Casting Emission Reduction Program

Prepared by:
TECHNIKON LLC
5301 Price Avenue ▼ McClellan, CA, 95652 ▼ (916) 929-8001
www.technikonllc.com

US Army Task N256

Melt Test
CERP Test Source

Technikon # WBS 1241 EE

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This document was revised for unlimited public distribution.

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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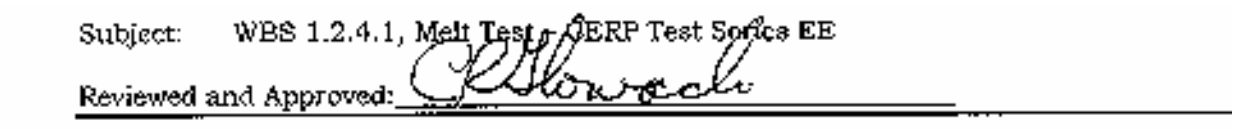

The data contained in this report were developed to assess the relative emissions profile of the product or process being evaluated. You may not obtain the same results in your facility. Data was not collected to assess casting quality, cost, or producibility.

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Summary:

The objectives of this test series were twofold. The first objective was to measure volatile organic compound (VOC) and organic hazardous air pollutant (HAP) emissions produced from the charging, melting, and tapping of induction melted gray iron charged with a mixture of approximately 70% coatings-free iron, and 30% cleaned and oil-free cast iron, to form an induction melting baseline. The second objective was to measure the same emissions from a paint-coated steel charge of the same proportion.

The following emissions (in Pounds per Ton of Metal) were determined for the unpainted, clean iron charged runs (EE001 and EE002), and for the painted iron charged run (EE003).

	EE001 (unpainted)	EE002 (unpainted)	EE003 (painted)
HC as Hexane	0.119	0.118	0.148
Benzene	ND	ND	0.005
Toluene	ND	ND	ND
Ethylbenzene	ND	ND	ND
m- & p–Xylene	ND	ND	ND
o–Xylene	ND	ND	ND

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

Introduction, Background, and Objectives:

Induction-melting VOC and organic HAP emissions were collected on sorbent tubes and analyzed for total hydrocarbons expressed as hexane, and for the BTEX compounds, benzene, toluene, Ethylbenzene, Meta- and Para- Xylene, and Ortho- Xylene. The method used is based on NIOSH Method 1500. This testing was performed to develop an induction-melting baseline. No molds were poured for this test series. Instead, a multi-cycle charge, melt, and tap sequence was used at the induction furnace to generate emissions. This cycle was performed over a two-hour period. The furnace was charged with clean gray iron for the first two runs using the ratio shown in Table 1. This table also shows the charge used for the third run that included painted metal.

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

Experimental:

In the Production Foundry, an InductoTherm Induction Furnace was pre-heated with 2600 lbs of gray iron and then tapped prior to the start of the first test run. The furnace was then charged with a mixture of gray iron foundry returns and clean scrap iron. Over the course of an approximately two (2) hour period, the furnace was charged a total of four times, and then tapped a total of four times. This cycle was repeated for the second test run. The third test run utilized gray iron foundry returns, clean scrap iron, and painted scrap iron to charge the furnace. Table 1 summarizes the amounts of each type of metal used for this melt test.

Table 1: Types of Metal Used to Charge the Induction Furnace (Lbs)

	Time	Grey Iron	Clean Iron	Painted Iron	Charge Amount	Tap Amount
Test #1	08:32	406	911	0	1317	---
	09:05	394	904	0	1298	---
	09:15	389	910	0	1299	---
	09:25	408	904	0	1312	---
	09:55	---	---	----	---	1306
	10:03	---	---	----	---	1307
	10:10	---	---	----	---	1306
	10:17	---	---	----	---	1307
Test #2	11:15	387	892	0	1279	---
	11:45	412	881	0	1293	---
	11:54	383	917	0	1300	---
	12:03	364	902	0	1266	---
	12:35	---	---	----	---	1280
	12:42	---	---	----	---	1290
	12:50	---	---	----	---	1280
	12:57	---	---	----	---	1288
Test #3	13:09	395	516	364	1275	---
	13:51	412	504	376	1292	---
	14:00	382	542	368	1292	---
	14:20	418	486	404	1308	---
	14:54	---	---	---	---	1292
	15:01	---	---	---	---	1292
	15:08	---	---	---	---	1292
	15:13	---	---	---	---	1291

The volumetric flow rate of the stack was measured according to USEPA Methods 1 and 2, and the moisture content according to USEPA Method 4. The tip of a heated sample probe and sampling manifold was located in the centroid of the stack to collect samples of the charging, melting and tapping emissions. Sorbent tubes were placed in each active channel of the sampling manifold. The sampling flow rate of each tube was controlled with a critical orifice.

Samples were collected on activated charcoal sorbent tubes at a single flow rate of 500ml/min, corresponding to a sample volume of 60 liters.

Results:

The raw data for all detected compounds for this test series are located in appendices maintained in the Technikon offices.

Method results showed that HC as Hexane was detected for all three test runs. There was good agreement between the first two test runs that were charged with clean iron. HC as Hexane was detected at concentrations of 0.119 and 0.118 (Lbs/Ton of Metal), respectively. None of the BTEX compounds were detected in the first two test runs. For the third test run, the furnace was charged with gray iron foundry returns and a mixture of clean and painted scrap iron. Approximately 30% of the total charge was painted iron. Results for this test run showed HC as Hexane detected at 0.148 (Lbs/Ton of Metal), an increase of 25% over the first two runs without painted iron. In addition, benzene was detected at 0.005 (Lbs/Ton of Metal). No other BTEX compounds were detected in the third test run.

Discussion:

The data shows that VOCs are generated during iron melting operations. More VOCs and organic HAPs are produced during melting activities with painted scrap iron compared to clean scrap or gray-iron re-melt.