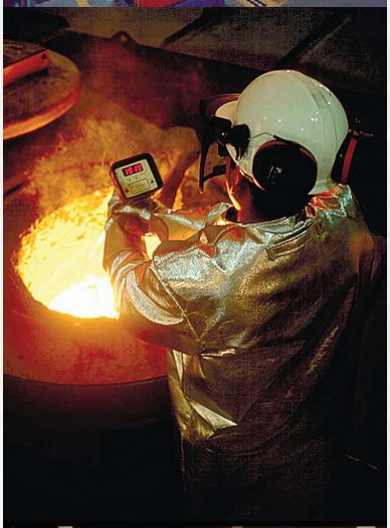
Casting Emission Reduction Program

www.cerp-us.org



Operated by

TECHNIKON

5301 Price Avenue
McClellan, CA 95652
916-929-8001
www.technikonllc.com

US Army Contract W15QKN-05-D-0030
FY2005 Tasks
WBS # 1.2.5

Waste Characterization of Various Sand Binder Systems from Foundry Processes

1412-125 NA

September 2007
(*Revised for public distribution - December 2007)*

CASTING INDUSTRY SUPPLIERS ASSOCIATION

AMERICAN FOUNDRY SOCIETY

ARMAMENT RESEARCH, DEVELOPMENT & ENGINEERING CENTER, PICATINNY, NJ

UNITED STATES COUNCIL FOR AUTOMOTIVE RESEARCH

DAIMLERCHRYSLER

Ford

GM General Motors

this page intentionally left blank

Waste Characterization of Various Sand Binder Systems from Foundry Processes

1412-125 NA

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

Project Manager	*//Original Signed//* Jodie Crandell	_____ Date
V.P. Operations	*//Original Signed//* George Crandell	_____ Date

The data contained in this report were developed to characterize and classify waste sands generated from foundry processes employing various sand binders. You may not obtain the same results in you facility. These data should not be used to characterize your foundry's sand waste streams.

this page intentionally left blank

Table of Contents

List of Figures and Tables

this page intentionally left blank

Executive Summary

This report provides information on waste sampling and analysis data from waste molding and core sands produced during testing at Technikon, LLC. The sands were used in testing the emissions characteristics of various resin systems for metal casting operations.

The data show that none of the Technikon waste sands tested exceed regulatory thresholds for characterization as a hazardous waste under Federal or California applicable regulations. In other words, these waste sands are non-hazardous and can be re-used or disposed of as non-hazardous.

The data contained in this report were developed to characterize and classify waste sands generated from foundry processes employing various sand binders. You may not obtain the same results in you facility. These data should not be used to characterize your foundry's sand waste streams.

this page intentionally left blank

1.0 INTRODUCTION

1.1. CERP Background and Objectives

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 point source 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). The parties to the CERP Cooperative Research and Development Agreement (CRADA) include The Environmental Leadership Council of USCAR, a Michigan partnership of DaimlerChrysler Corporation, Ford Motor Company, and General Motors Corporation; the U.S. Army Research, Development, and Engineering Command (RDECOM-ARDEC); the American Foundry Society (AFS); and the Casting Industry Suppliers Association (CISA). The US Environmental Protection Agency (US EPA) and the California Air Resources Board (CARB) also have been participants in the CERP program and rely on CERP published reports for regulatory compliance data. All published reports are available on the CERP web site at www.cerp-us.org.

1.2. CERP/Technikon Objectives

The primary objective of CERP is to evaluate materials, equipment, and processes used in the production of metal castings. Technikon's facility was designed to evaluate alternative materials and production processes designed to achieve significant air emission reductions. The facility's principal testing arena is designed to measure airborne emissions from individually poured molds. This testing facility enables the repeatable collection and evaluation of airborne emissions and associated process data.

1.3. Report Organization

This report has been written to document the methodology and results of activity that

evaluated the waste characteristics of sand resulting from metal casting operations using various sand binder systems.

Section 2.0 of this report includes a summary of the procedures used for waste sand sample collection. Specific data collected for this report are summarized in Section 3.0. Section 4.0 of this report contains a discussion of the results.

