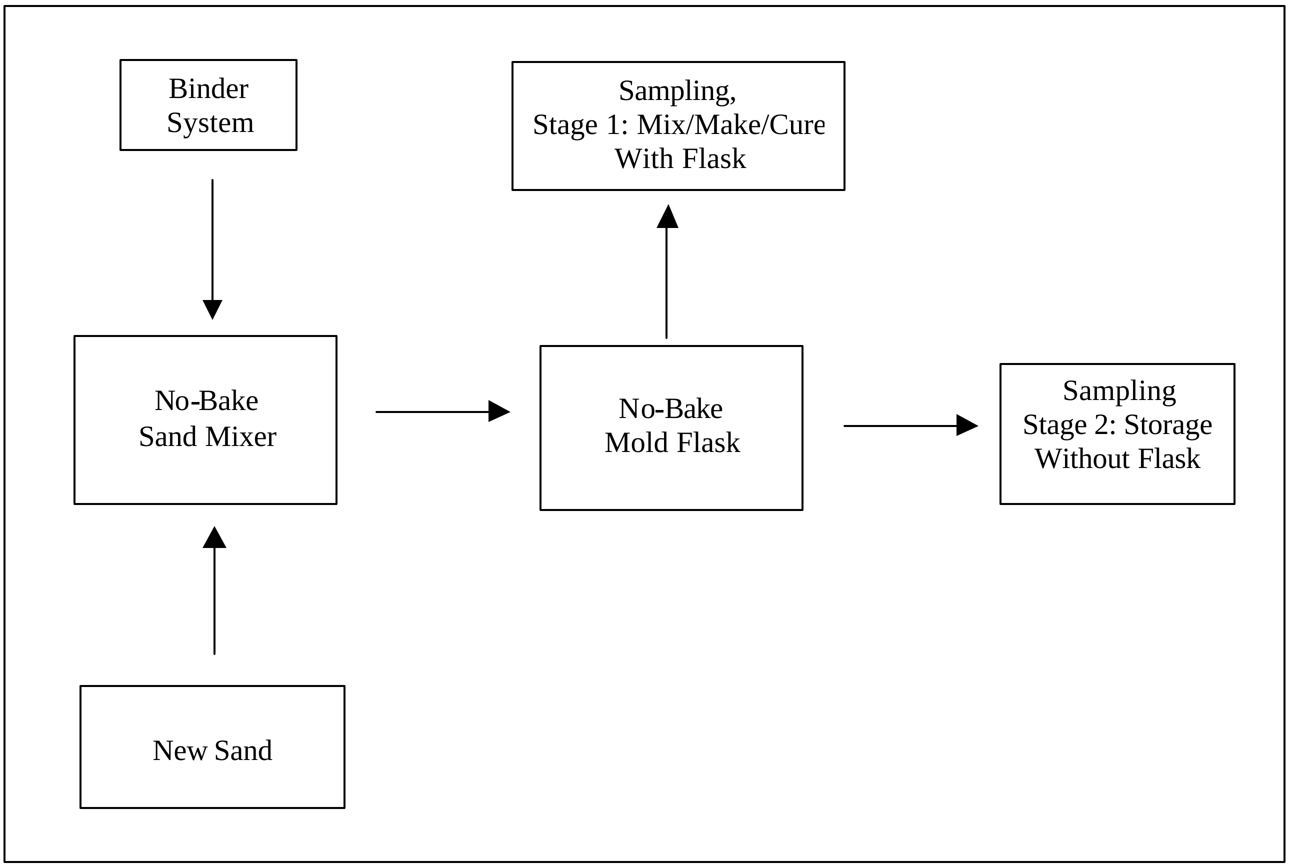


Figure 2-1. Mold Making and Testing Process

2.2 Description of Testing Program

The specific steps used in this sampling program are summarized below:

1. **Test Plan Review and Approval:** The proposed test plan was reviewed by the Technikon staff and the CERP Steering Committee, and approved.

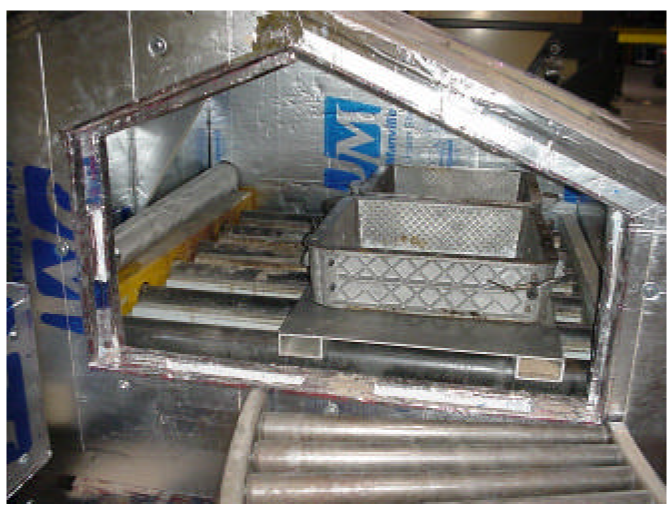
2. **Sand Preparation:** Sands were mixed with quantities of designated binders in a Kloster paddle mixer. The sand was preheated or cooled as required to a standard temperature

range. The sand was mixed thoroughly and then dispensed at approximately 100 lbs/min into two 19 x 20 x 6 inch flasks that were housed in a temporary total enclosure conforming to US EPA Method 204.

3. **Mold Preparation:** Mixed sand was dispensed into snap-flasks. Once the flasks were about one-half full, the vibration table was started to compact the mixed sand and it continued for an additional five (5) seconds after the flask was full. The excess sand was struck off and removed from the test enclosure to reduce test-to-test variability.

No-Bake Mold Total Temporary Enclosure

4. **Individual Sampling Events:** Six (6) replicate mold-making tests were performed. Sampling to determine the No-Bake mold making emissions consisted of two (2) segments. Sampling for both test segments was performed utilizing the same temporary total enclosure unit and exhaust stack. The mix/make/cure segment was defined as the first ten (10) minutes after the sand was initially introduced into the flask. The mixed sand was discharged from the Kloster mixer into the flask over approximately one (1) minute and then the mold was allowed to cure in the flask until ten (10) minutes had elapsed. Air samples were collected during the entire mix, make, and cure segment. Emission sampling was accomplished via a heated sample probe located in the centroid of the exhaust duct.



Core Storage

Once the ten (10) minute mix/make/cure segment had elapsed, the storage segment immediately began. The snap-flask was removed from the mold and set aside within the enclosure to allow air to pass freely over the mold for the duration of the test. Storage sampling continued until a total of three (3) hours had passed from when the mixed sand was first introduced into the flask. Sample tubes were collected utilizing the same sample train as used for the mix/make/cure segment ensuring a smooth transition between the two test sampling events.

5. Where new core materials are being evaluated, initial core emissions baseline data are gathered by placing five step-block cores under an**Process Parameter Measurements:** Table 2-1 lists the process parameters that are monitored during each test. The analytical equipment and methods used are also listed.

Table 2-1. Process Parameters Measured

Parameter	Analytical Equipment and Methods
Binder Weight (mixing)	Mettler PJ8000 Digital Scale (Gravimetric)
Sand Weight (mixing)	OHAUS 110# digital platform scale
Sand Temperature (mixing)	Stem type dial thermometer
Cycle Time	Digital elapsed time clocks
Enclosure Air Temperature	Thermocouple
Mold Weight	Cardinal 748 Digital Platform Scale

5.6. **Air Emissions Analysis:** The specific sampling and analytical methods used in the No-Bake mix/ make/cure and storage tests are based on the US EPA reference methods shown in Table 2-2. The details of the specific testing procedures and their variance from the reference methods, if any, are included in the Technikon Standard Operating Procedures.

Table 2-2. Sampling and Analytical Methods

Measurement Parameter	Test Method*
Port location	EPA Method 1
Number of traverse points	EPA Method 1
Gas velocity and temperature	EPA Method 2
HC as Hexane, Naphthalene, Phenol, Formaldehyde, 1 and 2-Methylnaphthalene	EPA Method 18, EPA Method TO-11, NIOSH 1500, NIOSH 2002
TGOC (THC) as Propane	EPA Method 25A
Volatile Matter content	EPA Method 24

* These methods were specifically modified to meet the testing objectives of the CERP Program.

7. **Data Reduction, Tabulation and Preliminary Report Preparation:** The analytical results of the emissions tests provide the mass of each analyte in the sample. For all test segments, the total mass of the analyte emitted is calculated by multiplying the mass of analyte in the sample times the ratio of the sample volume to the total stack gas volume during the test. The total stack gas volume is calculated from the measured stack gas velocity and duct diameter. The total mass of analyte is then divided by the weight of the binder and/or the total weight of the coated sand used to provide emissions data in pounds of analyte per pound of binder and pounds of analyte per ton of sand (coated).

8. **Report Preparation and Review:** The Preliminary Draft Report is reviewed by the Manager, Process Engineering, and the Emissions Team to ensure its completeness, consistency with the test plan, and adherence to the prescribed QA/QC procedures. Appropriate observations, conclusions and recommendations are added to the report to produce a Draft Report. The Draft Report is reviewed by the Vice President-Measurement Technologies, the Vice President-Operations. Comments are incorporated into a Final Report prior to final signature approval and distribution.

2.3 Quality Assurance and Quality Control (QA/QC) Procedures

Detailed QA/QC and data validation procedures for the process parameters, stack measurements, and laboratory analytical procedures are included in the Technikon Standard Operating Procedures and. In order to ensure the timely review of critical quality control parameters, the following procedures are followed:

Immediately following the individual sampling events performed for each test, specific process parameters are reviewed by the Manager - Process Engineering to ensure that the parameters are maintained within the prescribed control ranges. Where data are not within the prescribed ranges, the Manager - Process Engineering and the Vice President-Operations determine whether the individual test samples should be invalidated or flagged for further analysis following review of the laboratory data.

The source (stack) and sampling parameters, analytical results and corresponding laboratory QA/QC data are reviewed by the Emissions Measurement Team to confirm the validity of the data. The VP-Measurement Technologies reviews and approves the recommendation, if any, that individual sample data should be invalidated. Invalidated data are not used in subsequent calculations.

3.0 Test Results

The average measured emission results for Test EY in lbspounds. per pound of binder used are presented in Table 3-1.

The amount of available VOCs for the binder systems was determined using a method based on US EPA Method 24 and found to be 0.46 pounds per pound of binder or 46% of the binder weight. The average emissions results as a percentage of available VOCs is presented in Table 3-2.

Table 3-3 includes the average emissions results for the test system EY expressed in pounds per ton of sand.

Table 3-4 contains average test process and source data. The total binder weight and the total mold weight were calculated from the total amount of sand and the percent binder used in each section of the test.

Appendix B contains the detailed emissions results and Appendix C the detailed process and source data.

Figures 3-1 and 3-2 represent the results from Tables 3-1 and 3-3 in graphical form.

Method 25A charts are shown in Appendix D of this document.

Table 3-1. Average Emission Results for Test EY-Lb/Lb Binder

Analytes	Mix, Make, Cure	Storage
TGOC as Propane	0.0069	0.0118
HC as Hexane	0.0069	0.0129
Sum of VOCs	0.0005	0.0018
Sum of HAPs	0.0005	0.0018
Sum of POMs	0.0003	0.0021
Individual HAPs and VOCs		
1-Methylnaphthalene	0.0001	0.0017
Naphthalene	0.0001	0.0004
Phenol	0.0003	0.0002
Formaldehyde	>0.0001	0.0001
2-Methylnaphthalene	ND	ND

ND: Non Detect

Table 3-2. Test EY % of the Available Solvent

Test EY	Mix, Make, Cure	Storage	Total
HC as Hexane	1.5	2.8	4.3

Table 3-3. Test EY Average Emissions Results–Lb/Tn Sand

Analytes	Mix, Make, Cure	Storage
TGOC as Propane	0.1781	0.3022
HC as Hexane	0.1761	0.3316
Sum of VOCs	0.0140	0.0450
Sum of HAPs	0.0140	0.0450
Sum of POMs	0.0065	0.0533
Individual HAPs and VOCs		
Phenol	0.0076	0.0051
Naphthalene	0.0033	0.0093
1-Methylnaphthalene	0.0032	0.0442
Formaldehyde	0.0011	0.0019
2-Methylnaphthalene	ND	ND

ND: Non Detect

Table 3-4. Average Process and Source Data for Test EY

Mold Mix/Make/Cure Test	Average 1.30 %
EY101-EY106	
Number of tests	6
Length of test, minutes	10:00
Total binder coated sand weight, Lbs.	276.8
Total binder dispensing rate, Lbs/ 15 sec	0.40
Calculated Total Binder weight, Lbs.	3.55
Calculated % Binder (BOS)	1.30
Calculated standard % binder	1.28
1800 F LOI, % (note 1)	1.33
Ambient temperature, Deg F	65
Sand temperature, Deg F	81
Dogbone Core 2 hr. tensile strength, psi	74.5

Mold Storage Test	Average 1.30 %
EY301-EY306	
Number of tests	6
Length of test, minutes	170:00
Total mold weight less screeded sand, Lbs.	265.8
Calculated Total Binder weight per test, Lbs.	3.41
Calculated Average% Binder (BOS)	1.30
Calculated Average Standard % binder	1.28

Note1: 1800 F LOI is the net weight sample weight difference when combusted at 1800 F for 2 hours and includes decomposition of carbonates that originate in the source sand.

Figure 3-1. Test EY Average Emissions Results – Lb/Lb Binder

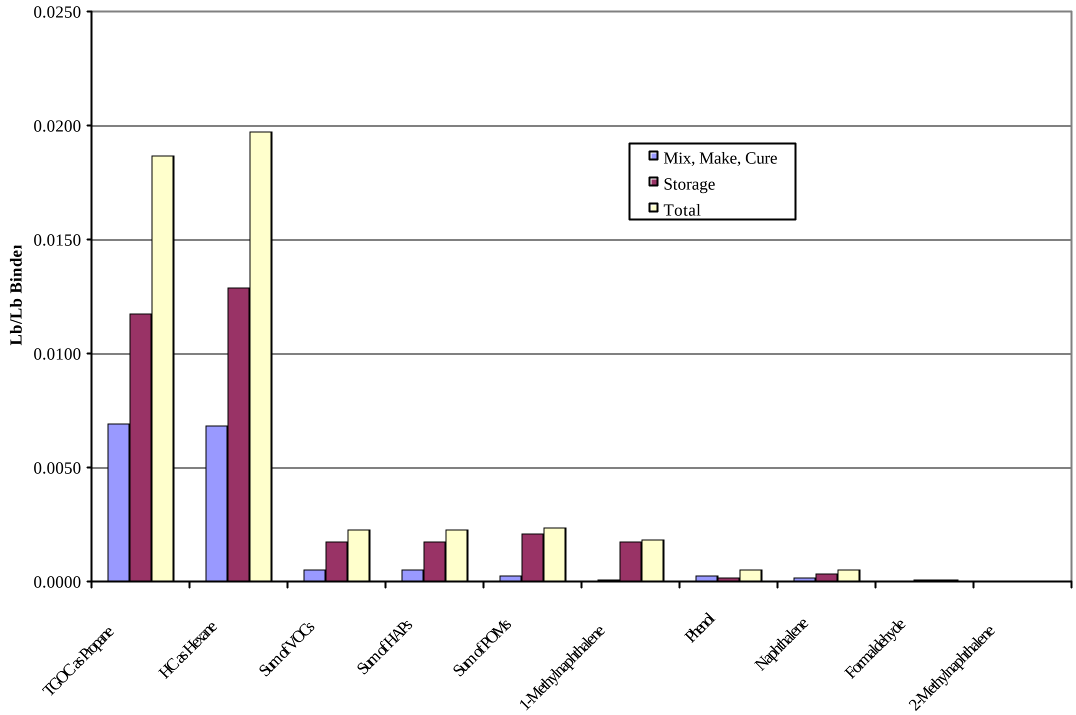
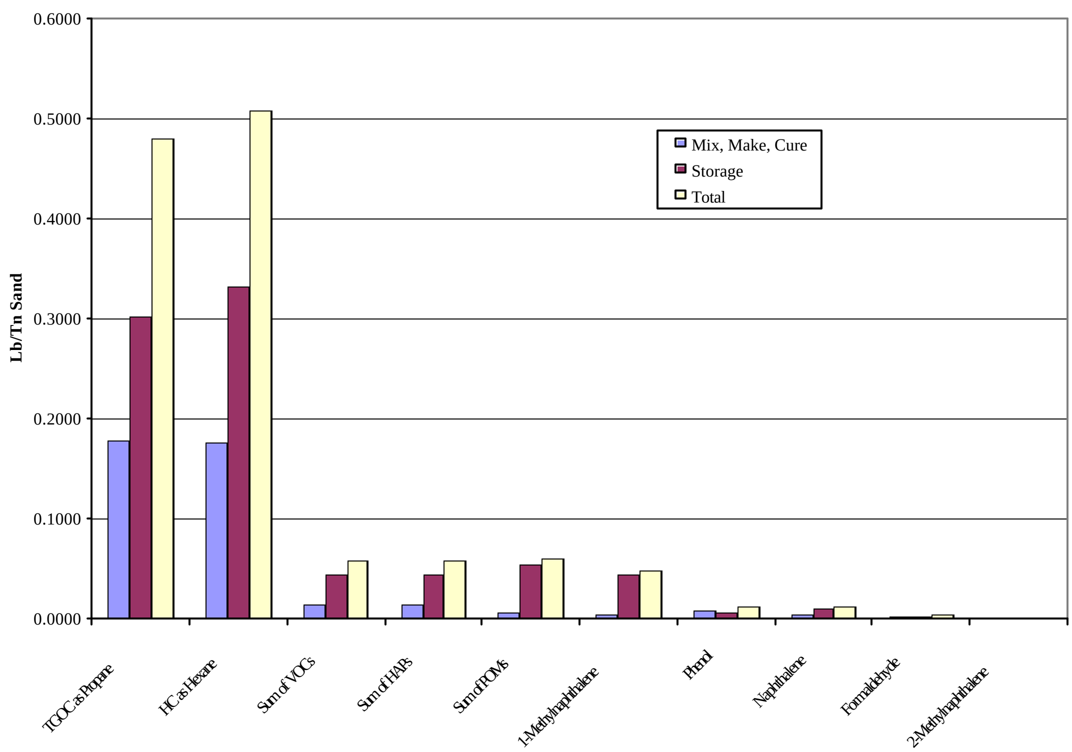


Figure 3-2. Test EY Average Emissions Results – Lb/Tn Sand



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4.0 Discussion of Results

Volatile organic compound (VOC), hazardous air pollutant (HAP), and polycyclic organic material (POM) emissions were measured during No-Bake mold making activities associated with the use of a phenolic urethane binder system. All of the mold-making measurements were conducted within a single enclosure meeting the criteria for a temporary total enclosure according to US EPA Method 204. Results in this report are expressed in Lb/Lb Binder as well as Lb/Tn Sand.

An independent test for volatile matter content based on EPA Method 24 was performed to determine the amount of available VOCs in the binder system used for this test. The HC as Hexane represents the sum of all compounds that elute from a gas chromatograph between the retention times of hexane and hexadecane. Certain analytes selected for this test may not be represented in the HC as Hexane: formaldehyde and phenol, but may be represented in the Method 24 results. Approximately 4.3% of the available VOCs were recovered from all data streams for Test EY (Table 3-2). This indicates that virtually all of the VOCs and HAPs in the binder system remained in the mold prior to pouring.

1. **Mix/Make/Cure:** The HC as Hexane results for mix/make/cure contributed approximately 35% of the total found for the two test segments. Of the percentage available solvent measured as HC as Hexane (Table 3-2), mix/make/cure contributed 1.5%.

2. **Storage:** The storage segment contributed approximately 65% of the total found during the two test segments. From Table 3-2, of the percent (%) available solvent measured as HC as Hexane, mold storage contributed 2.8%.

The distribution of analytes measured varied between the two test segments for Test EY. During both processes, 2-methylnaphthalene was not detected. 1-Methylnaphthalene increased by approximately ten times for the storage segment compared to the mix/make/cure segment while phenol decreased. Naphthalene and formaldehyde roughly doubled from mix/make/cure to storage.

These differences result from the impact, during storage, of removing the mold flask on the effective surface for evaporation.

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APPENDIX A APPROVED TEST PLAN AND SAMPLE PLAN FOR TEST EY

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TECHNIKON TEST PLAN

> **CONTRACT NUMBER:** 1409 **TASK NUMBER:** 1.2.4

> **WORK ORDER NUMBER:** 1173 **Series:** EY

> **SAMPLE EVENTS:** 6 mix/make/cure, 6 store

> **SITE:** _X_ **PRE-PRODUCTION (238)**_ **Core Room (238)**

> **TEST TYPE:** No-bake sand mixing/mold making/mold curing, & mold storage: a baseline.

> **METAL TYPE:** None

> **MOLD TYPE:** No-bake 19x20x6 block; HA International 20-665 Part I resin, 23-635 co-reactant Part II, & 17-727 Activator Part III Phenolic Urethane binder at 1.3%(BOS); part I, 55 %; part II, 45%, part III 5 % of part I.

> **NUMBER OF TESTS:** 6 mix/make/cure, 6 storage**.**

> **CORE TYPE:** N/A

> **TEST DATE** **START:** 7 Feb 2003
> **FINISHED:** 12 Feb 2003

TEST OBJECTIVES:

1. Use THC to certify no-bake emission collection facility. Balance air flows to make enclosure conform to US EPA method 204 for temporary total enclosures.

2. Use TGOC to determine order-of-magnitude concentrations for development of sample plan.

3. Measure TGOC and selected VOCs & HAPs from fugitive emissions from no-bake sand mixing/mold making/mold curing & mold storage. Conduct Six (6) mix/make/cure test runs and six (6) storage runs on six (6) no-bake molds. The mix/make/cure test will consist of filling and compacting a 19x20x6 inch deep mold with sand heated to 85-90^{o}F dispensed from a calibrated Kloster ribbon mixer over approximately one minute and allowing the mold to cure within its flask until 10 minutes have elapsed. After 10 total minutes have elapsed then the flask shall be removed from the mold and the Storage test will commence for an additional two hours 50 minutes until a total lapsed time of three (3) hours. All tests will be conducted in a temporary total emission enclosure conforming to US EPA method 204 maintained at a standard temperature.

4. A set of 12 dogbone tensile specimens shall be made from the material from each mold. Six (6) dogbones each will be weighed and tensile tested after one (1) and two (2) hours of curing at 80 degrees F.

VARIABLES:

1. **No-bake sand mixing:** The uncoated sand shall be Wexford W450 Lakesand. It shall be preheated or cooled to maintain a temperature of 85 +/- 5 degrees Fahrenheit. The binder shall be 1.30 +/-0.013% total HA 20-665 part I resin and HA23-635 part II co-reactant

mixed Part I/Part II in the ratio of 55/45 & HA 17-727 activator at 5% of part I. The sand will be mixed in the Kloster ribbon mixer and immediately dispensed.

2. **No-bake mold making:** Coated sand shall dispensed at a rate of 100 pounds per minute, total approximately 120-140 pounds, into a 19x20x6 inch snap flask for curing. The mold shall be compacted by vibration and struck off level. Excess materials shall be removed from the emission enclosure. The emission enclosure shall be maintained at 80+/-5^{o}F.

3. **No-bake mold curing:** The mold shall be cured in-situ in the heated enclosure with the snap flask in place for a period of ten (10) total elapsed minutes from the time when flask filling commenced. End mix/make/cure emission sampling.

4. **No-bake mold storage:** After 10 minutes elapsed time, begin the storage emission sample. Immediately remove the snap flask and set it aside within the enclosure. Continue storage sampling until a total elapsed time of three (3) hours since the filling of the flask commenced.

BRIEF OVERVIEW: No-bake manufacturing has, like other core making processes, multi-step continuous emission. Assignment of whether emissions are associated with one step or another is not clearly delineated in the process. For the purpose of standardization where no clear delineation exists the mixing, making, and curing will be treated as one multi-step continuous process with one emission. Since the curing step requires the retention of the molding flask curing will be defined as having been completed when the flask is removed. Simultaneously the storage segment will begin as a separate emission sample and continue until sufficient data is collected to create a characteristic concentration-time curve.

SPECIAL CONDITIONS: The emission enclosure air temperature and incoming sand temperature will be maintained to standardize the test for repeatability of both the emission process and the emission sampling technique.

Process Engineering Manager (Technikon)	Date
V.P. Measurement Technology (Technikon)	Date
V.P. Operations (Technikon)	Date
CERP Test Design Representative	Date
CERP Emissions Representative	Date

Series EY

No-Bake Mixing, Making, Curing Combination and Storage Baseline 2003

US Army 1409, WO 1173

A. Emission Enclosure Certification: Use THC to determine airflow rates that effect complete emission-capture.

B. Calibration: Use THC to determine order-of-magnitude concentrations for typical test mold to create a sample plan.

C. Experiment: Measure selected HAP and VOC emissions to create a no-bake mold-manufacturing baseline.

1. No-Bake sand mold:

a. WEXFORD W450 Lake Sand
b. HA International Techniset 20-665 Resin, 23-635 Co-reactant, & 17-727 activator.

2. Metal: None

Caution: Observe all safety precautions attendant to these operations as delineated in the Pre-production operating and safety instruction manual as applicable to bldg. 238.

D. Mold requirements:

1. Make twelve (12) no-bake molds, two (2) for each run, in a 19 x 20 x 6 inch deep snap flask clamped to an aluminum pallet.

E. Phenolic urethane No-bake Mold Sand preparation:

1. The phenolic urethane no-bake sand shall be 1.3% total binder (BOS), Part I/Part II ratio 55/45, Part III at 5% of Part I.
2. Weigh contents of a Part I resin container. Add 5% of that weight as Part III to that container and mix thoroughly.
3. Calibrate the Kloster no-bake sand mixer to dispense 100 pounds/min more or less.
4. Calibrate the resin pumps:

a. Part I + 5% Part III: Based on the actual measured sand dispensing rate calibrate the Part I resin to be 56.20% of 1.3 % total binder.
b. Part II: Based on the actual measured sand dispensing rate calibrate the Part II co-reactant to be 43.80% of 1.3% total binder.
c. All calibrations to have a tolerance of +/- 1% of the calculated value.

F. No-bake mold making and emission sampling:

1. A 19 x 20 by 6-inch cope snap flask is to be used. Make sure the clamps are closed.
2. The pattern to be used is a featureless aluminum pallet to which the snap flask is clamped.
3. Inspect the flask and pattern for damage. Repair before use.
4. Prepare the mold flask and pattern with a light coating of Ashland Zipslip® IP 78. Allow to fully dry.
5. Place the cope flask, parting line down, on the pallet and clamp in place.
6. Place the assembly on the Kloster vibrating compaction table via the south wall port. Start the THC.
7. Run 15-20 pounds of waste sand then begin filling the box without stopping the mixer. Start the run time clock. Start the sample train. Measure sand temperature in the waste bucket and record on the Process Log
8. When the flask is about half full start the table vibration.
9. Manually spread the sand around the box as it is filling.
10. Slightly overfill the flask. Minimize the sand spillage. Record when the mixer is stopped.
11. Allow the vibrator to run an additional 5 seconds after the box is full.
12. Strike off the flask when it is full to standardize the weight. Remove as much struck off sand from the emission enclosure as practicable. Record when the mold is finished.
13. Allow the mold to cure for a total elapsed time of 10 minutes from the start of filling.
14. At 10 minutes total lapsed time:

   a. Stop the mix/make/cure sample train. Start the storage sample train.
   b. Remove the mold flask from the mold by unclamping the corner clamps and lifting the flask off the mold. Set the flask aside within the enclosure.

15. Use the last of the wasted sand to make 12 dogbone tensile test samples. (approx. 3 pounds)

   a. Take dogbones to temperature controlled area (70-80^{o}F) to cure.
   b. Cure dogbones until hard then remove from the core box. (about 15 minutes)
   c. Immediately weight the dogbones to the nearest 0.1 grams.
   d. Store in desiccating cabinet.
   e. At one (1) hour break six (6) bones on the Universal 405 tensile tester and record the values on the Dogbone Tensile Log
   f. At two (2) hours break six (6) bones on the Universal 405 tensile tester and record the values on the Dogbone Tensile log.

16. Run dry sand through the mixer to clean it. Remove this sand from the test area.
17. Continue the storage sampling for a total lapsed time of three (3) hours from commencement of mold filling. Stop the sample train at three hours total lapsed time.
18. Remove the mold through the entry/exit port in the south wall of the emission enclosure.
19. Weigh and record the net weight of the closed mold on the Process Log.

G. Emission hood cleaning:

1. After each run loosen all sand stuck to vibratory table.
2. Blow all the spill sand to the floor inside the emission hood.
3. Lift the hood (about 10 inches) and block up in place.
4. Sweep the spill sand from the floor under the hood, weigh it, and record the weight on the Process Log.
5. Lower the hood to the floor.
6. Check for alignment.
7. Place the next mold into the hood through the entry/exit port in the south wall of the emission enclosure.
8. Replace the exit port cover.

Steven Knight
Mgr. Process Engineering

CORE MIX, MAKE, CURE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/19/2003											
EVENT 1											
THC	EY10101	X									TOTAL
	STOR								80	1	
	STOR								80	2	
	STOR								200	3	
	STOR								200	4	
	STOR								200	5	
TO11	EY10102		1						450	6	DNPH SKC 226-119
TO11	EY10103			1					450	7	DNPH SKC 226-119
TO11	EY10104				1				0		DNPH SKC 226-119
NIOSH 1500	EY10105		1						850	8	100/50 mg Charcoal SKC 226-01
NIOSH 1500	EY10106			1					850	9	100/50 mg Charcoal SKC 226-01
NIOSH 1500	EY10107				1				0		100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY10108		1						850	10	150/75 mg Silica SKC 226-10
NIOSH 2002	EY10109			1					850	11	150/75 mg Silica SKC 226-10
NIOSH 2002	EY10110				1				0		150/75 mg Silica SKC 226-10
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE MIX, MAKE, CURE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/19/2003											
EVENT 2											
THC	EY10201	X									TOTAL
	STOR								80	1	
	STOR								80	2	
	STOR								200	3	
	STOR								200	4	
	STOR								200	5	
TO11	EY10202		1						450	6	DNPH SKC 226-119
	Excess								450	7	Excess
NIOSH 1500	EY10203		1						850	8	100/50 mg Charcoal SKC 226-01
	Excess								850	9	Excess
NIOSH 2002	EY10204		1						850	10	150/75 mg Silica SKC 226-10
	Excess								850	11	Excess
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE MIX, MAKE, CURE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/20/2003											
EVENT 3											
THC	EY10301	X									TOTAL
	STOR								80	1	
	STOR								80	2	
	STOR								200	3	
	STOR								200	4	
	STOR								200	5	
TO11	EY10302		1						450	6	DNPH SKC 226-119
	Excess								450	7	Excess
NIOSH 1500	EY10303		1						850	8	100/50 mg Charcoal SKC 226-01
	Excess								850	9	Excess
NIOSH 2002	EY10304		1						850	10	150/75 mg Silica SKC 226-10
	Excess								850	11	Excess
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE MIX, MAKE, CURE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/20/2003											
EVENT 4											
THC	EY-10401	X									TOTAL
	STOR								80	1	
	STOR								80	2	
	STOR								200	3	
	STOR								200	4	
	STOR								200	5	
TO11	EY10402		1						450	6	DNPH SKC 226-119
	Excess								450	7	Excess
NIOSH 1500	EY10403		1						850	8	100/50 mg Charcoal SKC 226-01
	Excess								850	9	Excess
NIOSH 2002	EY10404		1						850	10	150/75 mg Silica SKC 226-10
	Excess								850	11	Excess
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE MIX, MAKE, CURE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/24/2003											
EVENT 5											
THC	EY-10501	X									TOTAL
	STOR								80	1	
	STOR								80	2	
	STOR								200	3	
	STOR								200	4	
	STOR								200	5	
TO11	EY10502		1						450	6	DNPH SKC 226-119
	Excess								450	7	Excess
NIOSH 1500	EY10503		1						850	8	100/50 mg Charcoal SKC 226-01
	Excess								850	9	Excess
NIOSH 2002	EY10504		1						850	10	150/75 mg Silica SKC 226-10
	Excess								850	11	Excess
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE MIX, MAKE, CURE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/24/2003											
EVENT 6											
THC	EY-10601	X									TOTAL
	STOR								80	1	
	STOR								80	2	
	STOR								200	3	
	STOR								200	4	
	STOR								200	5	
TO11	EY10602		1						450	6	DNPH SKC 226-119
	Excess								450	7	Excess
NIOSH 1500	EY10603		1						850	8	100/50 mg Charcoal SKC 226-01
	Excess								850	9	Excess
NIOSH 2002	EY10604		1						850	10	150/75 mg Silica SKC 226-10
	Excess								850	11	Excess
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE STORAGE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/19/2003											
EVENT 1											
THC	EY-30101	X									TOTAL
TO11	EY-30102		1						80	1	DNPH SKC 226-119
TO11	EY-30103			1					80	2	DNPH SKC 226-119
NIOSH 1500	EY-30104		1						200	3	100/50 mg Charcoal SKC 226-01
NIOSH 1500	EY-30105			1					200	4	100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY-30106		1						200	5	150/75 mg Silica SKC 226-10
	MMC								450	6	
	MMC								450	7	
	MMC								850	8	
	MMC								850	9	
	MMC								850	10	
	MMC								850	11	
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE STORAGE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/19/2003											
EVENT 2											
THC	EY-30201	X									TOTAL
TO11	EY-30202		1						80	1	DNPH SKC 226-119
	Excess								80	2	Excess
NIOSH 1500	EY-30203		1						200	3	100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY-30204		1						200	4	150/75 mg Silica SKC 226-10
NIOSH 2002	EY-30205			1					200	5	150/75 mg Silica SKC 226-10
	MMC								450	6	
	MMC								450	7	
	MMC								850	8	
	MMC								850	9	
	MMC								850	10	
	MMC								850	11	
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE STORAGE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/20/2003											
EVENT3											
THC	EY-30301	X									TOTAL
TO11	EY-30302		1						80	1	DNPH SKC 226-119
	Excess								80	2	Excess
NIOSH 1500	EY-30303		1						200	3	100/50 mg Charcoal SKC 226-01
NIOSH 1500	EY-30304			1					200	4	100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY-30305		1						200	5	150/75 mg Silica SKC 226-10
	MMC								450	6	
	MMC								450	7	
	MMC								850	8	
	MMC								850	9	
	MMC								850	10	
	MMC								850	11	
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE STORAGE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/20/2003											
EVENT 4											
THC	EY-30401	X									TOTAL
TO11	EY-30402		1						80	1	DNPH SKC 226-119
	Excess								80	2	Excess
NIOSH 1500	EY-30403		1						200	3	100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY-30404		1						200	4	150/75 mg Silica SKC 226-10
	Excess								200	5	Excess
	MMC								450	6	
	MMC								450	7	
	MMC								850	8	
	MMC								850	9	
	MMC								850	10	
	MMC								850	11	
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE STORAGE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/24/2003											
EVENT 5											
THC	EY-30501	X									TOTAL
TO11	EY-30502		1						80	1	DNPH SKC 226-119
TO11	EY-30505		1						80	2	BACKGROUND NO FLOW
NIOSH 1500	EY-30503		1						200	3	100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY-30504		1						200	4	150/75 mg Silica SKC 226-10
NIOSH 1500	EY30506		1						200	5	BACKGROUND NO FLOW
	MMC								450	6	
	MMC								450	7	
	MMC								850	8	
	MMC								850	9	
	MMC								850	10	
	MMC								850	11	
	Excess								400	12	Excess
	Excess								9500	13	Excess

CORE STORAGE EY - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
2/24/2003											
EVENT 6											
THC	EY-30601	X									TOTAL
TO11	EY-30602		1						80	1	DNPH SKC 226-119
	Excess								80	2	Excess
NIOSH 1500	EY-30603		1						200	3	100/50 mg Charcoal SKC 226-01
NIOSH 2002	EY-30604		1						200	4	150/75 mg Silica SKC 226-10
NIOSH 2002	EY-30605		1						200	5	BACKGROUND NO FLOW
	MMC								450	6	
	MMC								450	7	
	MMC								850	8	
	MMC								850	9	
	MMC								850	10	
	MMC								850	11	
	Excess								400	12	Excess
	Excess								9500	13	Excess

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APPENDIX B DETAILED TEST DATA FOR TESTS EY

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Individual Mold Making Results for Test EY– Lb/Lb Binder

Mix, Make, Cure

HAPs	POMs	Compound/Sample Number	EY101	EY102	EY103	EY104	EY105	EY106	Average	STDEV
		Test Dates	**2/19/03**	**2/19/03**	**2/20/03**	**2/20/03**	**2/24/03**	**2/24/03**		
		TGOC as Propane	7.32E-03	7.08E-03	6.33E-03	7.44E-03	6.54E-03	6.91E-03	6.93E-03	4.35E-04
		HC as Hexane	7.34E-03	7.38E-03	6.42E-03	6.67E-03	6.62E-03	6.71E-03	6.86E-03	4.02E-04
		Sum of VOCs	7.34E-04	6.50E-04	3.44E-04	6.33E-04	5.15E-04	3.91E-04	5.44E-04	1.55E-04
		Sum of HAPs	7.34E-04	6.50E-04	3.44E-04	6.33E-04	5.15E-04	3.91E-04	5.44E-04	1.55E-04
		Sum of POMs	3.24E-04	2.65E-04	3.03E-04	2.39E-04	2.01E-04	1.96E-04	2.55E-04	5.26E-05
			Individual HAPs and VOCs							
x		**Phenol**	3.65E-04	3.42E-04	I	3.46E-04	2.71E-04	1.51E-04	2.95E-04	8.79E-05
x	z	**Naphthalene**	1.35E-04	1.55E-04	1.18E-04	1.28E-04	1.15E-04	1.28E-04	1.30E-04	1.42E-05
x	z	**1-Methylnaphthalene**	1.90E-04	1.10E-04	1.85E-04	1.11E-04	8.54E-05	6.86E-05	1.25E-04	5.10E-05
x		**Formaldehyde**	4.53E-05	4.41E-05	4.06E-05	4.75E-05	4.37E-05	4.30E-05	4.40E-05	2.29E-06
x	z	**2-Methylnaphthalene**	ND	ND	ND	ND	ND	ND	ND	NA

Storage

HAPs	POMs	Compound/Sample Number	EY301	EY302	EY303	EY304	EY305	EY306	Average	STDEV
		Test Dates	**2/19/03**	**2/19/03**	**2/20/03**	**2/20/03**	**2/24/03**	**2/24/03**		
		TGOC as Propane	1.24E-02	1.15E-02	1.12E-02	1.28E-02	1.12E-02	1.16E-02	1.18E-02	6.60E-04
		HC as Hexane	1.23E-02	1.44E-02	1.51E-02	1.45E-02	1.10E-02	1.01E-02	1.29E-02	2.08E-03
		Sum of VOCs	4.50E-04	1.96E-03	2.82E-03	2.28E-03	6.77E-04	2.33E-03	1.75E-03	9.63E-04
		Sum of HAPs	4.50E-04	1.96E-03	2.82E-03	2.28E-03	6.77E-04	2.33E-03	1.75E-03	9.63E-04
		Sum of POMs	I	1.66E-03	2.53E-03	1.97E-03	I	2.14E-03	2.07E-03	3.59E-04
			Individual HAPs and VOCs							
x	z	**1-Methylnaphthalene**	I	1.30E-03	2.16E-03	1.56E-03	I	1.87E-03	1.72E-03	3.74E-04
x	z	**Naphthalene**	3.76E-04	3.66E-04	3.68E-04	4.15E-04	3.90E-04	2.65E-04	3.63E-04	5.16E-05
x		**Phenol**	NA	2.23E-04	2.06E-04	2.16E-04	2.06E-04	1.50E-04	2.00E-04	2.91E-05
x		**Formaldehyde**	7.37E-05	7.82E-05	8.27E-05	9.21E-05	8.14E-05	4.31E-05	7.52E-05	1.69E-05
x	z	**2-Methylnaphthalene**	ND	ND	ND	ND	ND	ND	ND	NA

ND: Non Detect; **NA:** Not Applicable **I:** Data rejected based on data validation considerations.

Test EY Quantitation Limits - Lb/Lb Binder

Analytes	Mix/Make/Cure
HC as hexane	4.87E-05
1-methylnaphthalene	4.87E-05
2-methylnaphthalene	4.87E-05
formaldehyde	3.03E-06
naphthalene	4.87E-05
phenol	2.47E-05

Analytes	Storage
HC as hexane	2.32E-04
1-methylnaphthalene	2.32E-04
2-methylnaphthalene	2.32E-04
formaldehyde	1.63E-05
naphthalene	2.32E-04
phenol	1.16E-04

Individual Mold Making Results for Test EY – Lb/Tn Sand

Mix, Make, Cure

HAPs	POMs	Compound/Sample Number	EY101	EY102	EY103	EY104	EY105	EY106	Average	STDEV
		Test Dates	2/19/03	2/19/03	2/20/03	2/20/03	2/24/03	2/24/03		
		TGOC as Propane	1.88E-01	1.81E-01	1.63E-01	1.91E-01	1.68E-01	1.78E-01	1.78E-01	1.09E-02
		HC as Hexane	1.88E-01	1.89E-01	1.65E-01	1.71E-01	1.71E-01	1.73E-01	1.76E-01	9.96E-03
		Sum of VOCs	1.88E-02	1.66E-02	8.82E-03	1.62E-02	1.33E-02	1.01E-02	1.40E-02	3.95E-03
		Sum of HAPs	1.88E-02	1.66E-02	8.82E-03	1.62E-02	1.33E-02	1.01E-02	1.40E-02	3.95E-03
		Sum of POMs	8.31E-03	6.77E-03	7.78E-03	6.14E-03	5.17E-03	5.07E-03	6.54E-03	1.34E-03
			Individual HAPs and VOCs							
x		**Phenol**	9.35E-03	8.74E-03	I	8.87E-03	6.97E-03	3.90E-03	7.57E-03	2.24E-03
x	z	**Naphthalene**	3.45E-03	3.96E-03	3.02E-03	3.29E-03	2.97E-03	3.30E-03	3.33E-03	3.57E-04
x	z	**1-Methylnaphthalene**	4.86E-03	2.82E-03	4.76E-03	2.85E-03	2.20E-03	1.77E-03	3.21E-03	1.30E-03
x		**Formaldehyde**	1.16E-03	1.13E-03	1.04E-03	1.22E-03	1.13E-03	1.11E-03	1.13E-03	5.75E-05
x	z	**2-Methylnaphthalene**	ND	ND	ND	ND	ND	ND	ND	NA

Storage

HAPs	POMs	Compound/Sample Number	EY301	EY302	EY303	EY304	EY305	EY306	Average	STDEV
		Test Dates	2/19/03	2/19/03	2/20/03	2/20/03	2/24/03	2/24/03		
		TGOC as Propane	3.18E-01	2.94E-01	2.86E-01	3.27E-01	2.89E-01	2.98E-01	3.02E-01	1.65E-02
		HC as Hexane	3.15E-01	3.70E-01	3.89E-01	3.71E-01	2.84E-01	2.60E-01	3.32E-01	5.29E-02
		Sum of VOCs	1.15E-02	5.04E-02	7.23E-02	5.85E-02	1.74E-02	5.99E-02	4.50E-02	2.47E-02
		Sum of HAPs	1.15E-02	5.04E-02	7.23E-02	5.85E-02	1.74E-02	5.99E-02	4.50E-02	2.47E-02
		Sum of POMs	I	4.27E-02	6.49E-02	5.06E-02	I	5.49E-02	5.33E-02	9.27E-03
			Individual HAPs and VOCs							
x	z	**1-Methylnaphthalene**	I	3.33E-02	5.54E-02	4.00E-02	I	4.81E-02	4.42E-02	9.65E-03
x	z	**Naphthalene**	9.64E-03	9.40E-03	9.45E-03	1.06E-02	1.00E-02	6.81E-03	9.33E-03	1.32E-03
x		**Phenol**	I	5.72E-03	5.30E-03	5.54E-03	5.30E-03	3.85E-03	5.14E-03	7.43E-04
x		**Formaldehyde**	1.89E-03	2.01E-03	2.13E-03	2.36E-03	2.10E-03	1.11E-03	1.93E-03	4.32E-04
x	z	**2-Methylnaphthalene**	ND	ND	ND	ND	ND	ND	ND	NA

I: Data rejected based on data validation considerations.
ND: Non Detect; **NA:** Not Applicable

Test EY Quantitation Limits - Lb/Tn Sand

Analytes	Mix/Make/Cure
HC as hexane	1.25E-03
1-methylnaphthalene	1.25E-03
2-methylnaphthalene	1.25E-03
formaldehyde	7.77E-05
naphthalene	1.25E-03
phenol	6.33E-04

Analytes	Storage
HC as hexane	5.95E-03
1-methylnaphthalene	5.95E-03
2-methylnaphthalene	5.95E-03
formaldehyde	4.18E-04
naphthalene	5.95E-03
phenol	2.98E-03

APPENDIX C DETAILED PROCESS AND SOURCE DATA FOR TEST EY

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Test EY Process and Source Data – Mix/Make/Cure & Storage

No-Bake Mold Mix/Make/Cure Test	**1**	**2**	**3**	**4**	**5**	**6**	**Average 1.30 % (1-6)**
Date	**2/19/2003**	**2/19/2003**	**2/20/2003**	**2/20/2003**	**2/24/2003**	**2/24/2003**	
Emission test no.	**EY101**	**EY102**	**EY103**	**EY104**	**EY105**	**EY106**	
Total dispensed binder-coated sand weight, Lbs.	259.0	284.5	279.5	281.5	281.7	274.5	**276.8**
Sand dispensing rate, Lbs/15 sec	31.2	31.2	30.5	30.5	30.0	30.0	**30.6**
Binder Part1 + Part3 dispensing rate, gms/15 sec	103.4	103.4	100.9	100.9	98.8	98.8	**101.0**
Binder Part 2 dispensing rate, gms/15 sec	80.3	80.3	78.9	78.9	78.8	78.8	**79.3**
Total binder dispensing rate, Lbs/ 15 sec	0.40	0.40	0.40	0.40	0.39	0.39	**0.40**
Calculated Total Binder weight, Lbs.	3.32	3.64	3.59	3.61	3.63	3.54	**3.55**
Calculated % Binder (BOS)	1.30	1.30	1.30	1.30	1.30	1.30	**1.30**
Calculated standard % binder	1.28	1.28	1.28	1.28	1.29	1.29	**1.28**
1800 F LOI, % (note 1)	1.27	1.37	1.35	1.34	n/d	n/d	**1.33**
Ambient temperature, Deg F	63	63	64	68	64	65	**65**
Sand temperature, Deg F	80	80	80	82	83	80	**81**
Dogbone Core 2 hr. tensile strength	74.5 psi average of 12 bones, St dev: 7.4						
Test length, minutes	10:00	10:00	10:00	10:00	10:00	10:00	**10:00**

Note 2

No-Bake Mold Storage Test	**1**	**2**	**3**	**4**	**5**	**6**	**Average 1.30 % (1-6)**
Date	**2/19/2003**	**2/19/2003**	**2/20/2003**	**2/20/2003**	**2/24/2003**	**2/24/2003**	
Emission test no.	**EY301**	**EY302**	**EY303**	**EY304**	**EY305**	**EY306**	
Total mold weight (dispensed less screeded) sand, Lbs	259.0	270.5	265.5	263.0	268.0	269.0	**265.8**
Calculated total binder weight, Lbs.	3.32	3.47	3.41	3.37	3.45	3.46	**3.41**
Calculated % binder (BOS)	1.30	1.30	1.30	1.30	1.30	1.30	**1.30**
Calculated standard % binder	1.28	1.28	1.28	1.28	1.29	1.29	**1.28**
Test length, minutes	170:00	170:00	170:00	170:00	170:00	170:00	170:00

Note1**:** 1800 F LOI is the net weight sample weight difference when combusted at 1800 F for 2 hours and includes decomposition of carbonates that originate in the source sand.
Note 2: mold weight only- no spill sand weight data available

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APPENDIX D METHOD 25A CHARTS

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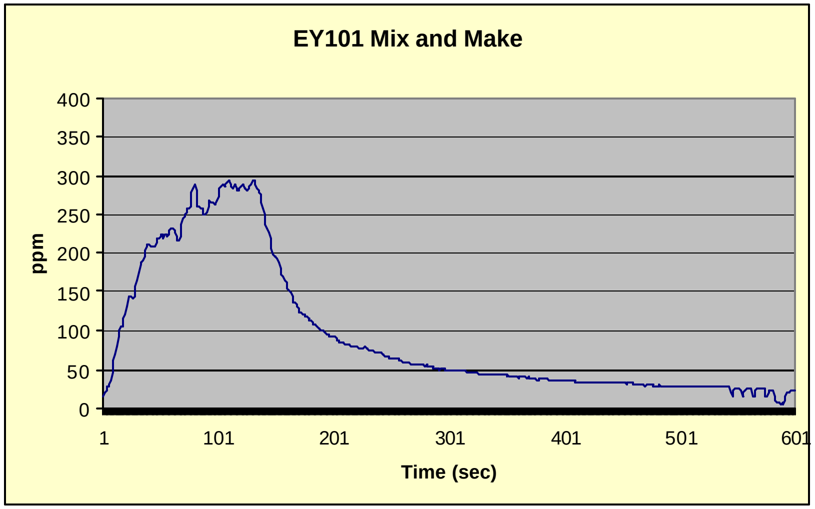
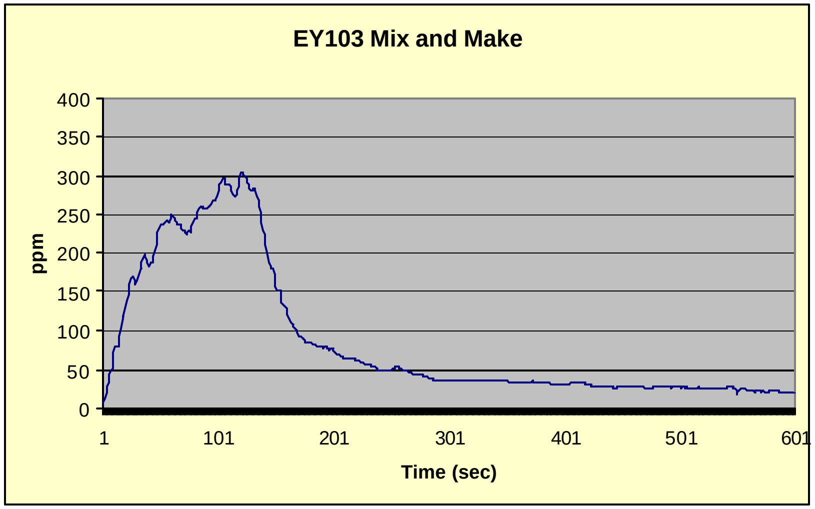

EY101 Mix and Make
ppm
400
350
300
250
200
150
100
50
0
1
101
201
301
401
501
601
Time (sec)


EY103 Mix and Make
ppm
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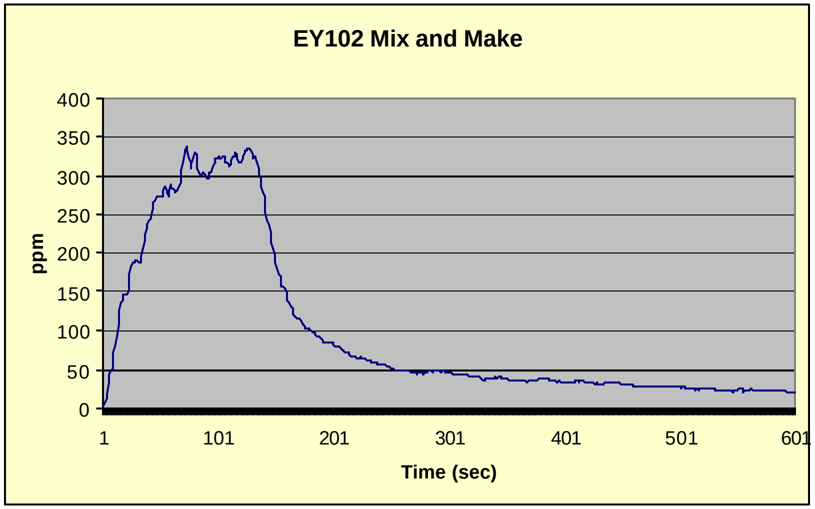
300
250
200
150
100
50
0
1
101
201
301
401
501
601
Time (sec)


EY102 Mix and Make
ppm
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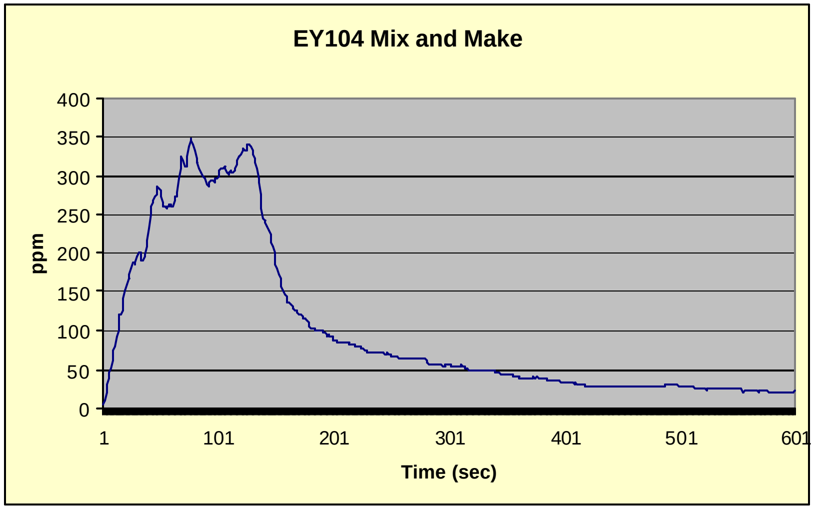
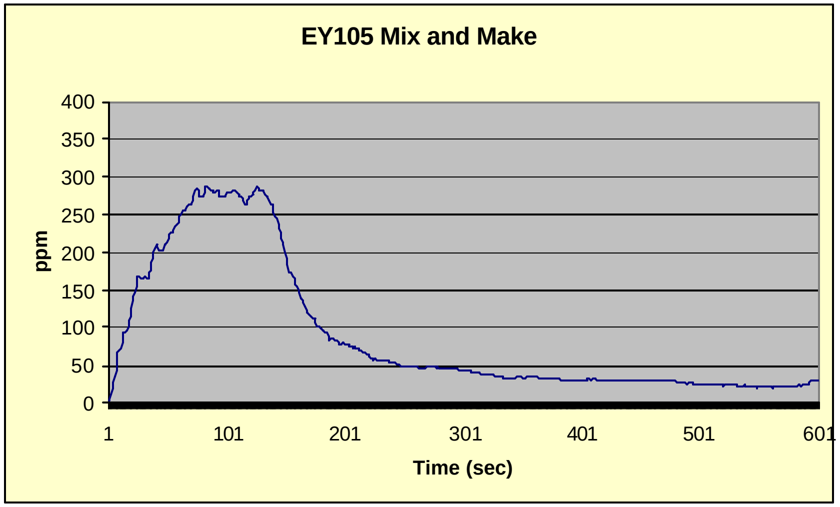
350
300
250
200
150
100
50
0
1
101
201
301
401
501
601
Time (sec)


EY104 Mix and Make
ppm
400
350
300
250
200
150
100
50
0
1
101
201
301
401
501
601
Time (sec)


EY105 Mix and Make
ppm
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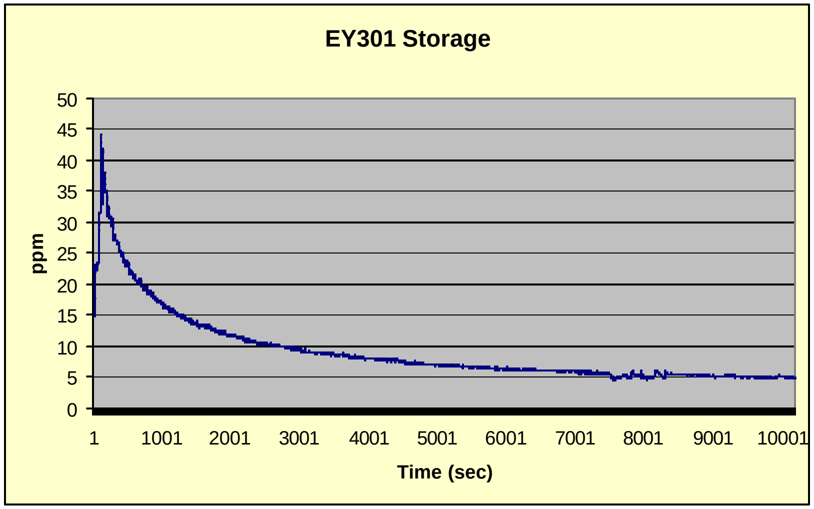
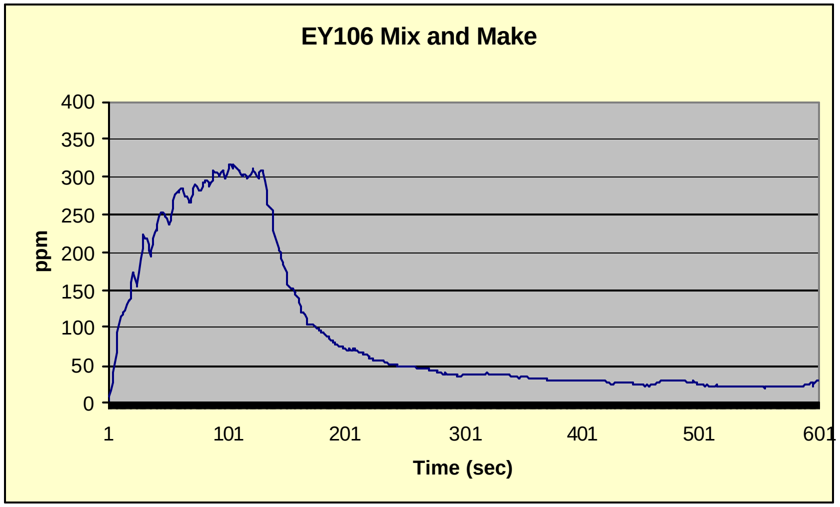
350
300
250
200
150
100
50
0
1
101
201
301
401
501
601
Time (sec)


EY301 Storage
ppm
50
45
40
35
30
25
20
15
10
5
0
1
1001
2001
3001
4001
5001
6001
7001
8001
9001
10001
Time (sec)


EY106 Mix and Make
ppm
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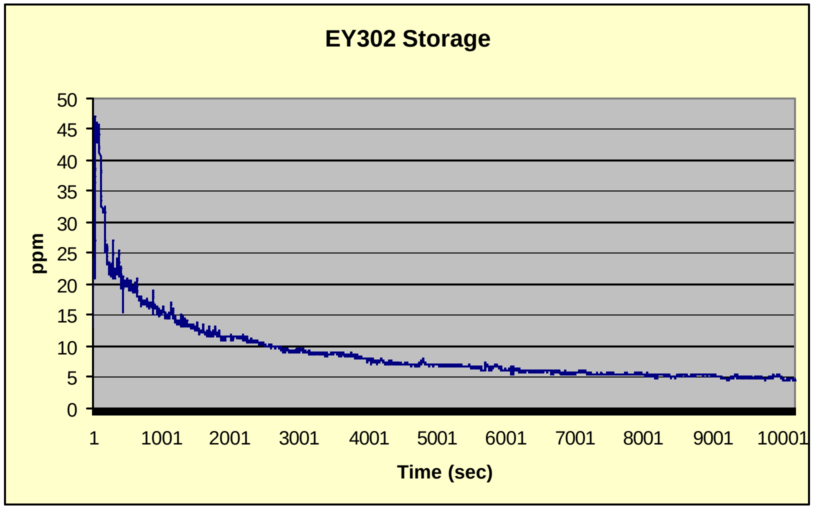
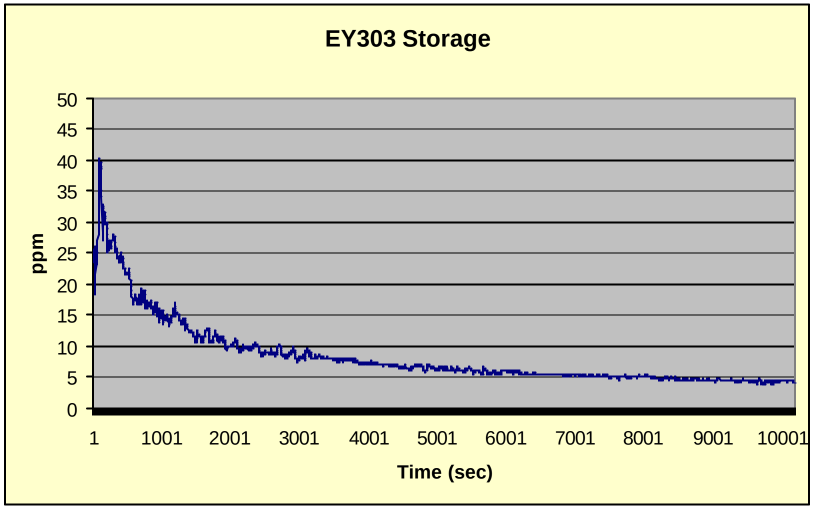
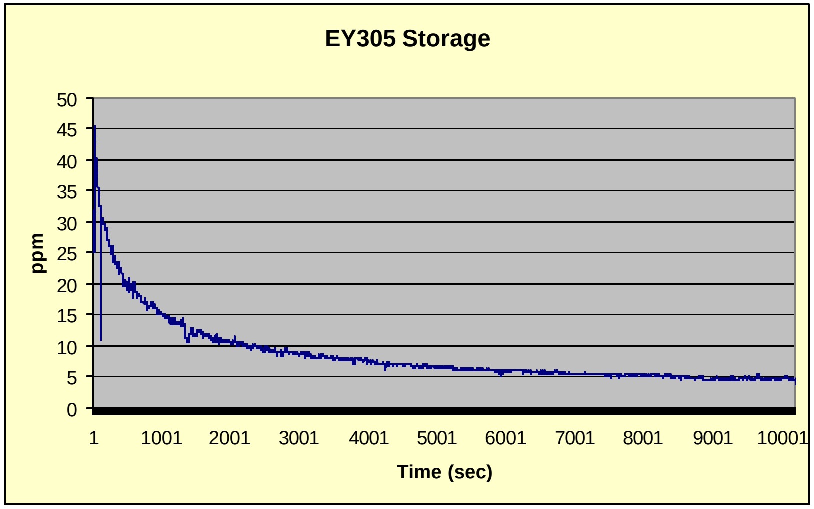
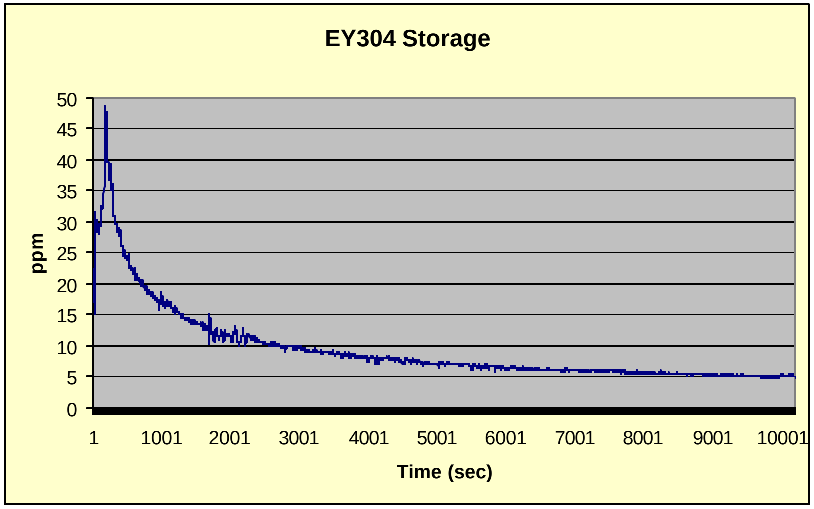
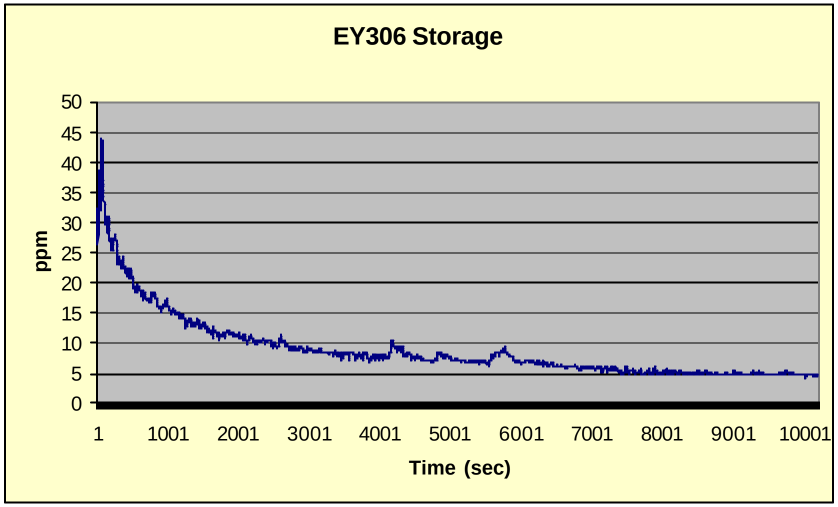
350
300
250
200
150
100
50
0
1
101
201
301
401
501
601
Time (sec)


EY302 Storage
ppm
50
45
40
35
30
25
20
15
10
5
0
1
1001
2001
3001
4001
5001
6001
7001
8001
9001
10001
Time (sec)


EY303 Storage
ppm
50
45
40
35
30
25
20
15
10
5
0
1
1001
2001
3001
4001
5001
6001
7001
8001
9001
10001
Time (sec)


EY305 Storage
ppm
50
45
40
35
30
25
20
15
10
5
0
1
1001
2001
3001
4001
5001
6001
7001
8001
9001
10001
Time (sec)


EY304 Storage
ppm
50
45
40
35
30
25
20
15
10
5
0
1
1001
2001
3001
4001
5001
6001
7001
8001
9001
10001
Time (sec)


EY306 Storage
ppm
50
45
40
35
30
25
20
15
10
5
0
1
1001
2001
3001
4001
5001
6001
7001
8001
9001
10001
Time (sec)

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APPENDIX E GLOSSARY

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I	Data rejected based on data validation considerations
NA	Not Applicable
ND	Non-Detect
NT	Lab testing was not done
BO	Based on ( ).
BOS	Based on Sand.
TGOC as Propane	Weighted to the detection of more volatile hydrocarbon species, beginning at C1 (methane), with results calibrated against a three-carbon alkane (propane).
HC as Hexane	Calculated by the summation of all area between elution of Hexane through the elution of Hexadecane. The quantity of HC is performed against a five-point calibration curve of Hexane by dividing the total area count from C6 through C16 to the area of Hexane from the initial calibration curve.
VOC	Volatile Organic Compound
HAP	Hazardous Air Pollutant defined by the 1990 Clean Air Act Amendment
POM	Polycyclic Organic Matter (POM) including Naphthalene and other compounds that contain more than one benzene ring and have a boiling point greater than or equal to 100 degrees Celsius.