Casting Emission Reduction Program

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US Army Task N256

Core Room Monitoring

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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

WORKER SAFETY
Core Room Monitoring

WBS 4.2.1

26 April 2001

A. Summary

This technical memorandum presents the results of the worker exposure sampling that was performed in the core production area of the Technikon Production Foundry, located in McClellan, California. The purpose of the sampling was to measure worker exposures to selected airborne contaminants during the core production process, to assess the significance of the measured exposures relative to established health based criteria, and to establish a baseline for worker exposure from a typical binder system against which low emission binder systems may be compared.

The worker exposure monitoring was conducted during core production on March 16, 2001. Sampling was performed for triethylamine and aromatic petroleum distillates. All employee exposures to triethylamine and aromatic petroleum distillates were found to be below the appropriate Federal and California limits except the core handler in the core room. This employee's potential 8-hour time weighted average (TWA) was 7.2 ppm compared to the California Permissible Exposure Limit (PEL) of 1.0 ppm. This employee was wearing a negative pressure full-face respirator while in the core room; therefore, his actual exposure to triethylamine was well below the PEL. All short term exposure limit (STEL) samples were below the appropriate regulatory limits.

B. Core Production Process

The core production process begins on the second level of the core process area. Sand is delivered to the core sand heater/cooler through the pneumatic sand delivery system.

After processing through the heater/cooler, the sand enters the core sand mixer, where it is mixed with the resin binder system. The baseline binder system being used at the Technikon Production Foundry is a two-part ISOCURE® system, manufactured by Ashland Specialty Chemical Company. This system consists of ISOCURE® I LF 305 (phenolic resin with solvents) and ISOCURE® II 52-904 (Polymeric MDI type diisocyanate with solvent). These products present the potential for worker exposures to the solvents that off-gas during core sand mixing, core processing and core storage activities. Airborne exposures to these toxic substances may cause health effects in exposed workers. This resin system was selected for baseline testing because it is considered to represent the "Worst-Case" scenario for potential worker exposures to chemical contaminants.

During core production, onc (1) operator is typically responsible for overseeing the operation of the core sand delivery system, core sand heater/cooler and the core sand mixer.

After the core sand is mixed with the resin binder system, an aliquot of the mixture passes into the core machine, where it is processed and compressed into the components

of a core. During the compression phase, triethylamine (TEA) vapor is blown through the core as a catalyst for the ISOCURE® binder system. The primary core machine is enclosed in an environmental enclosure that is designed to capture chemicals that off-gas from the core making process (solvents, and triethylamine). Some fugitive emissions from the core making process are suspected to occur, especially as the environmental enclosure opens and the cores are conveyed out of the machine. One operator typically oversees the operation of the core machine. This individual operates the core machine from the operator station on the West Side of the core machine. In addition to operating the core machine, the operator also removes the cores as they pass out of the core machine and places them on the conveyor that transports them into the adjacent core storage room.

In the core storage room, one or two workers (core handlers) remove the cores from the conveyor and place them on storage carts. To allow the binder system to cure properly, the core storage room is environmentally controlled (temperature and relative humidity) and operates under it's own heating, ventilation, and air conditioning (HVAC) system. When the cores have cured sufficiently, they are removed from the core storage room, banded and stocked for use at the mold line. Due to the off gassing of chemicals (solvents and TEA) that occurs in the core storage room, the core handlers have the potential of exposure to these chemicals. To control potential inhalation hazards, workers in the core storage room are currently provided with negative pressure air purifying respirators, equipped with organic vapor cartridges.

C. Worker Exposure Air Sampling Strategy

Based on the recognized chemicals that are used in the core production process, and their potential to cause health effects, the following chemicals of concern were identified for sampling:

- Aromatic Petroleum Distillates: These chemicals are used as solvents in the ISOCURE® binder system and they may be present in the work area through off gassing from the liquid product or from the cores themselves. Samples were collected on activated charcoal and analyzed according to NIOSH 1500 for total aromatic petroleum distillates (TAPD). The analytical results are compared to the permissible exposure limit (PEL) for Stoddard Solvent (525 mg/m3) as established by the California Occupational Safety and Health Administration (Cal/OSHA). There is no Short Term Exposure Limit (STEL) for Stoddard Solvent.

- Triethylamine (TEA): This is the catalyst for the ISOCURE® binder system. Although considerable capture of this vaporous chemical occurs within the core machine environmental enclosure, this vapor continues to off-gas from the cores during the curing period. Samples were collected on silica gel and analyzed according to NIOSH 2010. The analytical results are compared the California PEL of 1.0ppm and the STEL of 4.1 ppm.

The sampling strategy included collecting:

- Integrated, work shift personal air samples, to quantify potential worker exposures to each of the contaminants of concern;

- Short-term exposure limit (STEL) samples, to evaluate the potential for short term worker exposures; and

- Area air samples, to evaluate the worker exposure potential associated with background core room concentrations.

All sampling was performed in accordance with established sampling methods. The sampling was supervised by a Technikon certified industrial hygienist (CIH). Actual sample collection was conducted by a Technikon chemist. The samples were collected using battery powered air sampling pumps to draw air through the specified sampling media at an appropriate sample flow rate. The sampling pumps were calibrated using a primary standard calibrator.

At the completion of sampling, the collection media was sealed, stored on ice (as appropriate) and shipped, along with completed chain-of-custody records to Clayton Group Services, an AIHA accredited laboratory.

D. AIR SAMPLING RESULTS

The worker exposure samples were collected during one core production run that occurred on March 16, 2001. Sampling was initiated at approximately 9:35 a.m. and continued until 2:30 p.m. During that time approximately ten (10) tons of sand and approximately 175 pounds of binder were processed into cores and stored in the core storage area.

The results of the personal air monitoring for aromatic petroleum distillates (APD) and triethylamine (TEA) are presented in Table 1. All employees' actual exposures were found to be below Federal and California regulatory limits. The employee working in the core room transferring freshly made cores from the conveyer belt to storage racks had a potential exposure above the California PEL for triethylamine, however, he wore a negative pressure respirator with organic vapor cartridges while in the core room. This resulted in an actual employee exposure well below the PEL.

The results of the area samples are also presented in Table 1. These data show that employees working in the core room may encounter triethylamine concentrations high enough to exceed the California PEL.

E. QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

The overall QA/QC objective of the worker exposure monitoring program was to ensure the precision and accuracy of the data generated during the project. The QA/QC procedures that were used during this monitoring program are described below.

- Sampling was conducted during representative operational conditions.
- All sampling was performed under the supervision of a certified industrial hygienist (CIH).
- Sampling flow rates were calibrated using a DriCal primary standard calibrator.
- One field blank sample was prepared and submitted to the laboratory for each of the selected analytical methods.
- Sample specific information was recorded during sampling. Copies of the forms are included in Appendix A.
- Chain-of-custody (COC) procedures were adhered to during sample recovery and submittal to the analytical laboratory.

F. CONCLUSIONS

The following conclusions are drawn based upon the results of the worker exposure sampling that was performed in the core production area of the Technikon Production Foundry (CERP), located in McClellan, California.

- All employee exposures to aromatic petroleum distillates were below applicable Federal and California regulatory limits.
- All potential employee exposures to triethylamine were below the applicable Federal and California regulatory limits except for the core handler in the core room.
- All actual employee exposures to triethylamine were below applicable Federal and California regulatory limits because the core handler was wearing a negative pressure respirator with an organic vapor cartridge while in the core room.
- Area samples collected in the core room support the personal sampling data that suggests that the core is an area of potential employee overexposure to triethylamine

F. RECOMMENDATIONS

The following recommendations are made based upon the results of the worker exposure monitoring that was conducted during core production on March 16, 2001 at the Technikon Foundry located in McClellan, California.

- Respiratory protection should be worn be all employees entering the core room during core production activities if that employee is expected to be in the room longer than one (1) hour in any eight (8) hour period.
- Efforts should be made to reduce the triethylamine concentration in the core room when cores are being produced through increased ventilation or other engineering modifications.

TABLE 1

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Personal and Area Exposure Monitoring Results
Core Making Operation

Name	Employee Number	Work Area	Date and Time of Sampling	Personal Exposure Monitoring Results 8-hr TWA[1]		Personal Exposure Monitoring Results STEL		Cal OSHA Permissible Exposure Limit (PEL) 8-hr TWA		Cal OSHA Short Term Exposure Limit (STEL)		Area Monitoring Results	
				Aromatic Petroleum Distillates	Triethyl amine	Aromatic Petroleum Distillates	Triethyl amine	Aromatic Petroleum Distillates	Triethyl amine	Aromatic Petroleum Distillates	Triethyl amine	Aromatic Petroleum Distillates	Triethyl amine
J. McCully	69	Core Assembly	3/14/01	3.3	0.1	1.3	0.1	525	1.0	NA	4.1		
J. Snider	76	Core Room	3/14/01	61.3[2]	7.2[2]	46.7[2]	3.0[2]	525	1.0	NA	4.1		
D. Draper	60	Mixer	3/14/01	1.3	0.1	1.3	0.03	525	1.0	NA	4.1		
F. Girocco	83	Sampling	3/14/01	1.3	0.1	1.3	0.1	525	1.0	NA	4.1		
		Core Room	3/14/01									25.1	3.2

[1] TWA: Time Weighted Average
[2] Employee was wearing a negative pressure respirator while in the core room, therefore, actual employee exposures are well below the measured values.