1.4. Study Objectives

The objective of this study is to evaluate the waste analysis characteristics of sands used for metal casting operations using various binder systems. This information is important for foundries that are considering incorporating the use of a new binder system in their operations. Knowing the impact of a different binder system on the characteristics of waste sand streams is critical in making this decision.

2.0 SCOPE OF STUDY

2.1. Description of Sampling Methods, Sand Sampled and Analysis of Waste Samples

This study involved the waste characterization of various sand binder systems. Six systems were chosen for analysis from Technikon emissions tests. These binders systems were chosen as representative of the commercially available binder systems in the United States. Cores made using a particular binder system were placed in molds and poured with either iron or aluminum. After shakeout, the sand was segregated in a hopper and kept separate from other tests sands. The binder system used in each sample and the type of metal that was poured are included in Table 2-1.

The waste sands generated from CERP testing here sampled and analyzed by following the Technikon waste sampling and analysis protocol in Appendix A. The sands were not tested for pH.

The primary objective of the sampling and analysis protocol (SAP) followed is to obtain samples that are representative of the medium being investigated and suitable for subsequent analysis. More specifically, the objective of the SAP is to acquire information in the most scientifically credible manner to assist in the environmental characterization of the waste streams generated from pouring, cooling and shakeout of casting using the various binder systems. The sampling techniques and analytical procedures are consistent with Technikon's SAP and the results are accurate and responsive to all applicable regulatory and scientific criteria.

Table 2-1 Summary of Metals and Binder Systems

Waste ID	Resin, Coating and Sand information	Type of Emissions Test
HD	Lampe LK700-403 Beach Box®; 2.5% Based on Sand (BOS) in Iron; Ashland Weissfilm® coating; Sand type – Wedron 530	PCS
HK	Sigma Cure® 7227-7707; EX74522/75869; EX76210/76211 at 1.1% BOS; in aluminum; no coating; Sand type – Wedron 530	PCS
HL	Isocure® LF305/52-904GR, using Rheotec® XL+ and Rheotec® 204P coating in iron	PCS
HM	Fairmount 630BN Gold® shell binder at 3.0% BOX in iron; no coating; sand type – Wexford 450 Lakesand with 7.0 Western and Southern Bentonite	PCS
HP	Ecolotec® 750 at 2.0% BOS in aluminum; no coating; Sand type – Wedron 530	PCS
HQ	Low odor GM Bond® formulation in aluminum, no coating; sand type – Wexford 450 Lake Sand	PCS

PCS=Pouring, Cooling, Shakeout

Upon receipt at the laboratory, each of the Technikon samples underwent the following analytical procedures:

- Percent moisture
- Zero Headspace extraction per SW846-1311
- TCLP Extraction per SW846-1311
- TCLP Volatiles per SW846-8260B
- TCLP Semi-volatiles per SW846-8270C
- TCLP metals per SW846-6010B/74

3.0 STUDY RESULTS

Tables 3-1 through 3-4 present the results from the analyses performed on the waste samples.

Table 3-1 GC/MS Semivolatiles

Test Sample	HP	HQ	HK	HD	HL	HM	Federal Regulatory Level
Analyte							
1,4-Dichlorobenzene	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	7.5
2,4,5-Trichlorophenol	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	400
2,4,6-Trichlorophenol	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	2
2,4-Dinitrotoluene	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	0.13 *
o-Cresol	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	200
m-Cresol	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	200
p-Cresol	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	200
Hexachlorethane	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	3
Hexachlorobenzene	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	0.13 *
Hexachlorobutadiene	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	0.5
Nitrobenzene	<0.57	<0.50	<0.50	<0.50	<0.50	<0.50	2
Pentachlorophenol	<2.80	<2.50	<2.50	<2.50	<2.50	<2.50	100
Pyridine	<1.10	<1.00	<1.00	<1.00	<1.00	<1.00	5.0 *

