Casting Emission Reduction Program

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FY2002 Tasks

Core Room Baseline

Technikon # 1409-123-EQ

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EPA United States Environmental Protection Agency

CISA

AFS AMERICAN FOUNDRY SOCIETY, INC.

UNITED STATES COUNCIL FOR AUTOMOTIVE RESEARCH
USCAR
DAIMLERCHRYSLER Ford Motor Company General Motors

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Baseline: Core Room Emissions
Sand Mixing Core Making, Core Storage

1409-123 Test EQ

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

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The data contained in this report were developed to provide baseline data for assessing the relative emissions profile of product or process as submitted for evaluation. You may not obtain the same results in your facility. Data was not collected to assess casting quality, cost, or producability.

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Executive Summary

This report contains the results of VOC emission testing during phenolic urethane Cold Box core making. All testing was conducted in the Technikon, LLC Production foundry core making facility.

The test was divided into three segments, core mixing, core blowing, and core storage. Core mixing was performed using a Redford/Carver 50 pound core sand mixer. During the core-blowing portion of the test, the gassing and purge emissions and the "fugitive" emissions were measured together. The storage emissions represent the VOCs released to the environment from the time of core removal from the core box until the core is used to produce a casting. For this study, a five (5) hour storage time was established. All components of mold making were conducted within enclosures meeting the criteria for a temporary total enclosure (TTE) as specified in US EPA Method 204.

Each test segment consisted of nine (9) replicate runs. Samples were collected on sorbent tubes during each run for selected VOCs and HAPs for subsequent laboratory analysis in accordance with US-EPA Method 18. All sampling locations were consistent with US EPA Method 1 except for core storage. The storage segment of the test used a laminar flow-through enclosure to sweep all of the emissions to the Method 18 sampling manifold. US EPA Method 25A, Total Gaseous Organic Concentration (TGOC), was used to monitor all segments of the test.

The table below summarizes the results for each of the test segments in lbs/lb of binder.

Analyte	Mixing	Gas/Purge Fugitives	Storage	Total
TGOC as Propane	0.0041	NA	NA	NA
HC as Hexane	0.0021	0.0752	0.0171	0.0944
Sum of VOCs	0.0001	0.0014	0.0008	0.0023
Sum of HAPs	0.0001	0.0014	0.0008	0.0023
Sum of POMs	ND	0.0010	0.0007	0.0017

NA: Not Applicable. **TGOC**: measures all carbon-containing organic compounds. The predominant organic in these test-segments was the triethylamine catalyst which was not a target analyte.

It must be noted that the reference 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 (USEPA); 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 USEPA 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 relative emission reductions 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 should not 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 ISOCURE® core 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, and Section 5 contains recommendations for further testing.

The raw data for this test series are included in a folder 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 the core making process. Table 1-1 provides a summary of the test plan for the mixing, core making, and storage phase. The details of the approved test plan are included in Appendix A.

Table 1-1 Test Plan Summary

	Test Plan
Type of Process tested	Core Making Emissions Study
Test Plan Number	1409-123
Binder System	Ashland ISOCURE® 305/904
Number of tests	9 each at core blowing, core mixing, and core storage
Test Date	8/19/02 > 9/13/02
Emissions Measured	TGOC as Propane, HC as Hexane, o-Cresol, Phenol, Formaldehyde, Naphthalene, 1-Me Naphthalene, 2-Me Naphthalene
Process Parameters Measured	Sand, and Binder Weights, Incoming Sand Temperature, Sand Mixing Time, Core Machine Cycle Time
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 core making process and testing equipment.

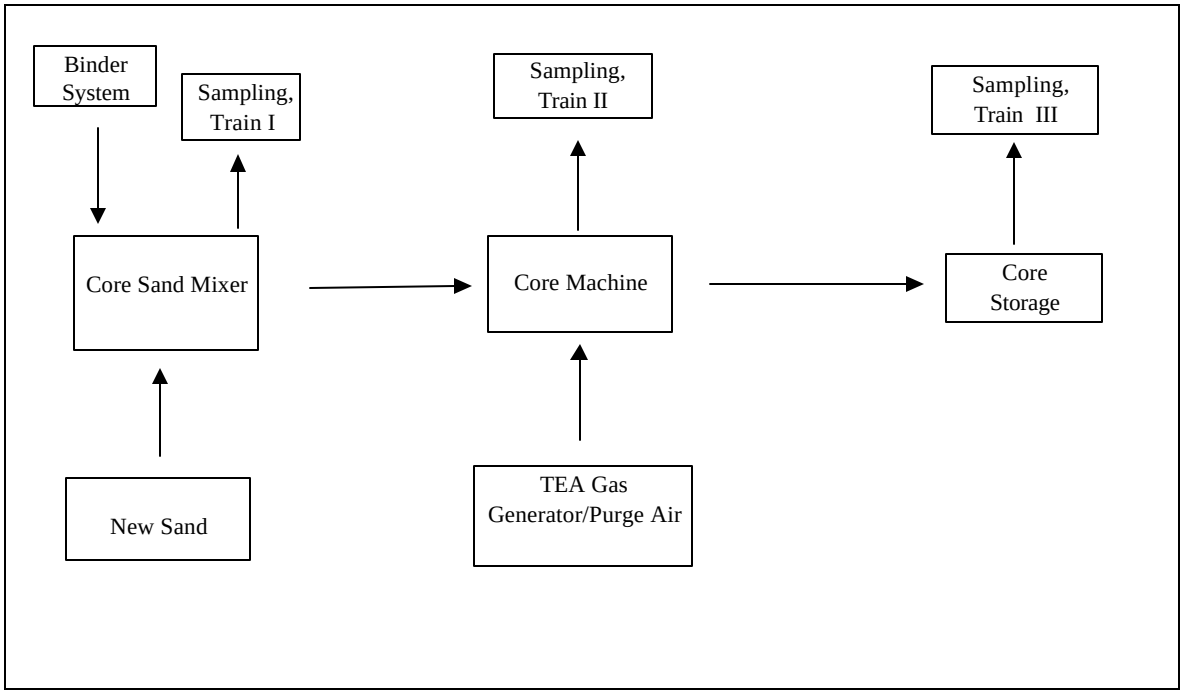


Figure 2-1 Core Making and Testing Process

2.2 Description of Testing Program

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

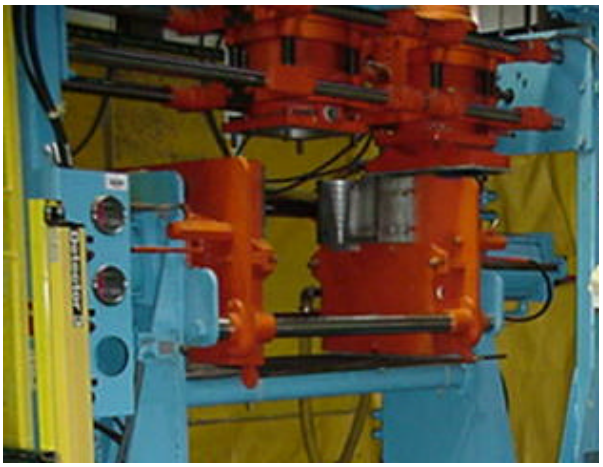
1. **Test Plan Review and Approval:** The proposed test plan was reviewed by the Technikon staff and the CERP Steering Committee, and approved.

2. **Core Preparation**: Step cores were prepared for this test in the Production foundry core room area. The sand and binder were mixed in a Paddle Wheeled Sand Mixer, and then introduced (blown) into the core tooling of the Redford-Carver core machine. The core-making machine was contained in a permanent total enclosures meeting US EPA Method 204 criteria. A weighed amount of the catalyst triethylamine (TEA) gas was heated to 84^{o}F and allowed to expand into the sand in the core box to cure the core. Finally, purge air, heated to 80^{o}F, was blown through the sand mixture in the core box. All these gases

are exhausted to a wet gas scrubber charged with sulfuric acid at pH 4 or less. Step cores are fabricated in a single cavity core box. One blow produces a single step core.

3. **Individual Sampling Events:** Sampling to determine the core making emissions consisted of three (3) segments. The mixing emissions were collected from a Paddle Wheeled 50 pound core sand mixer for seven (7) minutes. The mixed sand was dumped into the Redford Carver sand storage hopper. Air samples were collected during the seven (7) minute mix cycle prior to dumping. During the production of step cores, air sample were also collected to determine the amount of solvents being vented off the core process. The samples were collected during each of the nine (9) thirty (30) minute runs that comprised this portion of the test. The storage segment of the test consisted of placing four (4) cores in the flow-through storage enclosures as soon as they were removed from the core machine. The storage enclosures were sealed and sampling begun. A five (5) hour integrated sample was collected. All of the enclosures used during this test meet or exceed US-EPA Method 204 criteria for Temporary Total Enclosures.

Sand Mixing



Core Making

Core Storage

4. **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	Mettler PJ8000 Digital Scale (Gravimetric)
Core Sand Weight	Simpson IQ-800-3A Digital Scale

5. **Air Emissions Analysis:** The specific sampling and analytical methods used in the core sand mixing, making, and core storage tests are based on the USEPA 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 Benzene, Naphthalene, Formaldehyde, o-Cresol, Phenol,	EPA Method 18, NIOSH 1500, NIOSH 2002, TO-11
TGOC (THC) as Propane concentration	EPA Method 25A
Volatile Matter content	EPA Method 24

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

6. **Data Reduction, Tabulation and Preliminary Report Preparation:** The analytical results of the emissions tests provide the mass of each analyte in the sample. For the core-blowing segment of the test, 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 used to provide emissions data in pounds of analyte per pound of binder.

In the case of the storage segment of this test, the stack parameters are replaced by the total volume of gas flowing through the storage enclosure during each sampling period. The total flow rate through the enclosure was controlled with critical orifices. The total mass of the analyte emitted is then calculated by multiplying the measured mass of analyte in the sample times the ratio of sample volume to total gas volume over the same time period.

7. **Report Preparation and Review:** The Preliminary Draft Report is reviewed by the Process Team and 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. 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 emission results, in pounds per pound of binder used, are presented in Table 3-1.

The average emission results, in pounds per ton of sand used, are presented in Table 3-2.

The amount of available VOCs for this binder system was determined using a method based on US EPA Method 24 and found to be 0.33 pounds per pound of binder or 33% of the binder weight. This data is presented in Table 3-3

Table 3-4 contains average test process and source data. The total binder weight and the total core 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 and process data.

Figure 3-1 shows the data from Table 3-1 while Figure 3-2 shows the data from Table 3-2.

Table 3-1 Average Emission Results – Lb/Lb Binder

Core Mixing

Analytes	Average	STDEV
TGOC as Propane	0.0041	<0.0001
HC as Hexane	0.0021	<0.0003
Sum of VOCs	<0.0001	<0.0001
Sum of HAPs	<0.0001	<0.0001
Sum of POMs	ND	NA
Individual Organic HAPs and VOCs		
Phenol	<0.0001	<0.0001
Formaldehyde	<0.0001	<0.0001
o-Cresol	ND	NA
1-Methylnaphthalene	ND	NA
2-Methylnaphthalene	ND	NA
Naphthalene	ND	NA

ND = Not Detected: **NA** = Not Applicable

Table 3-1 Average Emission Results – Lb/Lb Binder (continued)

Core Making

Analytes	Average	STDEV
HC as Hexane	0.0752	0.0051
Sum of VOCs	0.0014	<0.0002
Sum of HAPs	0.0014	<0.0002
Sum of POMs	0.0010	<0.0002
Individual Organic HAPs and VOCs		
2-Methylnaphthalene	0.0004	<0.0001
Naphthalene	0.0003	<0.0001
Phenol	0.0003	<0.0001
1-Methylnaphthalene	0.0003	<0.0001
Formaldehyde	0.0001	<0.0001
o-Cresol	ND	NA

ND = Not Applicable: NA = Not Applicable

Core Storage

Analytes	Average	STDEV
HC as Hexane	0.0171	0.0019
Sum of VOCs	0.0008	0.0001
Sum of HAPs	0.0008	0.0001
Sum of POMs	0.0007	0.0001
Individual Organic HAPs and VOCs		
2-Methylnaphthalene	0.0003	<0.0001
Naphthalene	0.0003	<0.0001
1-Methylnaphthalene	0.0002	<0.0001
Formaldehyde	<0.0001	<0.0001
o-Cresol	ND	NA
Phenol	ND	NA

ND = Not Detected: NA = Not Applicable

Table 3-2 Average EQ Emission Results – Lb/Tn Sand

Core Mixing

Analytes	Average	STDEV
TGOC as Propane	0.1392	0.0021
HC as Hexane	0.0889	0.0564
Sum of VOCs	0.0031	0.0001
Sum of HAPs	0.0031	0.0001
Sum of POMs	ND	NA
Individual Organic HAPs and VOCs		
Phenol	0.0030	0.0001
Formaldehyde	0.0001	<0.0001
o-Cresol	ND	NA
1-Methylnaphthalene	ND	NA
2-Methylnaphthalene	ND	NA
Naphthalene	ND	NA

ND = Not Detected: NA = Not Applicable

Core Making

Analytes	Average	STDEV
HC as Hexane	2.7191	0.3557
Sum of VOCs	0.0534	0.0149
Sum of HAPs	0.0534	0.0149
Sum of POMs	0.0398	0.0144
Individual Organic HAPs and VOCs		
Phenol	0.0108	0.0006
Formaldehyde	0.0028	0.0006
o-Cresol	ND	NA
1-Methylnaphthalene	0.0102	0.0044
2-Methylnaphthalene	0.0165	0.0057
Naphthalene	0.0131	0.0043

ND = Not Detected: NA = Not Applicable

Core Storage

Analytes	Average	STDEV
HC as Hexane	0.6005	0.0696
Sum of VOCs	0.0264	0.0044
Sum of HAPs	0.0264	0.0044
Sum of POMs	0.0259	0.0044
Individual Organic HAPs and VOCs		
Phenol	ND	NA
Formaldehyde	0.0005	0.0002
o-Cresol	ND	NA
1-Methylnaphthalene	0.0075	0.0015
2-Methylnaphthalene	0.0093	0.0015
Naphthalene	0.0090	0.0014

ND = Not Detected: NA = Not Applicable

Table 3-3 Average Emission Results – % Available Solvent

Analyte	Mixing	Gas/Purge Fugitives	Storage
HC as Hexane	0.6%	23.6%	5.1%

Table 3-4 Average Process and Source Data

Parameter	Mixing	Gas/Purge Fugitives	Storage
Available Solvent (lb)	0.289	1.21	0.042
Calculated Total Binder Weight (lb)	0.875	3.67	0.127
Calculated Total Sand Weight (lb)	50.2	209.9	7.2
Average Binder Percentage (BOS)	1.74	1.75	1.75
Test Run Duration (min)	7	30	300
Volumetric Flow Rate (cfm)	1.05	320	.33
Core Machine Cycle Time (min)	---	1.2	---
Purge Duration (sec)	---	20	---

Figure 3-1 Average Emission Results – Lb/Lb Binder

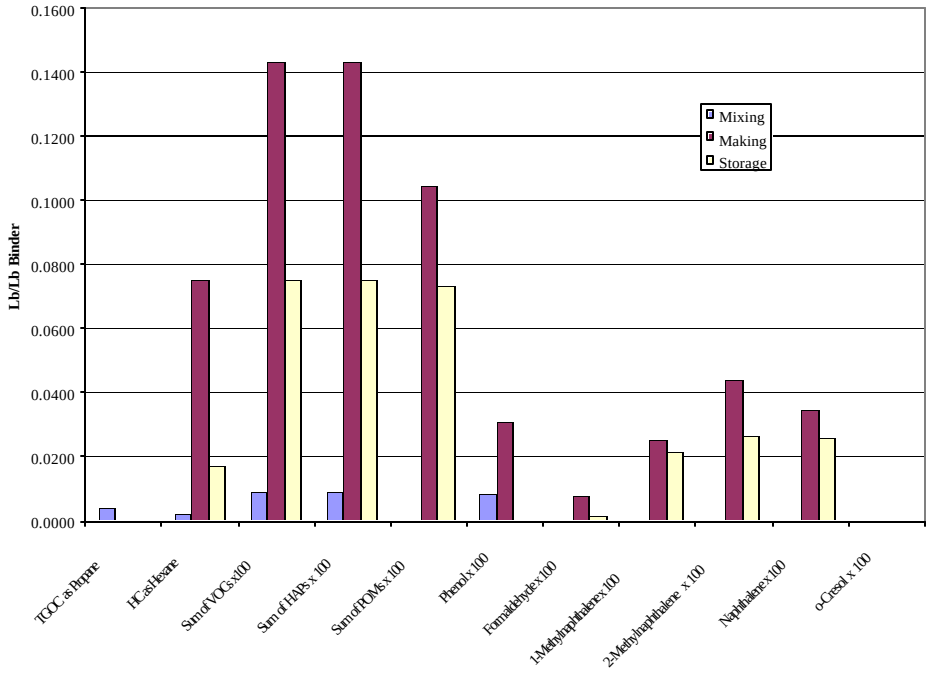
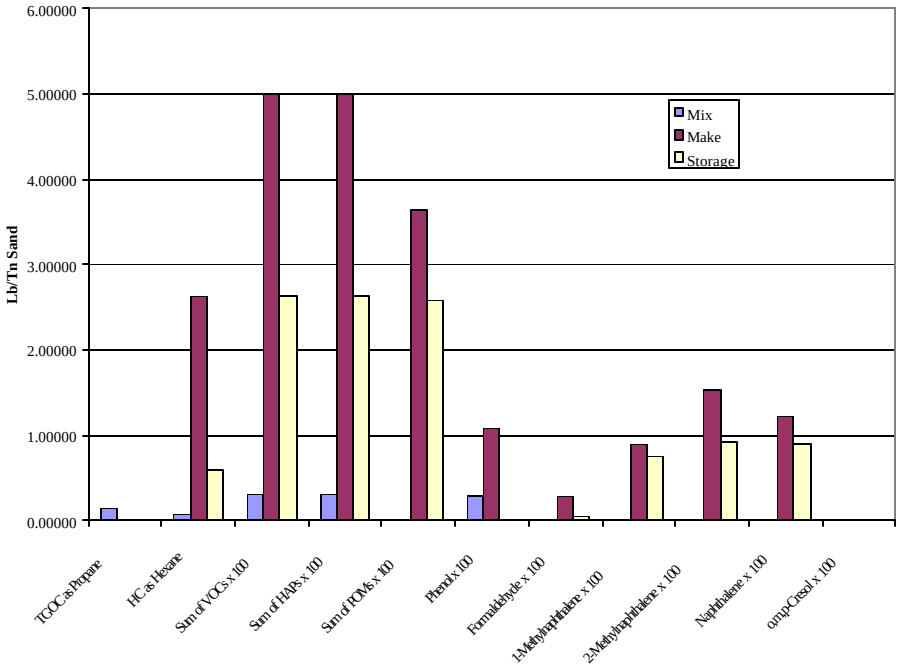


Figure 3-2 Average Emission Results – Lb/Tn Sand



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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 core making activities associated with the use of a phenolic urethane binder system in the Technikon research and development core production facility. All of the core-making measurements were conducted within enclosures meeting the criteria for a temporary total enclosure according to US EPA Method 204.

Mixing

The mixing HAP emissions mainly consisted of phenol and formaldehyde. The HC as Hexane results for mixing contributed approximately 2% of the total found during these three test segments.

Gas/Purge and Fugitives

The HC as hexane results for gas/purge and fugitive emissions contributed approximately 80% of the total found during these three test segments.

Storage

The storage segment contributed 18% of the total found during these three test segments.

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APPENDIX A APPROVED TEST PLAN AND SAMPLE PLAN

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TECHNIKON TEST PLAN

CONTRACT NUMBER: 1409 **TASK NUMBER:** 1.2.3

WORK ORDER NUMBER: 1165 **SERIES:** EQ

SAMPLE EVENTS: EQ001-009 mix, EQ021-029 make, EQ031-039 store

SITE: ___PRE-PRODUCTION (243) _X__ FOUNDRY(238)

TEST TYPE: Capability, core mixing, core making, core storage baseline 2002

METAL TYPE: None

MOLD TYPE: None

NUMBER OF MOLDS: NONE

CORE TYPE: AFS Step Core, Ashland Isocure ® LF305/52-904GR Phenolic urethane binder, TEA catalyzed

TEST DATE: **START:** 19 Aug 2002

FINISHED: 13 Sep 2002

TEST OBJECTIVES:

1. Develop facility and methods to make a core mix, make, and store baseline having significantly reduced process variability and improved independent sample capture methods.

2. Measure selective HAP and VOC emissions from Core sand mixing, Gas & Purge and Fugitive Core Making, and Core Storage of AFS step cores made with 1.75% Ashland binder to make a 2002 Core baseline.

VARIABLES:

1. Core 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 1.75 +/- .0175% Ashland 305/52-904 mixed Part I/Part II in the ratio of 55/45. The sand will be coated in the Redford/Carver 50 pound core sand mixer for 7 minutes. One minute shall be used to dispense the sand and the two binder components and one additional minute shall be used strictly for discharging the muller. Each core sand mixing test shall be one seven (7) minute 50-pound cycle within the muller only monitored continuously by TGOC and adsorption tube sampling. Prior to the first test five (5) batches shall be run to the storage hopper to normalize the background. Sampling media will be changed after each one-cycle test, during which time mixing will continue in order to maintain the background concentration. A total of nine (9) mixing tests shall be run.

2. Core Making: The Redford/Carver core machine will operate on a nominal one (1) minute door-to-door cycle. The environmental enclosure shall be supplied with air controlled to 82 +/- 5 degrees Fahrenheit. TEA will be fed to the core machine at a nominal 5 grams per cycle. The purge pressure shall be 20+/-2 psi. The core-make test will begin after the

core machine has run sufficient time, at rate, to have the background emission concentration stabilize. Each core-make test will be 30 core cycles, about one half hour long, with continuous TGOC and adsorption tube sampling. Sample media will be changed after each 30-cycle test. The core machine will run continuously during media change and testing to maintain the background concentration. The gas & purge and fugitive emissions will be collected to a common sampling stack.

3. Core Storage: The store test will consist of weighed cores sampled four (4) at a time, from the core machine and placed in individual sampling domes. The domes are in a temperature-controlled room at 82+/- 5 degrees Fahrenheit and sampled continuously with TGOC and adsorption tubes for 5 hours.

BRIEF OVERVIEW: Core making is not a single process but rather a series of steps, each with its own process collectable and fugitive emissions. This test will look at selected HAP & VOC emissions from combined process collectable and fugitive emission streams during each of the core sand mixing, core making, and core storage steps.

SPECIAL CONDITIONS: The sand mixer will have a removable lid that allows air to infiltrate radially from the perimeter. Materials will be charged though a closeable door in the lid. Samples will be extracted from the center of the headspace below the lid. The core machine with step core tooling shall be housed in a double walled emission enclosure. The area between the walls shall be flushed with temperature-controlled air at 80+/-5 degrees Fahrenheit. This air shall be the ambient make up air for the core process within the enclosure. The core box and core machine shall be tightly plumbed to extract gasses passed through the core box into a common sampling stack with the fugitive gasses. The sampling environment will be maintained at 75-85^{o}F.

Original Signed	_____
Process Engineering Manager (Technikon)	**Date**
Original Signed	_____
V.P. Measurement Technology (Technikon)	**Date**
Original Signed	_____
V.P. Operations (Technikon)	**Date**
Original Signed	_____
CERP Representative	**Date**

Series EQ (Baseline)

Core Sand Mixing, Curing, and Storage

A. The Experiment:

1. Design and develop improved capability to evaluate the standard emissions from the mixing, making, and storage of gas catalyzed cold reacting core sand mixtures.
2. Evaluate the emissions from Ashland ISOCURE® LF305/52-904 part I and part II binder system to form a mixing, making, storage baseline for Iron-Phenolic Urethane binder systems.

B. Capability Study:

1. Mixing: Design and manufacture a capture hood for the Carver 50 pound capacity core sand mixer consisting of:

   a. An annular air makeup port which allows air to enter the mixer radially in such a way as to not significantly affect the emission evaporation from the sand surface.
   b. The ventilation rate shall be sufficient to prevent escape of the emissions except to the emission-sampling stream.
   c. An emission sampling port centered on the capture hood.
   d. A discharge pipe connected to a sampling train and pump via a heated line to the THC analyzer.

2. Core Making: Design and manufacture a total emission enclosure to capture and sample aggregate emissions from both the core box gas-purge cycles and fugitives from the enclosure.

   a. A gassing head capable of independently delivering a catalyzing gas and purge air from the external Luber gas generator to the common fugitives collection pipe. The flow rate in the sampling pipe at the sampling location must be virtually independent of the whether the gas-purge cycle is active.

3. Storage: Design and manufacture a set of four-storage emission sampling chambers.

   a. Each chamber shall have independent air flow controls.
   b. The sum of the chamber flows shall not exceed 50 liters/minute.
   c. One chamber shall be connected to the THC analyzer.
   d. Three chambers shall be connected to a sampling train via independent sampling media.

4. Conduct a set of preliminary tests to verify that the design criteria are met.

a. Conduct a "mixedness" test to verify that the mixer will create a homogeneous mixture within the prescribed mixing time.
b. Conduct a THC mixing calibration run according to the mixing schedule described below in order to determine the required media flow rates.
c. Conduct a THC core making calibration at 60 core /hour in order to determine the required media flow rates.
d. Conduct a THC core storage calibration run using core made per the core make procedure in order to determine the required media flow rates.
e. Record the ambient air temperature, pressure, and moisture content; scavenging air velocity; all machine parameters; all core weights; and all events.

C. Mixing Test: Nine discrete seven (7) minute batches run contiguously.

1. The test shall be conducted in the 50-pound Carver core sand mixer fitted with the capture hood with make-up air ventilation.

a. The emission sample shall be taken from the air space above the mixing sand.

2. Mixing

a. Turn on the Kloster sand heater/cooler. Adjust the set point so that sand is delivered to the mixer in the temperature range of 80-90°F.
b. Attach the emission sampling equipment to the 50-pound Carver core sand mixer.
c. Pre-measure 1.75% (BOS) Ashland ISOCURE® binder based on a 50 pound batch.

1) Part I (LF305) is 55% of the total resin and is 218.3 grams.
2) Part II (52-904) is 45% of the total resin and is 178.6 grams

Note: pre-wet the dispensing cup and tare the wet cup.

d. Pre-Weigh 50 pounds of Wexford W450 Lake Sand, heated to 80-90°F in the Kloster sand heater/cooler, in the Simpson Technologies weight system.
e. Place the capture hood on top of the mixer. Start the mixer.
f. Start the timer. Start monitoring with the THC only. Monitor with the THC continuously until the end of the test.
g. Make five (5) emission background-generating batches.
h. The procedure for this and the contiguously run test batches shall be as follows: Add the 50 pounds of raw sand, about 20-25 seconds, followed by the binder part I dispensed over 20 seconds, followed by binder part II dispensed over 20 seconds. All materials should be in the mixer within 50-70 seconds from start of the batch. Mix each batch until a total of 6 minutes have elapsed, then discharge the batch until a total of 7 minutes has elapsed from the start of the batch. Be prepared to recharge the mixer for the next batch immediately at the end of each 7-minute period.
i. During this activity the next set of components must be weighed and made ready. Having two or three material sets weighed and protected at all times makes the process go smoothly.

j. At the end of fifth batch (35 minutes)

1) Close the discharge door.
2) Open the sample train to the mixer.
3) The emission sample size will be one (1) batch.
4) During the next batch the media will be changed.
5) The next batch will be an emission sample again.
6) Continue alternating until nine (9) emission tests are complete.

k. Repeat steps C.2.g-h for as many cycles as is necessary to complete the five (5) background batches, the nine (9) emission test batches, and nine (9) media changing periods, a total of 23 batches. Continue batches uninterrupted during media changes between tests.

D. Core Making test: Nine (9) tests each having thirty (30) approximately one (1) minute core cycles.

1. Turn on the core storage room temperature control system 24 hours ahead of expected use time. Set control so that the core machine sees 80^{o}F.
2. Turn on and adjust the Luber TEA gas generator.

a. Make sure there is enough TEA in the Luber TEA storage tank.
b. Set the MAX WORKING PRESSURE to 45 psi.
c. Set the gassing time (T1) to 0.75 seconds
d. Adjust the TEA flow rate to .019 pounds/second.

Note: This will give an amine input of 5.1 grams per cycle.

e. Leave the Timer TR1 at 0.3 seconds, the proportional valve voltage at 7.5 volts and timer at 3 seconds, the low purge pressure at 10 psi and high purge pressure at 45 psi.

Note: This should yield a working pressure of about 7 psi.

f. Connect the TEA weighing container to the Luber supply line.

1) Dispense about 250 grams of TEA into the weigh container. The scale has a 300-gram capacity.
2) Isolate the Luber TEA storage tank.

g. Conduct 5 gassing purge cycles within ½ hour of testing to stabilize the Luber generator.

1) Vent this material to the scrubber.
2) Record the TEA weight dispensed.

h. Record the ambient temperature, the inlet pressure, Max working pressure, working pressure, TEA flow rate, gassing timer value, & purge timer value.

3. Attach the emission sample train to the gas-purge-fugitive sample pipe.
4. Begin monitoring with the THC.
5. Prepare the core sand in the Carver mixer according to section C.2.g-h except without the emission sampling equipment attached to the mixer.
6. Prepare the core machine emission enclosure.
7. Verify that the temperature controlled core test room is set to deliver air at 75-85^{o}F to the core enclosure.
8. Set up the Redford/Carver core machine with the step core corebox.
9. Verify that the air temperature in the gas-purge-fugitive exhaust tube is 75-85 degrees Fahrenheit.
10. Set the Redford/Carver core machine to gas for 0.75 seconds with zero (0) second delay after gassing and twenty (20) second purge. Total cycle time to be one (1) minute. Set the cycle counter to zero (0).
11. Start and calibrate the Luber TEA vaporizer to dispense 5.0-5.2 grams of TEA per machine cycle.
12. Mix core sand per section C.2.g-h, as required, in fifty (50) pound batches to assure continuity of production.
13. Cycle the core machine for 10-15 cycles or until fugitives emissions are stable based on the THC and good core manufacture is achieved. Note: if release agent is required brush release agent on to core box do not spray.
14. Make cores continuously as above. Any stoppage will impact the fugitives emission level.
15. Record the number and weight of each core throughout the test.
16. When everybody is ready, start the emission-sampling clock and open the sample train. Sample continuously for 30 core cycles, approximately thirty (30) minute, then close the sample train.
17. Do not stop making core.
18. Set up the sample train again and repeat the test for another thirty-core test. A total of nine (9) half-hour tests are to be performed.
19. Empty and clean the core machine and core sand mixer.

E. Core storage tests.

1. Prepare the 4 individual core storage emission enclosures.
2. Set up a THC to monitor one enclosure and the sample train to monitor the other three enclosures and calibrate them.
3. Mix sand by the method of section C.2.g-h.
4. Make core by the method of Section D.
5. Number, weigh, and record each core.
6. When good core are being made sample four (4) cores whose weight is 7.30, 7.35, or 7.40 pounds for the storage test. Place these cores in the core storage emission enclosures.

7. Close the enclosure bonnet, start the test clock, open to the THC or the sample train.
8. Record the start time for each core as well as the core weight
9. Continue sampling train for 5 hours then close the sample train. Separate longer tests may be conducted by this procedure at the discretion of the emission team.
10. Continue the THC monitoring for 24 hours.
11. Repeat this procedure to obtain nine (9) discrete tests plus the THC monitoring.

Steven Knight
Mgr. Process Engineering

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 1											
THC	EQ-00101	X									TOTAL
NIOSH 1500	EQ-00102		1						20	1	100/50 mg Charcoal (SKC 226-01)
NIOSH 1500	EQ-00103			1					20	2	400/200 mg Charcoal (Orbo 32)
NIOSH 1500	EQ-00104				1						400/200 mg Charcoal (Orbo 32)
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00105		1						1000	8	400/200 mg Silica Gel (Orbo 53)
NIOSH 2002	EQ-00106			1					1000	9	400/200 mg Silica Gel (Orbo 53)
NIOSH 2002	EQ-00107				1						400/200 mg Silica Gel (Orbo 53)
TO11	EQ-00108		1						1000	10	(DNPH cartridge sep-pak)
TO11	EQ-00109				1				1000	11	(DNPH cartridge sep-pak)
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 2											
THC	EQ-00201	X									TOTAL
NIOSH 1500	EQ-00202		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00203		1						1000	8	400/200 mg Silica Gel (Orbo 53)
TO11	EQ-00204		1						1000	9	(DNPH cartridge sep-pak)
TO11	EQ-00205			1					1000	10	(DNPH cartridge sep-pak)
									1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 3											
THC	EQ-00301	X									TOTAL
NIOSH 1500	EQ-00302		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00303		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00304		1						1000	10	(DNPH cartridge sep-pak)
TO11	EQ-00305					1			1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 4											
THC	EQ-00401	X									TOTAL
NIOSH 1500	EQ-00402		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00403		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00404		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 5											
THC	EQ-00501	X									TOTAL
NIOSH 1500	EQ-00502		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00503		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00504		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 6											
THC	EQ-00601	X									TOTAL
NIOSH 1500	EQ-00602		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00603		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00604		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 7											
THC	EQ-00701	X									TOTAL
NIOSH 1500	EQ-00702		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00703		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00704		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 8											
THC	EQ-00801	X									TOTAL
NIOSH 1500	EQ-00802		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00803		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00804		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 9											
THC	EQ-00901	X									TOTAL
NIOSH 1500	EQ-00902		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-00903		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-00904		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 10											
THC	EQ-01001	X									TOTAL
NIOSH 1500	EQ-01002		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-01003		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-01004		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 11											
THC	EQ-01101	X									TOTAL
NIOSH 1500	EQ-01102		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-01103		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-01104		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 12											
THC	EQ-01201	X									TOTAL
NIOSH 1500	EQ-01202		1						20	1	400/200 mg Charcoal (Orbo 32)
	Excess								20	2	Excess
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-01203		1						1000	8	400/200 mg Silica Gel (Orbo 53)
	Excess								1000	9	Excess
TO11	EQ-01204		1						1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MIXING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/9/02											
EVENT 13											
THC	EQ-01301	X									TOTAL
NIOSH 1500	EQ-01302		1						20	1	100/50 mg Charcoal (SKC 226-01)
NIOSH 1500	EQ-01303			1					20	2	400/200 mg Charcoal (Orbo 32)
	Excess								45	3	Excess
	Excess								35	4	Excess
	Excess								60	5	Excess
	Excess								750	6	Excess
	Excess								900	7	Excess
NIOSH 2002	EQ-01305		1						1000	8	400/200 mg Silica Gel (Orbo 53)
NIOSH 2002	EQ-01306			1					1000	9	400/200 mg Silica Gel (Orbo 53)
TO11	EQ-01308		1						1000	10	(DNPH cartridge sep-pak)
TO11	EQ-01309					1			1000	10	(DNPH cartridge sep-pak)
	Excess								1000	11	
	Excess								200	12	Excess
	Excess								22000	13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 1											
THC	EQ-02101	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02102		1						500	5	100/50 mg Charcoal (SKC 226-01)
NIOSH 1500	EQ-02103			1					500	6	100/50 mg Charcoal (SKC 226-01)
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02104		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
NIOSH 2002	EQ-02105			1					1000	10	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02106		1						1000	11	(DNPH cartridge sep-pak)
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 2											
THC	EQ-02201	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02202		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02203		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02204		1						1000	10	(DPNH cartridge sep-pak)
	EQ-02205			1					1000	11	(DPNH cartridge sep-pak)
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 3											
THC	EQ-02301	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02302		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02303		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02304		1						1000	10	(DPNH cartridge sep-pak)
TO11	EQ-02305					1			1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 4											
THC	EQ-02401	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02402		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02403		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02404		1						1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 5											
THC	EQ-02501	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02502		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02503		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02504		1						1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 6											
THC	EQ-02601	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02602		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02603		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02604		1						1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 7											
THC	EQ-02701	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02702		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02703		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02704		1						1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											
EVENT 8											
THC	EQ-02801	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02802		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02803		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02804		1						1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	Excess

CORE MAKING EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**30 Minute Test**
EVENT 9											
THC	EQ-02901	X									TOTAL
	Excess									1	Excess
	Excess									2	Excess
	Excess									3	Excess
	Excess									4	Excess
NIOSH 1500	EQ-02902		1						500	5	100/50 mg Charcoal (SKC 226-01)
	Excess								500	6	Excess
	Excess									7	Excess
	Excess									8	Excess
NIOSH 2002	EQ-02903		1						1000	9	150/75 mg Silica Gel (SKC 226-10)
TO11	EQ-02904		1						1000	10	(DPNH cartridge sep-pak)
	Excess								1000	11	Excess
	Excess									12	Excess
	Excess									13	Excess

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/10/02											**5-Hr. Test-Core 1**
EVENT 1											
NIOSH 1500	EQ-03101		1						25	1	100/50 mg Charcoal (SKC 226-01)
NIOSH 1500	EQ-03102			1					25	2	100/50 mg Charcoal (SKC 226-01)
NIOSH 2002	EQ-03103		1						60	3	150/75 mg Silica Gel (SKC 226-10)
NIOSH 2002	EQ-03104			1					30	4	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-03105		1						200	5	(DPNH cartridge sep-pak)
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/10/02											**5 Hour Test-Core 2**
EVENT 2											
NIOSH 1500	EQ-03201		1						30	1	100/50 mg Charcoal (SKC 226-01)
	Excess								20	2	Excess
NIOSH 2002	EQ-3202		1						60	3	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-3203		1						200	4	(DPNH cartridge sep-pak)
TO-11	EQ-3204			1					200	5	(DPNH cartridge sep-pak)
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/10/02											**5 Hour Test-Core 3**
EVENT 3											
NIOSH 1500	EQ-03301		1						30	1	100/50 mg Charcoal (SKC 226-01)
	Excess								30	2	Excess
NIOSH 2002	EQ-03302		1						60	3	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-03303		1						200	4	(DPNH cartridge sep-pak)
TO-11	EQ-03304					1			200	4	(DPNH cartridge sep-pak)
	Excess								200	5	Excess
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**5 Hour Test-Core 4**
EVENT 4											
NIOSH 1500	EQ-03401		1						25	1	100/50 mg Charcoal (SKC 226-01)
	Excess								25	2	Excess
NIOSH 2002	EQ-03402		1						60	3	150/75 mg Silica Gel (SKC 226-10)
	Excess								30	4	Excess
TO-11	EQ-03403		1						200	5	(DPNH cartridge sep-pak)
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**5 Hour Test-Core 5**
EVENT 5											
NIOSH 1500	EQ-03501		1						30	1	100/50 mg Charcoal (SKC 226-01)
	Excess								20	2	Excess
NIOSH 2002	EQ-03502		1						60	3	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-03503		1						200	4	(DPNH cartridge sep-pak)
	Excess								200	5	Excess
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**5 Hour Test-Core 6**
EVENT 6											
NIOSH 1500	EQ-03601		1						30	1	100/50 mg Charcoal (SKC 226-01)
	Excess								30	2	Excess
NIOSH 2002	EQ-03602		1						60	3	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-03603		1						200	4	(DPNH cartridge sep-pak)
	Excess								200	5	Excess
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**5 Hour Test-Core 7**
EVENT 7											
NIOSH 1500	EQ-03701		1						25	1	100/50 mg Charcoal (SKC 226-01)
	Excess								25	2	Excess
NIOSH 2002	EQ-03702		1						60	3	150/75 mg Silica Gel (SKC 226-10)
	Excess								30	4	Excess
TO-11	EQ-03703		1						200	5	(DPNH cartridge sep-pak)
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**5 Hour Test-Core 8**
EVENT 8											
NIOSH 1500	EQ-03801		1						30	1	100/50 mg Charcoal (SKC 226-01)
	Excess								20	2	Excess
NIOSH 2002	EQ-03802		1						60	3	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-03803		1						200	4	(DPNH cartridge sep-pak)
	Excess								200	5	Excess
	Excess								Variable	6	No Critical Orifice

CORE STORAGE EQ - SERIES SAMPLE PLAN

Method	Sample #	Data	Sample	Duplicate	Blank	Breakthrough	Spike	Spike Duplicate	Flow (ml/min)	Train Channel	Comments
9/11/02											**5 Hour Test-Core 9**
EVENT 9											
NIOSH 1500	EQ-03901		1						30	1	100/50 mg Charcoal (SKC 226-01)
	Excess								30	2	Excess
NIOSH 2002	EQ-03902		1						60	3	150/75 mg Silica Gel (SKC 226-10)
TO-11	EQ-03903		1						200	4	(DPNH cartridge sep-pak)
	Excess								200	5	Excess
	Excess								Variable	6	No Critical Orifice

APPENDIX B DETAILED TEST AND PROCESS DATA

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Individual Mixing Test Results – Lb/Lb Binder

Core Mixing 1.75% Binder

HAPs	POMs	Compound/Sample Number	EQ004	EQ005	EQ006	EQ007	EQ008	EQ009	EQ010	EQ011	EQ012	Average	STDEV
		Test Dates	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02		
		TGOC as Propane	4.20E-03	4.00E-03	4.00E-03	4.00E-03	4.10E-03	4.00E-03	4.00E-03	4.00E-03	4.10E-03	4.04E-03	7.26E-05
		HC as Hexane	2.23E-03	1.43E-03	1.79E-03	2.05E-03	2.10E-03	2.17E-03	1.99E-03	2.43E-03	2.31E-03	2.06E-03	2.98E-04
		Sum of VOCs	9.33E-05	8.88E-05	9.15E-05	8.97E-05	8.52E-05	8.97E-05	8.90E-05	8.88E-05	9.95E-05	9.06E-05	3.97E-06
		Sum of HAPs	9.33E-05	8.88E-05	9.15E-05	8.97E-05	8.52E-05	8.97E-05	8.90E-05	8.88E-05	9.95E-05	9.06E-05	3.97E-06
		Sum of POMs	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
			Individual Organic HAPs and VOCs										
x		Phenol	8.98E-05	8.54E-05	8.81E-05	8.63E-05	8.18E-05	8.63E-05	8.55E-05	8.53E-05	9.61E-05	8.72E-05	3.98E-06
x		Formaldehyde	3.50E-06	3.42E-06	3.37E-06	3.41E-06	3.42E-06	3.48E-06	3.49E-06	3.53E-06	3.42E-06	3.45E-06	5.47E-08
x		o-Cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
x	z	1-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
x	z	2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
x	z	Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA

ND: Non Detect; **NA:** Not Applicable
Formaldehyde results reported as a mimimum.

Individual Gas/Purge and Fugitive Test Results – Lb/Lb Binder

Core Making 1.75% Binder

HAPs	POMs	Compound/Sample Number	EQ021	EQ022	EQ023	EQ024	EQ025	EQ026	EQ027	EQ028	EQ029	Average	STDEV
		Test Dates	9/11/02	9/11/02	9/11/02	9/11/02	9/11/02	9/12/02	9/12/02	9/12/02	9/12/02		
		TGOC as Propane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		HC as Hexane	7.29E-02	7.70E-02	7.83E-02	8.51E-02	7.96E-02	6.93E-02	7.29E-02	7.04E-02	7.15E-02	7.52E-02	5.14E-03
		Sum of VOCs	1.14E-03	1.70E-03	1.58E-03	1.68E-03	1.40E-03	1.22E-03	1.32E-03	1.38E-03	1.49E-03	1.43E-03	1.96E-04
		Sum of HAPs	1.14E-03	1.70E-03	1.58E-03	1.68E-03	1.40E-03	1.22E-03	1.32E-03	1.38E-03	1.49E-03	1.43E-03	1.96E-04
		Sum of POMs	7.58E-04	1.27E-03	1.21E-03	1.27E-03	1.07E-03	8.32E-04	9.07E-04	9.73E-04	1.10E-03	1.04E-03	1.88E-04
			Individual Organic HAPs and VOCs										
x	z	2-Methylnaphthalene	3.04E-04	5.49E-04	5.08E-04	5.47E-04	4.52E-04	3.47E-04	3.69E-04	4.08E-04	4.58E-04	4.38E-04	8.77E-05
x	z	Naphthalene	2.77E-04	4.47E-04	3.96E-04	4.00E-04	3.44E-04	2.80E-04	3.16E-04	3.21E-04	3.66E-04	3.50E-04	5.77E-05
x		Phenol	2.98E-04	3.41E-04	2.92E-04	3.30E-04	2.98E-04	3.07E-04	3.15E-04	3.15E-04	2.97E-04	3.10E-04	1.67E-05
x	z	1-Methylnaphthalene	1.77E-04	2.77E-04	3.04E-04	3.23E-04	2.70E-04	2.06E-04	2.22E-04	2.45E-04	2.77E-04	2.55E-04	4.73E-05
x		Formaldehyde	8.02E-05	9.05E-05	8.03E-05	7.81E-05	3.39E-05	8.35E-05	9.37E-05	8.95E-05	9.15E-05	8.01E-05	1.83E-05
x		o-Cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA

ND: Non Detect; **NA:** Not Applicable

Individual Storage Test Results – Lb/Lb Binder

Core Storage 1.75% Binder

HAPs	POMs	Compound/Sample Number	EQ031	EQ032	EQ033	EQ034	EQ035	EQ036	EQ037	EQ038	EQ039	Average	STDEV
		Test Dates	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02		
		TGOC as Propane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		HC as Hexane	1.71E-02	1.47E-02	1.80E-02	I	1.74E-02	2.09E-02	1.54E-02	1.59E-02	1.74E-02	1.71E-02	1.91E-03
		Sum of VOCs	8.64E-04	6.08E-04	8.66E-04	I	7.18E-04	8.92E-04	5.80E-04	6.78E-04	8.04E-04	7.51E-04	1.22E-04
		Sum of HAPs	8.64E-04	6.08E-04	8.66E-04	I	7.18E-04	8.92E-04	5.80E-04	6.78E-04	8.04E-04	7.51E-04	1.22E-04
		Sum of POMs	8.46E-04	5.92E-04	8.48E-04	I	7.11E-04	8.84E-04	5.64E-04	6.61E-04	7.85E-04	7.36E-04	1.23E-04
			Individual Organic HAPs and VOCs										
x	z	2-Methylnaphthalene	3.16E-04	2.13E-04	2.96E-04	I	2.53E-04	3.09E-04	2.11E-04	2.34E-04	2.96E-04	2.66E-04	4.34E-05
x	z	Naphthalene	2.90E-04	1.99E-04	2.86E-04	I	2.48E-04	3.08E-04	2.05E-04	2.43E-04	2.78E-04	2.57E-04	4.01E-05
x	z	1-Methylnaphthalene	2.41E-04	1.79E-04	2.66E-04	I	2.10E-04	2.67E-04	1.48E-04	1.84E-04	2.10E-04	2.13E-04	4.27E-05
x		Formaldehyde	1.75E-05	1.69E-05	1.84E-05	I	7.16E-06	8.16E-06	1.63E-05	1.68E-05	1.83E-05	1.49E-05	4.56E-06
x		o-Cresol	ND	ND	ND	I	ND	ND	ND	ND	ND	NA	NA
x		Phenol	ND	ND	ND	I	ND	ND	ND	ND	ND	NA	NA

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

Individual Results for Test EQ – Lb/Tn Sand

Core Mixing 1.75% Binder

HAPs	POMs	Compound/Sample Number	EQ004	EQ005	EQ006	EQ007	EQ008	EQ009	EQ010	EQ011	EQ012	Average	STDEV
		Test Dates	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002		
		TGOC as Propane	1.44E-01	1.37E-01	1.38E-01	1.38E-01	1.41E-01	1.39E-01	1.39E-01	1.39E-01	1.41E-01	1.39E-01	2.18E-03
		HC as Hexane	7.59E-02	4.88E-02	6.10E-02	7.06E-02	7.22E-02	7.47E-02	6.84E-02	8.36E-02	7.95E-02	7.05E-02	1.04E-02
		Sum of VOCs	3.18E-03	3.02E-03	3.12E-03	3.08E-03	2.93E-03	3.09E-03	3.06E-03	3.05E-03	3.42E-03	3.11E-03	1.36E-04
		Sum of HAPs	3.18E-03	3.02E-03	3.12E-03	3.08E-03	2.93E-03	3.09E-03	3.06E-03	3.05E-03	3.42E-03	3.11E-03	1.36E-04
		Sum of POMs	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
		Individual Organic HAPs and VOCs											
x		Phenol	3.06E-03	2.91E-03	3.00E-03	2.97E-03	2.81E-03	2.97E-03	2.94E-03	2.93E-03	3.30E-03	2.99E-03	1.36E-04
x		Formaldehyde	1.19E-04	1.16E-04	1.15E-04	1.17E-04	1.17E-04	1.20E-04	1.20E-04	1.21E-04	1.17E-04	1.18E-04	2.07E-06
x		o-cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
x	z	1-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
x	z	2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
x	z	Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA

ND: Non Detect; **NA;** Not Applicable

Formaldehyde results reported as a minimum due to apparent breakthrough.

Core Making 1.75% Binder

HAPs	POMs	Compound/Sample Number	EQ021	EQ022	EQ023	EQ024	EQ025	EQ026	EQ027	EQ028	EQ029	Average	STDEV
		Test Dates	9/11/2002	9/11/2002	9/11/2002	9/11/2002	9/11/2002	9/12/2002	9/12/2002	9/12/2002	9/12/2002		
		TGOC as Propane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		HC as Hexane	2.54E+00	2.69E+00	2.74E+00	2.98E+00	2.79E+00	2.41E+00	2.53E+00	2.47E+00	2.51E+00	2.63E+00	1.84E-01
		Sum of VOCs	3.96E-02	5.95E-02	5.54E-02	5.87E-02	4.90E-02	4.25E-02	4.58E-02	4.82E-02	5.21E-02	5.01E-02	6.94E-03
		Sum of HAPs	3.96E-02	5.95E-02	5.54E-02	5.87E-02	4.90E-02	4.25E-02	4.58E-02	4.82E-02	5.21E-02	5.01E-02	6.94E-03
		Sum of POMs	2.64E-02	4.44E-02	4.24E-02	4.44E-02	3.74E-02	2.89E-02	3.15E-02	3.41E-02	3.85E-02	3.65E-02	6.65E-03
		Individual Organic HAPs and VOCs											
x	z	2-Methylnaphthalene	1.06E-02	1.92E-02	1.78E-02	1.91E-02	1.59E-02	1.21E-02	1.28E-02	1.43E-02	1.60E-02	1.53E-02	3.09E-03
x	z	Naphthalene	9.66E-03	1.56E-02	1.39E-02	1.40E-02	1.20E-02	9.73E-03	1.10E-02	1.12E-02	1.28E-02	1.22E-02	2.03E-03
x		Phenol	1.04E-02	1.19E-02	1.03E-02	1.16E-02	1.04E-02	1.07E-02	1.10E-02	1.10E-02	1.04E-02	1.08E-02	5.73E-04
x	z	1-Methylnaphthalene	6.17E-03	9.65E-03	1.07E-02	1.13E-02	9.46E-03	7.15E-03	7.72E-03	8.56E-03	9.70E-03	8.93E-03	1.67E-03
x		Formaldehyde	2.80E-03	3.16E-03	2.82E-03	2.73E-03	1.19E-03	2.90E-03	3.26E-03	3.13E-03	3.21E-03	2.80E-03	6.36E-04
x		o-cresol	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA

ND: Non Detect; NA; Not Applicable

Core Storage 1.75% Binder

HAPs	POMs	Compound/Sample Number	EQ031	EQ032	EQ033	EQ034	EQ035	EQ036	EQ037	EQ038	EQ039	Average	STDEV
		Test Dates	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002	9/9/2002		
		TGOC as Propane	NA	NA	NA	I	NA	NA	NA	NA	NA	NA	NA
		HC as Hexane	5.97E-01	5.16E-01	6.31E-01	I	6.14E-01	7.39E-01	5.42E-01	5.58E-01	6.09E-01	6.01E-01	6.85E-02
		Sum of VOCs	3.02E-02	2.13E-02	3.03E-02	I	2.54E-02	3.15E-02	2.03E-02	2.38E-02	2.82E-02	2.64E-02	4.30E-03
		Sum of HAPs	3.02E-02	2.13E-02	3.03E-02	I	2.54E-02	3.15E-02	2.03E-02	2.38E-02	2.82E-02	2.64E-02	4.30E-03
		Sum of POMs	2.96E-02	2.07E-02	2.97E-02	I	2.51E-02	3.12E-02	1.98E-02	2.32E-02	2.75E-02	2.58E-02	4.33E-03
		Individual Organic HAPs and VOCs											
x	z	2-Methylnaphthalene	1.10E-02	7.47E-03	1.04E-02	I	8.94E-03	1.09E-02	7.38E-03	8.21E-03	1.04E-02	9.34E-03	1.52E-03
x	z	Naphthalene	1.01E-02	6.97E-03	1.00E-02	I	8.75E-03	1.09E-02	7.20E-03	8.50E-03	9.75E-03	9.02E-03	1.41E-03
x	z	1-Methylnaphthalene	8.43E-03	6.26E-03	9.30E-03	I	7.42E-03	9.42E-03	5.19E-03	6.45E-03	7.37E-03	7.48E-03	1.50E-03
x		Formaldehyde	6.12E-04	5.92E-04	6.45E-04	I	2.53E-04	2.88E-04	5.70E-04	5.87E-04	6.42E-04	5.24E-04	1.59E-04
x		o-cresol	ND	ND	ND	I	ND	ND	ND	ND	ND	NA	NA
x		Phenol	ND	ND	ND	I	ND	ND	ND	ND	ND	NA	NA

I: Data rejected based on data validation considerations.

ND: Non Detect; NA; Not Applicable

Individual Detection Levels for Test EQ

Test EQ Quantitation Limits - Lb/Tn Sand

Analytes	Core Mixing	Core Making	Core Storage
HC as hexane	2.30E-03	3.81E-03	2.32E-03
1-methylnaphthalene	2.30E-03	3.81E-03	2.32E-03
2-methylnaphthalene	2.30E-03	3.81E-03	2.32E-03
naphthalene	2.30E-03	3.81E-03	2.32E-03
o,m,p-cresol	3.00E-05	1.12E-03	5.69E-04
formaldehyde	1.24E-06	6.46E-05	9.32E-06
phenol	1.50E-05	9.30E-04	4.74E-04

Test EQ Quantitation Limits - Lb/Lb Binder

Analytes	Core Mixing	Core Making	Core Storage
HC as hexane	6.69E-05	1.09E-04	6.57E-05
1-methylnaphthalene	6.69E-05	1.09E-04	6.57E-05
2-methylnaphthalene	6.69E-05	1.09E-04	6.57E-05
naphthalene	6.69E-05	1.09E-04	6.57E-05
o,m,p-cresol	8.73E-07	3.19E-05	1.61E-05
formaldehyde	3.62E-08	1.85E-06	2.64E-07
phenol	4.37E-07	2.66E-05	1.34E-05

Detailed Process Data

Core Sand Mixing Test	1	2	3	4	5	6	7	8	9	10	11	12	13	Average All	Report Average
Date	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02		
Emission test No.	EQ001	EQ002	EQ003	EQ004	EQ005	EQ006	EQ007	EQ008	EQ009	EQ010	EQ011	EQ012	EQ013		
Total coated sand weight, Lbs.	51.4	50.9	50.9	**51.4**	**51.4**	**51.4**	**50.9**	**50.9**	**50.9**	**50.9**	**50.9**	**50.9**	50.9	51.0	**51.0**
Binder weight, Lbs.	0.876	0.875	0.874	**0.876**	**0.875**	**0.876**	**0.875**	**0.875**	**0.876**	**0.874**	**0.875**	**0.875**	0.874	0.875	**0.875**
Calculated % binder (BOS)	1.73	1.75	1.75	1.73	1.73	1.73	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.74	**1.74**
Calculated binder content,%	1.71	1.72	1.72	**1.71**	**1.70**	**1.71**	**1.72**	**1.72**	**1.72**	**1.72**	**1.72**	**1.72**	1.72	1.71	**1.71**
1800 F LOI, %	1.58	1.71	1.72	**1.62**	**1.54**	**1.65**	**1.58**	**1.56**	**1.64**	**1.64**	**ND**	**1.62**	1.60	1.62	**1.61**
Sand temperature, Deg F	84	83	84	**95**	**90**	**90**	**90**	**89**	**88**	**88**	**88**	**89**	90	88	**89.7**
													Note 2	Note 1	Note 1

Core Make Test	1	2	3	4	5	6	7	8	9	Average All	Report Average
Date	9/11/02	9/11/02	9/11/02	9/11/02	9/11/02	9/12/02	9/12/02	9/12/02	9/12/02		
Emission test No.	EQ021	EQ022	EQ023	EQ024	EQ025	EQ026	EQ027	EQ028	EQ029		
Total coated sand weight, Lbs.	212.8	210.9	213.3	200.6	197.4	212.2	212.8	213.7	215.8	209.9	**209.9**
Calculated Total Binder weight, Lbs.	3.71	3.68	3.74	3.51	3.46	3.69	3.70	3.74	3.78	3.7	**3.67**
Calculated % Binder (BOS)	1.745	1.747	1.754	1.750	1.754	1.741	1.738	1.750	1.750	1.748	**1.748**
1800 F LOI, %	1.62	1.60	1.60	1.58	1.56	1.58	1.53	1.56	1.55	1.58	**1.58**
Sand temperature, Deg F	87.4	86.8	87	89	87	87.2	89.2	90.8	89.2	88.5	**88.5**
TEA Injection/cycle, gm/cycle	3.90	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.50	**3.50**
Blow pressure, psi	30	30	30	30	30	30	30	30	30	30.0	**30.0**
Max. Purge Pressure, psi	45	45	45	45	45	45	45	45	45	45.0	**45.0**
Purge duration, sec	20	20	20	20	20	20	20	20	20	20.0	**20.0**
Machine cycles per test	30	30	30	31	29	30	30	30	30	30.0	**30.0**
Ave.core machine cycle time, sec.	65.3	75.7	71.0	95.6	82.6	69.8	66.9	64.6	63.2	72.7	**72.7**
										Note 1	Note 1

Core Storage Test	1	1	1	1	2	2	2	2	3	3	3	3	Average All	Report Average
Date	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02	9/9/02		
Emission test No.	THC1	EQ031	EQ032	EQ033	THC2	EQ034	EQ035	EQ036	THC-3	EQ037	EQ038	EQ039		
Total coated sand weight, Lbs.	7.25	**7.20**	**7.20**	**7.15**	7.25	**7.25**	**7.25**	**7.20**	7.30	**7.30**	**7.25**	**7.25**	7.2	**7.2**
Calculated total binder weight, Lbs.	0.127	**0.126**	**0.126**	**0.125**	0.128	**0.128**	**0.128**	**0.127**	0.128	**0.128**	**0.127**	**0.127**	0.127	**0.127**
Calculated % binder (BOS)	1.748	**1.748**	**1.748**	**1.748**	1.766	**1.766**	**1.766**	**1.766**	1.748	**1.748**	**1.748**	**1.748**	1.754	**1.754**
1800 F LOI, %	ND	**ND**	**ND**	**ND**	1.54	**1.54**	**1.54**	**1.54**	1.57	**1.57**	**1.57**	**1.57**	1.56	**1.56**
Average core weight, Lbs.	7.25	**7.20**	**7.20**	**7.15**	7.25	**7.25**	**7.25**	**7.20**	7.30	**7.30**	**7.25**	**7.25**	7.24	**7.24**
Sand temperature, Deg F	88	**88**	**88**	**88**	85	**85**	**85**	**85**	90	**90**	**90**	**90**	87.6	**87.6**
TEA Injection/cycle, gm/cycle	3.9	**3.9**	**3.9**	**3.9**	3.45	**3.45**	**3.45**	**3.45**	**–**	**--**	**–**	**--**	3.7	**3.7**
Blow pressure, psi	30	**30**	**30**	**30**	30	**30**	**30**	**30**	30	**30**	**30**	**30**	30	**30**
Max purge pressure, psi	45	**45**	**45**	**45**	45	**45**	**45**	**45**	45	**45**	**45**	**45**	45.0	**45.0**
Purge duration, sec	20	**20**	**20**	**20**	20	**20**	**20**	**20**	20	**20**	**20**	**20**	20.0	**20.0**
Ave.core machine cycle time, sec.	81.0	**61.0**	**61.0**	**58.0**	--	**61.0**	**59.0**	**64.0**	–	**62.0**	**85.0**	**84.0**	67.6	**67.6**

Note 1: Report Averages included only validated test for which emission data are used in reporting a result Note 1 Note 1

Average All included all tests even thought they may have been invalidated for a process or emission data reason

Note2: Mix test 13 was stopped prematurely. It will not be used.

APPENDIX C METHOD 25A CHARTS

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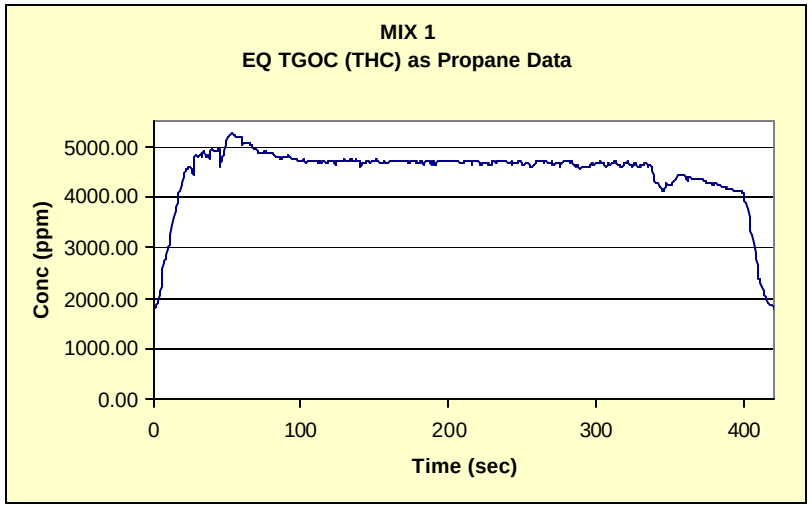
MIX 1
EQ TGOC (THC) as Propane Data
Conc (ppm)
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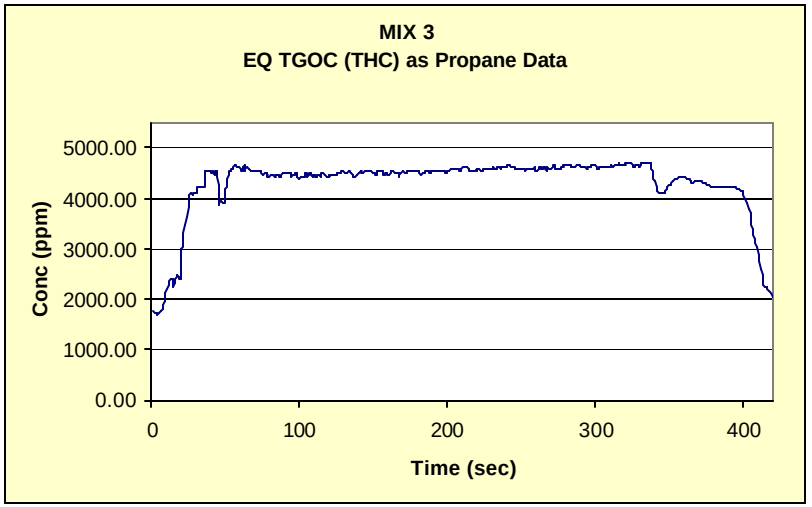
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)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EQ TGOC (THC) as Propane Data
Conc (ppm)
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0.00
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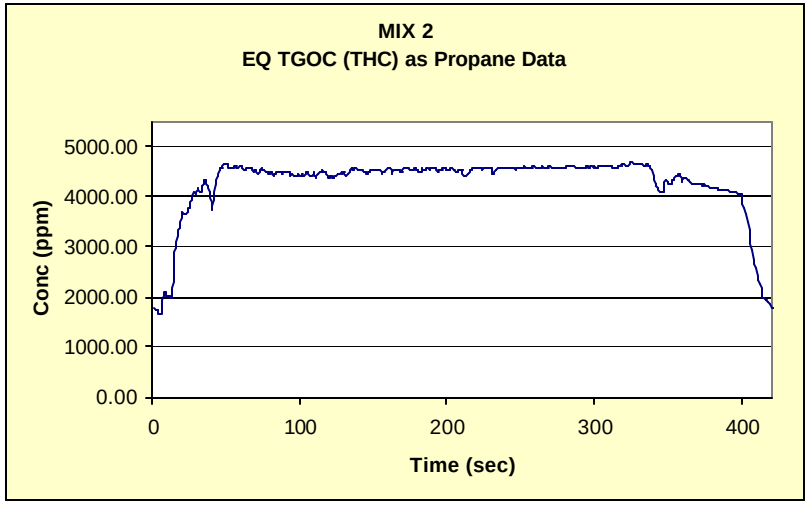
100
200
300
400
Time (sec)


MIX 2
EQ TGOC (THC) as Propane Data
Conc (ppm)
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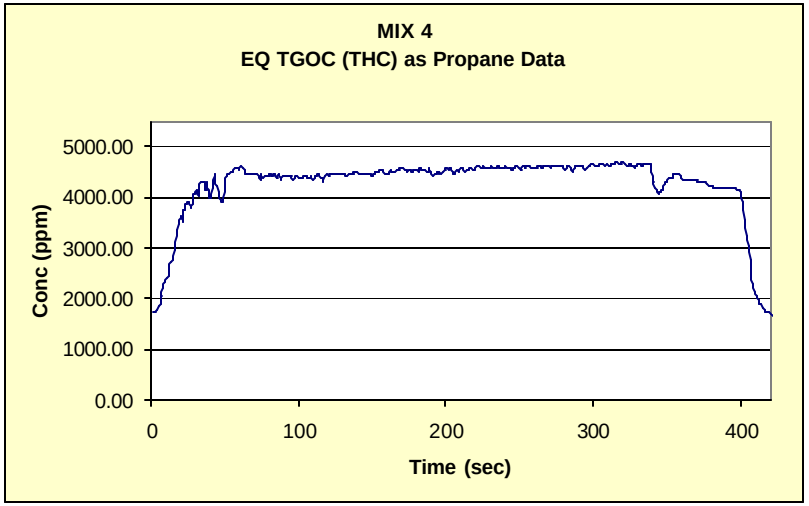
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)


MIX 4
EQ TGOC (THC) as Propane Data
Conc (ppm)
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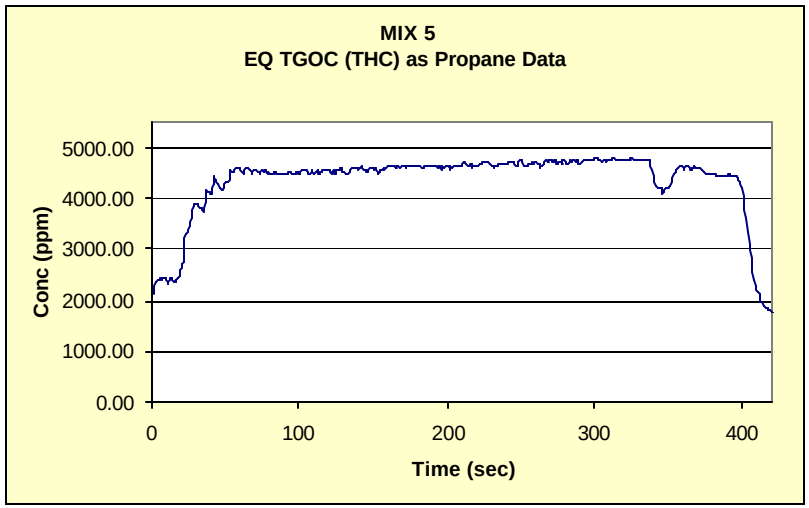
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)


MIX 5
EQ TGOC (THC) as Propane Data
Conc (ppm)
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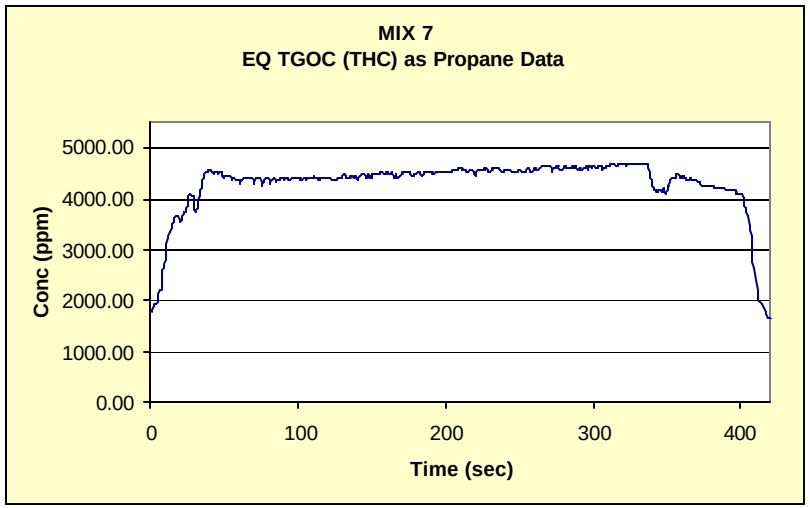
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)


MIX 7
EQ TGOC (THC) as Propane Data
Conc (ppm)
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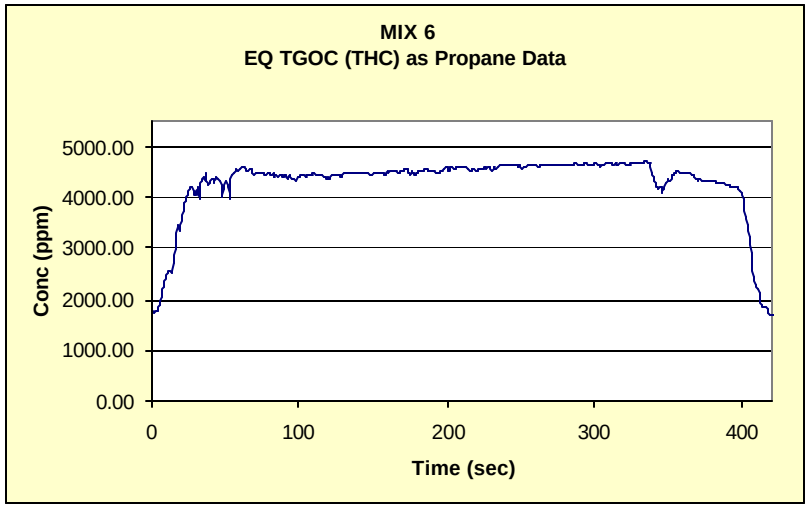
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)


MIX 6
EQ TGOC (THC) as Propane Data
Conc (ppm)
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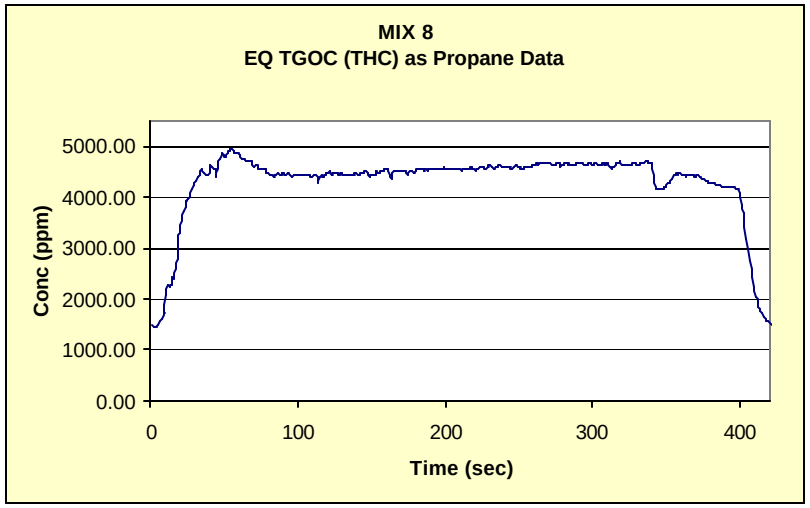
4000.00
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)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EQ TGOC (THC) as Propane Data
Conc (ppm)
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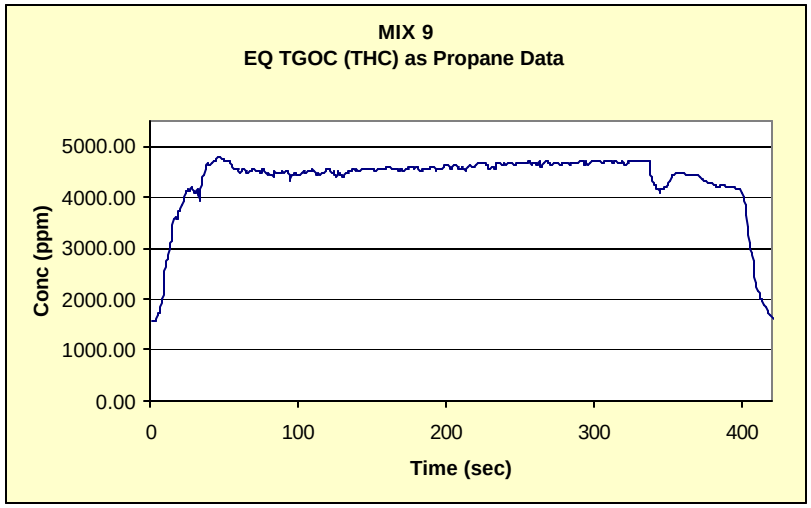
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)


MIX 9
EQ TGOC (THC) as Propane Data
Conc (ppm)
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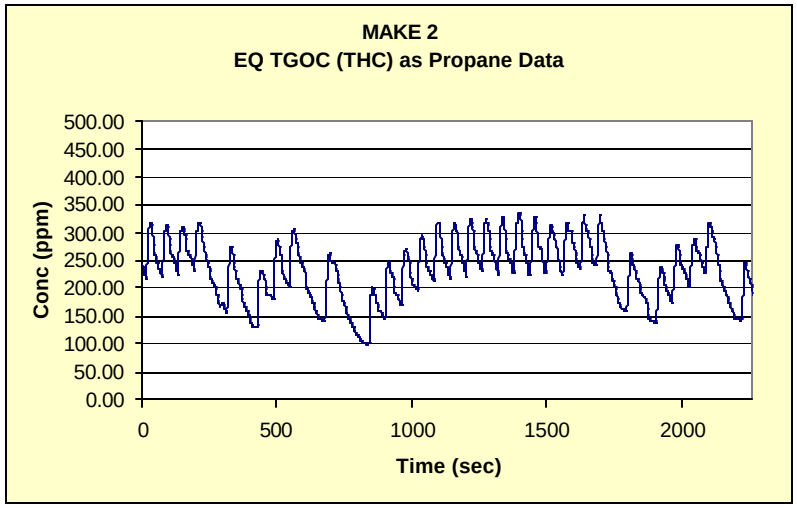
3000.00
2000.00
1000.00
0.00
0
100
200
300
400
Time (sec)


MAKE 2
EQ TGOC (THC) as Propane Data
Conc (ppm)
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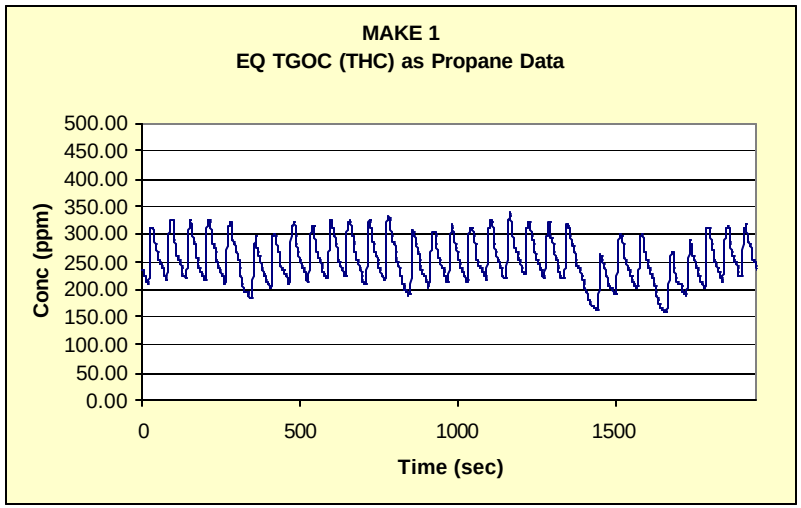
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
2000
Time (sec)


MAKE 1
EQ TGOC (THC) as Propane Data
Conc (ppm)
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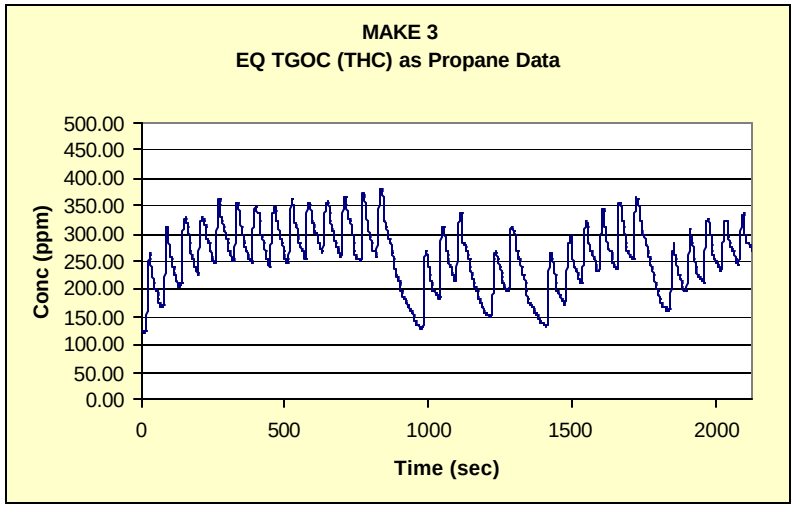
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)


MAKE 3
EQ TGOC (THC) as Propane Data
Conc (ppm)
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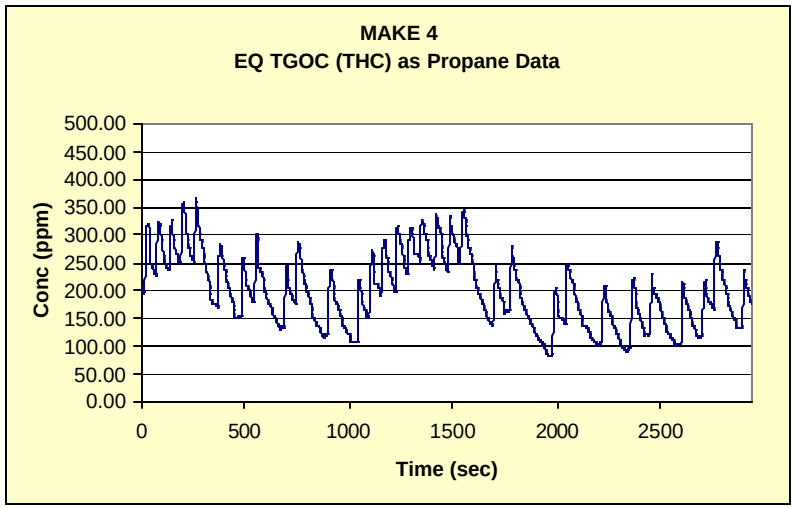
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
2000
Time (sec)


MAKE 4
EQ TGOC (THC) as Propane Data
Conc (ppm)
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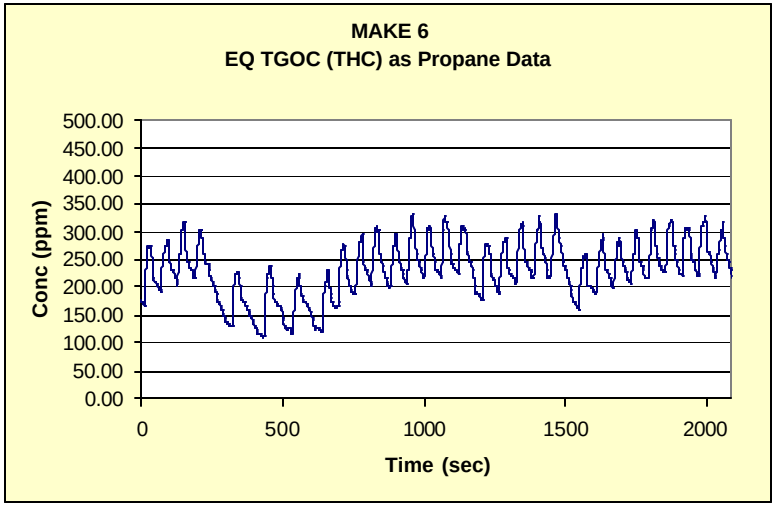
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
2000
2500
Time (sec)


MAKE 6
EQ TGOC (THC) as Propane Data
Conc (ppm)
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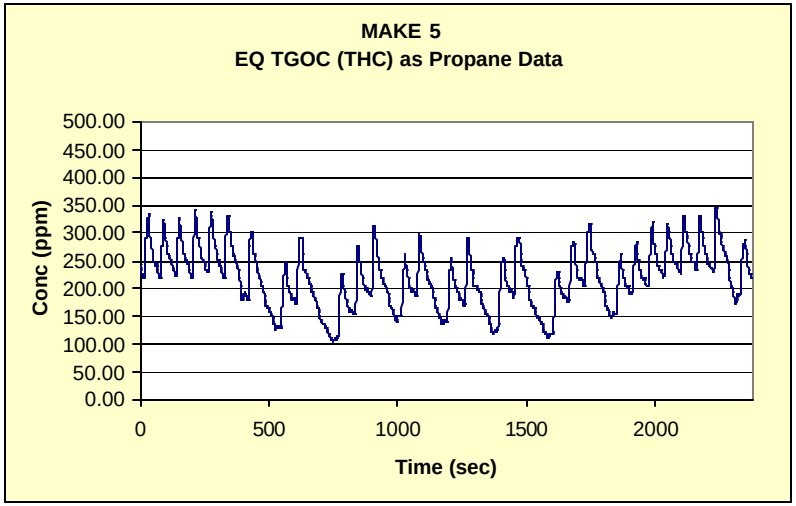
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
2000
Time (sec)


MAKE 5
EQ TGOC (THC) as Propane Data
Conc (ppm)
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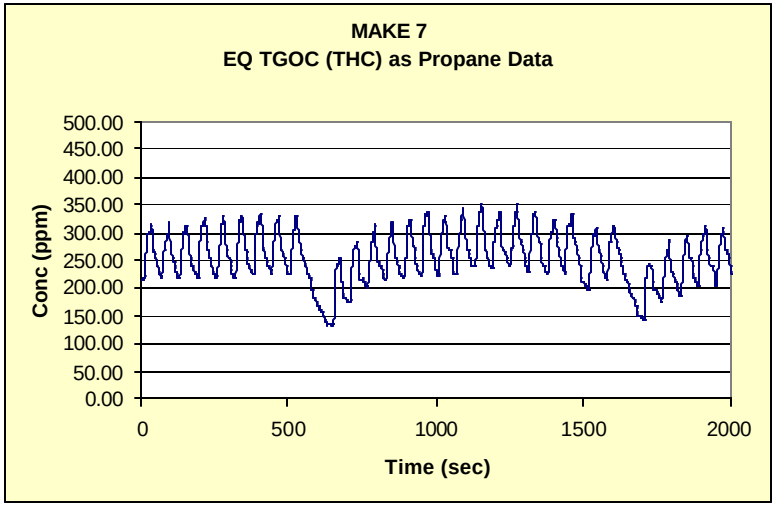
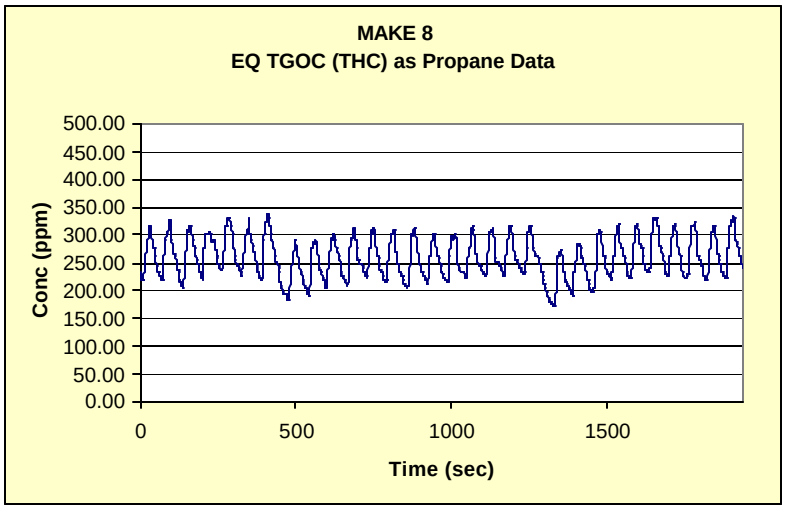
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
2000
Time (sec)


MAKE 7
EQ TGOC (THC) as Propane Data
Conc (ppm)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
2000
Time (sec)


MAKE 8
EQ TGOC (THC) as Propane Data
Conc (ppm)
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400.00
350.00
300.00
250.00
200.00
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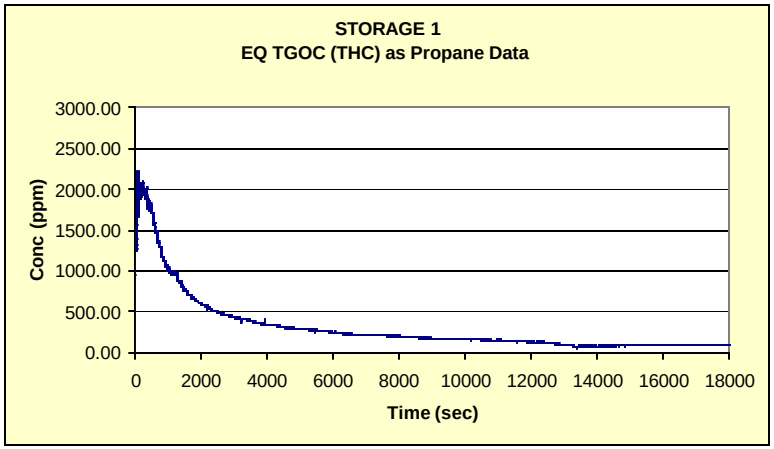
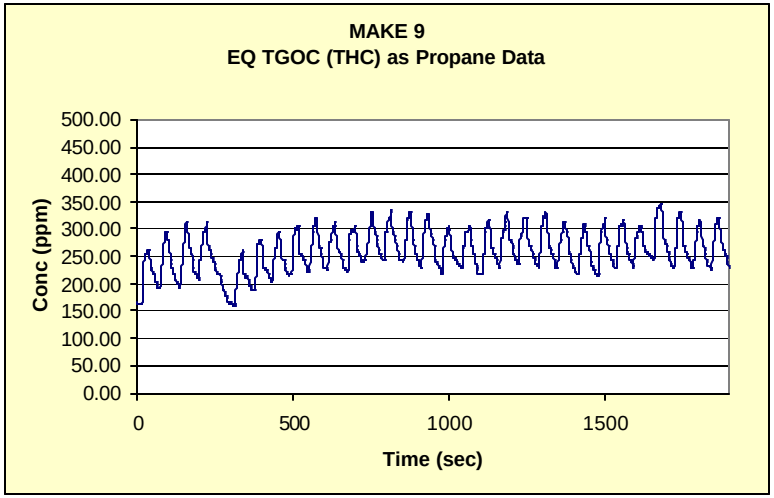
50.00
0.00
0
500
1000
1500
Time (sec)


STORAGE 1
EQ TGOC (THC) as Propane Data
Conc (ppm)
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Time (sec)


MAKE 9
EQ TGOC (THC) as Propane Data
Conc (ppm)
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400.00
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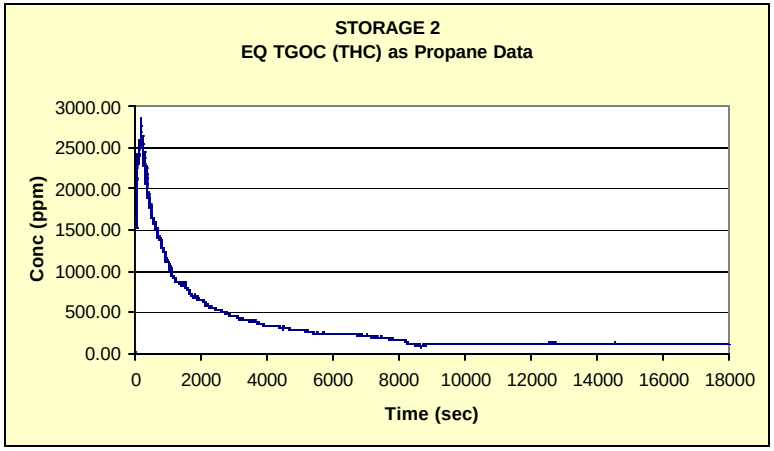
200.00
150.00
100.00
50.00
0.00
0
500
1000
1500
Time (sec)


STORAGE 2
EQ TGOC (THC) as Propane Data
Conc (ppm)
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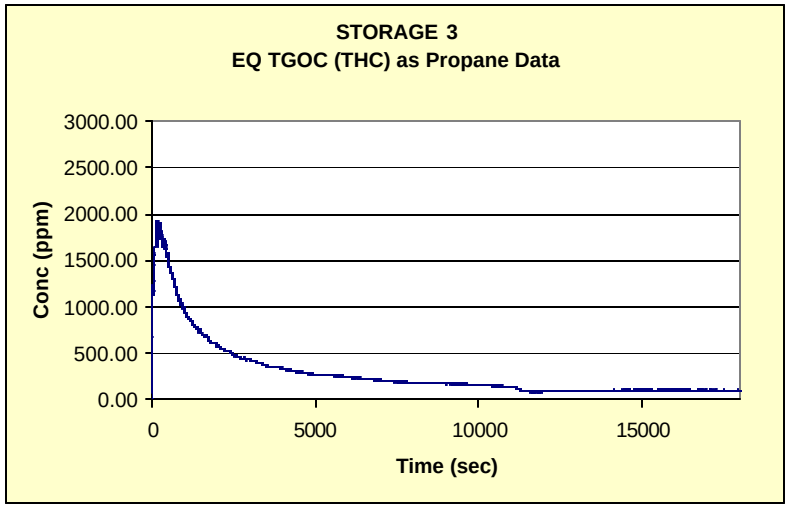
2500.00
2000.00
1500.00
1000.00
500.00
0.00
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Time (sec)


STORAGE 3
EQ TGOC (THC) as Propane Data
3000.00
2500.00
2000.00
1500.00
1000.00
500.00
0.00
Conc (ppm)
0
5000
10000
15000
Time (sec)

APPENDIX D GLOSSARY

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ND	Non Detect
NA	Not Applicable
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.
BOS	Based on Sand
Binder	Part 1 plus Part II