Units in mg/l

* Quantitaion limit is greater than the calculated regulatory limit. The quantation limit therefore, becomes the regulatory limit (40CFR 261.24, Table 1

Table 3-2 TCLP GC/MS Volatiles

Test Sample	HP	HQ	HK	HD	HL	HM	Federal Regulatory Level
Analyte							
1,1-Dichloroethene (Dichloroethylene)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.7
1,2-Dichloroethane	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.5
2-Butanone (Methyl Ethyl Ketone)	<0.120	<0.120	<0.120	<0.120	<0.120	<0.120	200
Benzene	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.5
Carbon tetrachloride	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.5
Chlorobenzene	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	100
Chloroform	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	6
Tetrachloroethene (Tetrachloroethylene)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.7
Trichloroethylene	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.5
Vinyl chloride	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.2

Units in mg/l

Table 3-3 TCLP Metals

Test Sample	HP	HQ	HK	HD	HL	HM	Federal Regulatory Level
Metal							
Arsenic	0.021 B	<1.0	<1.0	<1.0	<1.0	<1.0	5.0
Barium	0.19 B	0.22 B	0.23 B	0.25 B	0.22B	0.22 B	100.0
Cadmium	0.0021 B	<0.050	0.0025 B	0.0020 B	0.0029 B	<0.050	1.0
Chromium	0.0031 B	0.0030 B	<0.10	0.016 B	0.012 B	0.010 B	5.0
Lead	<0.50	<0.50	0.022 B	<0.50	0.0098 B	<0.50	5.0
Mercury	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.2
Selenium	0.026 B,J	<0.050	<0.050	0.023 B,J	0.029 B,J	<0.050	1.0
Silver	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	5.0

Units in mg/l

B=Estimated result. Result is less than reporting limit

J=Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Analysis performed in accordance with US EPA Toxicity Characteristic Leaching Procedure Method 1311

Table 3-4 Percent Moisture

Test Sample	HP	HQ	HK	HD	HL	HM
Percent Moisture	0.89	0.96	0.15	0.61	0.70	1.40

4.0 CONCLUSIONS

The data show that none of the Technikon waste sands tested exceed regulatory thresholds for characterization as a hazardous waste under Federal or California applicable regulations. In other words, these waste sands are non-hazardous and can be re-used or disposed of as non-hazardous.

this page intentionally left blank

APPENDIX A TECHNIKON WASTE SAMPLING AND ANALYSIS PROTOCOL

this page intentionally left blank

TECHNIKON

WASTE SAMPLING, ANALYSIS and CLASSIFICATION PROTOCOL

WASTE SAMPLING, ANALYSIS AND CLASSIFICATION PROTOCOL

1.0 INTRODUCTION

This Waste Sampling Analysis Protocol (SAP) was developed to sample and analyze waste streams generated at Technikon.

The objective of the SAP is to obtain the most accurate scientific information based on the samples and the laboratory findings, characterize the waste stream, and dispose of it properly.

This Protocol meets all Federal and State regulatory requirements for waste analysis, sampling and transporting and disposal. The applicable regulations and methods are listed in the following table.

APPLICABLE REGULATIONS		
Environmental Protection Agency – Region 9	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods	SW-846
Code of Federal Regulations	Protection of the Environment	40 CFR, Parts 261-268
Code of Federal Regulations	Transportation	49 CFR, Parts 172-179
California Code of Regulations	Identification and Listing of Hazardous Waste	22 CCR §66261.1 – 66261.126
California Code of Regulations	Representative Sampling Methods	22 CCR Appendix I
California Code of Regulations	Waste Extraction Test (WET) Procedures	22 CCR Appendix II
California Code of Regulations	Chemical Analysis Test Methods	22 CCR Appendix III
American Society of Testing Materials	"RCRA Waste Management, Protocoling, Implementation, and Assessment of Sampling Activities	ASTM MNL-42

2.0 WASTE STREAM IDENTIFICATION

The waste streams to be covered by this sampling Protocol are listed in the Technikon Waste Identification document.

The reference document "Technikon Waste Identification" is maintained at the Technikon Facility.

Each waste stream created at Technikon will be characterized using generator knowledge if applicable. If laboratory analysis is required, the sample and analysis Protocol (Section 3.0 below) applies.

For sand waste streams, all sand related to a specific CERP test will be placed in a covered container and staged until the appropriate sample can be obtained for laboratory analysis and a disposal method is determined.

3.0 SAMPLE AND ANALYSIS PROTOCOL

Sample Collection

For sand, a container will be used to segregate all the sand used for each different CERP test. The container will be labeled with the CERP Subtask number and CERP Double Alpha Identification. The sampling method used is the "random sampling within blocks" method, described in the next 2 paragraphs.

By dividing the waste into strata or sections, the given number of samples within a given sample size often results in a more precise estimate of chemical properties of the waste.

The container will be divided into 12 equal sections that comprise a "grid". A random sample will be taken from each section of the grid (see Figure 1).

A hand held metal scoop will be used to take the samples.

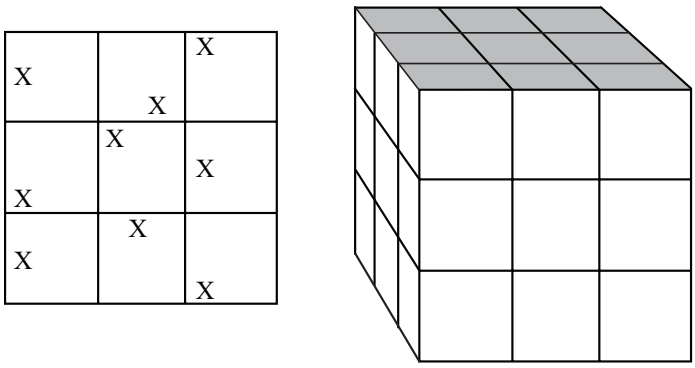


Figure 1 Random Sampling Sections for Sand Waste Streams

For all other waste streams requiring analysis for waste characterization, one (1) grab sample will be collected from the accumulation container.

All sampling personnel will wear new disposable gloves for protection against exposure to contaminated media, and to minimize the potential for cross-contamination. Samples will be collected by placing the material directly into new, pre-cleaned 1-Liter glass jars supplied by the laboratory. The jars will be sealed with Teflon-coated plastic lids.

After the sample container has been filled, a sample label will be adhered to the container to prevent misidentification of samples and to ensure that the samples are not disturbed during transportation to the laboratory.

The samples will then be placed directly into an iced cooler until presented to the laboratory for analysis. The samples will be presented to the laboratory for the analytical parameters outlined discussed in the next Section.

After the samples have been collected, properly labeled, and placed into an iced cooler, the Chain of Custody form will be completed.

Toxicity Testing and Analysis

Samples will be characterized using the Toxicity Characteristic Leaching Procedure (TCLP) test method 1311 referenced in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846. However, in California the Maximum Concentration of Contaminants for the Toxicity Characteristic is called the Total Threshold Limit Concentration (TTLC). Both tests use EPA method mentioned above, but in California when any target analyte exceeds the TTLC limits, the waste is classified as hazardous and its waste code is determined by the compound(s) that failed TTLC. In addition, the following analyses will be performed:

- Neutral Leachate preparation/inorganic analytes by appropriate USEPA methodology.
- PH will be recorded by appropriate USEPA methodology (as needed)
- Quality Assurance/Quality Control (QA/QC) documentation required by SW-846

Severn Trent Laboratories (STL) will perform all laboratory testing for the Sample and Analysis Protocol. Laboratory testing will be performed with a standard turnaround time of 14 working days.

APPENDIX B ACRONYMS AND ABBREVIATIONS

this page intentionally left blank

Acronyms and Abbreviations

CERP	Casting Emission Reduction Program
CFR	Code of Federal Regulations
MSDS	Material Safety Data Sheet
NA	Not Applicable; Not Available
ND	Non-Detect; Not detected below the practical quantitation limit
PCS	Pouring, Cooling, Shakeout
SAP	Sampling and Analysis Protocol
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound