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August 10, 2005

ESH-IHS-2005-00340

TO: James Morgan, CMC Manager 731-N

FROM: Steven Jahn, IH Manager, 730-4B

Notification of Sherwin Williams of WSRC Assessment of Benzene in Tile-Clad Paints

Please send this report to your vendor contact on my behalf. In accordance with OSHA obligations, anytime a vendor has information regarding material content that could possibly lead to an overexposure, the vendor needs to act on it. Our (WSRC) ethical obligation then becomes notification that such information was created in this report. We fulfill the obligation when we give it to them; should they choose not to act is solely their prerogative.

Thanks for your support.
Steve

SDJ:ehe
Attachment

OCCUPATIONAL EXPOSURE TO BENZENE FROM PAINTING WITH
EPOXY AND OTHER HIGH PERFORMANCE COATINGS

ESH-IHS-2005-00292

April 20, 2005

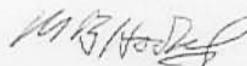
Westinghouse Savannah River Company (WSRC)
P.O. Box 616
Aiken, SC 29808

Approval:


S. D. Jahn, Industrial Hygiene Manager

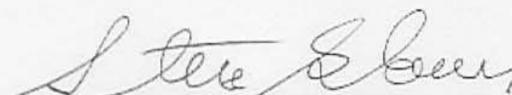
4-21-05
Date

Review:


M. B. Hook Jr., Industrial Hygiene Laboratory Director

4/22/05
Date

Author:


D. S. Glover, NMM/SFP Industrial Hygienist

4-21-05
Date

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OCCUPATIONAL EXPOSURE TO BENZENE FROM PAINTING WITH EPOXY AND OTHER HIGH PERFORMANCE COATINGS

Description

Industrial Hygiene (IH) initiated a sampling campaign to evaluate potential occupational exposure to benzene when workers apply epoxy and other industrial coatings likely to contain benzene as an unintentional trace contaminant. Exposure monitoring for volatile solvents during a painting operation led to the discovery that benzene can contribute to occupational exposure. IH had conducted air monitoring in 2003 on construction painters coating the 105-L fan room floor with epoxy paint. A high-solids epoxy coating, Tile-Clad, manufactured by Sherwin Williams (MSDS 30026) was applied using brush and roller. Air sampling was conducted to evaluate occupational exposure to ethyl benzene, xylene, and benzene. Although benzene is not identified in Sherwin Williams' Material Safety Data sheet, it was included in sampling and analysis because of previous sample results showing benzene in a similar epoxy product, Amerlock (IH Report, OBU-NMM-2003-00246). It was suspected that the source of benzene was other aromatic products like xylene used as a reducer and thinner. Bulk samples of the product contain benzene in the range of 33 to 110 ppm by weight. A discussion with the paint manufacturer confirmed that benzene is a contaminant in commercial grades of xylene at low concentrations. Since the concentration of benzene in paint is well below 0.1% and the manufacturer's hazard assessment has not identified benzene as a significant exposure risk, it is not listed as a hazardous constituent on their Material Safety Data Sheet (MSDS). However, according to OSHA 1910.1200, even if present below 0.1%, a chemical should be identified on an MSDS if it can be released in concentrations that may exceed the OSHA PEL or ACGIH TLV.

Purpose

Following the discovery of trace benzene in paint products, an assessment was needed to determine potential for benzene exposures to exceed the established ACGIH Threshold Limit Value (TLV) during painting operations. Sample data was collected by area industrial hygienists for benzene during routine maintenance and construction activities at Savannah River Site. A set of available data from the IH database, Sentry, was analyzed to provide guidance to the industrial hygiene staff and draw conclusions on the exposure potential during typical painting operations.

Study Results

A query of the industrial hygiene Sentry Database following the benzene discovery yielded 39 data points. Personnel and area samples were collected by several industrial hygienists during a 15 month period. The majority of samples were collected when construction painters were coating floors and painting in Central Shops with epoxy paint. Good ventilation controls were in place and the painters used conventional application techniques such as brushing and rolling. The majority of samples were collected on 3M passive monitors and analyzed by the WSRC IH laboratory. Data points showing the concentration and Time Weighted Average (TWA) exposure to benzene can be seen in Attachment A. The average concentration of benzene during sampling ranged from below detection to a high of 1.13 ppm with a mean of 0.35 ppm. The ACGIH recommended Threshold Limit Value (TLV) TWA for benzene is 0.5 ppm for an 8 hour work day. The TLV can be adjusted to 0.4 ppm to provide a more conservative threshold for the 10 hour extended work shift used by construction painters. From 39 data points, 14 samples or 36% indicated a benzene concentration (not a TWA) at or above 0.4 ppm during painting activities.

A painting operation involves numerous tasks including staging equipment, site preparation, painting, and housekeeping. The painting task may require a few minutes or several hours. The balance of a work shift does not contribute to exposure since painters conduct house keeping and leave the work area when a painting task is completed. Potential exposure associated with solvent cleaning of brushes and equipment is generally not a factor with epoxy coatings because the equipment can not be effectively cleaned and is discarded. If the exposure concentration is averaged over a 10 hour work shift to determine a TWA, only three data points exceed the adjusted TLV of 0.4 ppm. From the sampling times and work observations it is evident that painting operations require less than a full shift. The short duration of painting tasks greatly reduces the probability of exceeding the TLV-TWA.

A regression analysis of the data supports an increasing exposure potential with increasing duration of painting activities (Attachment B). The graphic representation shows a moderate slope with data points near the TLV as apparent outliers. Further investigation of two sample reports with TLVs above 0.5 ppm involved the use of a reducer during painting. The reducer has a high percentage of solvent and may exacerbate potential exposure to benzene. There is insufficient data in the sampling record on when reducers were used and the exposure characteristics associated with using a reducer to determine if it significantly increased exposure risk.

Due to the carcinogenic potential of benzene, the TLV at 0.5 ppm is a relatively low number when compared to other hazardous volatile organic solvents such as xylene. Xylene has a TLV of 100 ppm. Xylene is a major constituent in many paint formulations and the solvent can exceed 10% of an epoxy coating mixture. Attachment C pairs the benzene concentration and xylene concentration measured during painting applications to determine if a relationship is readily apparent. The 26 data points appear to have no relationship that would allow an industrial hygienist to infer that benzene exposures are in an acceptable range when xylene is controlled well below the TLV.

Conclusion

Five conclusions can be drawn from this data:

- 1) Benzene is a trace contaminant (below 0.1%) in some commercial grade solvents such as xylene and should be considered as a volatile organic constituent in paints, thinners, and other products that contain xylene, even when not identified in the MSDS.
- 2) There is a low probability that workers will exceed the TLV for benzene when good ventilation controls are in place and the painting projects are short duration (roughly 1 to 2 hours). Longer duration painting projects increase the probability for over exposure, and therefore necessitate greater oversight for control implementation.
- 3) The influence that a reducer or thinner has on benzene exposure when painting is unknown, but should be considered to increase exposure potential.
- 4) Monitoring and controlling xylene during painting does not provide a good indication that exposure to benzene is acceptable.
- 5) Medical surveillance must be available to workers exposed to benzene for 30 days per year at the OSHA action level of 0.5 ppm calculated as an 8-hour TWA. Based on the historic sampling data assembled, there is a low probability of exposure at or above this level. Medical surveillance is not required for the work group (painters).

Recommendations

Industrial hygienists are advised to consider benzene as a trace contaminant in paint products that contain xylene or similar aromatic solvents. Although benzene is a trace contaminant and may not be identified in the product MSDS, it is sufficiently volatile to present an exposure hazard. Engineering controls, which may appear adequate for xylene, do not infer benzene exposure is acceptable and the use of reducing agents in the paint mixture may increase the benzene exposure potential. Industrial hygienists should analyze for benzene in addition to other solvents identified on an MSDS and consider additive effects of solvents with similar toxicity characteristics. The Chemical Commodities Management Center is advised via this report to inform appropriate paint manufacturers of the benzene exposure potential and seek paint products that have suitable performance without trace benzene contamination.

Attachment A:

Sentry query of sample data for benzene during painting, including sampling time (sampling time generally reflects the time duration of a painting application task).

SAMPLE ID	TYPE OF WORK	LOCATION	SAMPLE	BENZENE	BENZENE
			MINUTES	CONC.(ppm)	TWA(ppm)
10522L040503-01	brush painting	sand filter basin	180	0.01	NA
10522L040503-04	brush painting	sand filter basin	20	<1.72	<0.11
10522L040503-05	brush painting	sand filter basin	165	<0.21	<0.11
10522L040503-06	brush painting	sand filter basin	170	<0.20	<0.06
10522L040504-01	brush painting	sand filter basin	270	0.03	NA
10522L040504-04	brush painting	sand filter basin	30	<1.15	<0.06
10522L040504-05	brush painting	sand filter basin	225	<0.15	<0.06
10522L040504-06	brush painting	sand filter basin	145	<0.24	<0.11
105L030626-01	brush painting	Reactor Building	420	0.88	0.62
105L030626-02	brush painting	Reactor Building	420	0.55	0.38
105L030626-04	brush painting	Reactor Building	420	0.25	0.18
105L030821-01	brush painting	Reactor Building	90	0.1	0.01
105L030909-02	brush painting	Reactor Building	60	0	0
105L030909-06	brush painting	Reactor Building	60	0.15	0.01
2642H041012-01	brush painting	H Area	210	0.04	0.04
7171N031223-01	brush painting	Boilermaker Shop	290	0.06	0.03
7173N031202-01	brush painting	Boilermaker Shop	120	<0.07	<0.01
7251N031106-01	brush painting	Sand Blast Shed	90	0.1	0.01
748A030919-01	brush painting	maintenance bldg	280	0.22	0.1
748A030919-02	brush painting	maintenance bldg	280	1.13	0.53
105K030430-01	Roller Painting	Reactor Building	90	0.89	0.13
105K030430-02	Roller Painting	Reactor Building	90	1.08	0.16
105L030626-03	Roller Painting	Reactor Building	420	0.52	0.37
105L030821-03	Roller Painting	Reactor Building	105	0.08	0.01
105L030909-01	Roller Painting	Reactor Building	75	0.02	0
749A030919-03	Roller Painting	Reactor Building	280	0.98	0.46
235F040818-01	Roller Painting	vestibule floor	210	0.04	0.04
235F040818-02	Roller Painting	vestibule floor	140	0.13	0.04
235F040818-03	Roller Painting	vestibule floor	210	0.04	0.19
235F040818-04	Roller Painting	vestibule floor	140	0.76	0.19
235F040818-05	Roller Painting	vestibule floor	205	0.04	0.12
235F040818-06	Roller Painting	vestibule floor	140	0.44	0.12
235F040818-07	Roller Painting	vestibule floor	140	0.5	0.12
7252N031022-1A	spay paint	paint shed	47	<0.56	<0.04
7252N031028-1A	spay paint	paint shed	33	<0.80	<0.04
7252N040129-01	spay paint	paint shed	79	<0.33	<0.04
645N030215-1A	spay paint	paint shed	235	<0.11	<0.04
645N030215-2A	spay paint	paint shed	325	<0.08	<0.04
645N030215-3A	spay paint	paint shed	235	<0.11	<0.04
AVERAGE			183.179487	0.347692308	0.1608333

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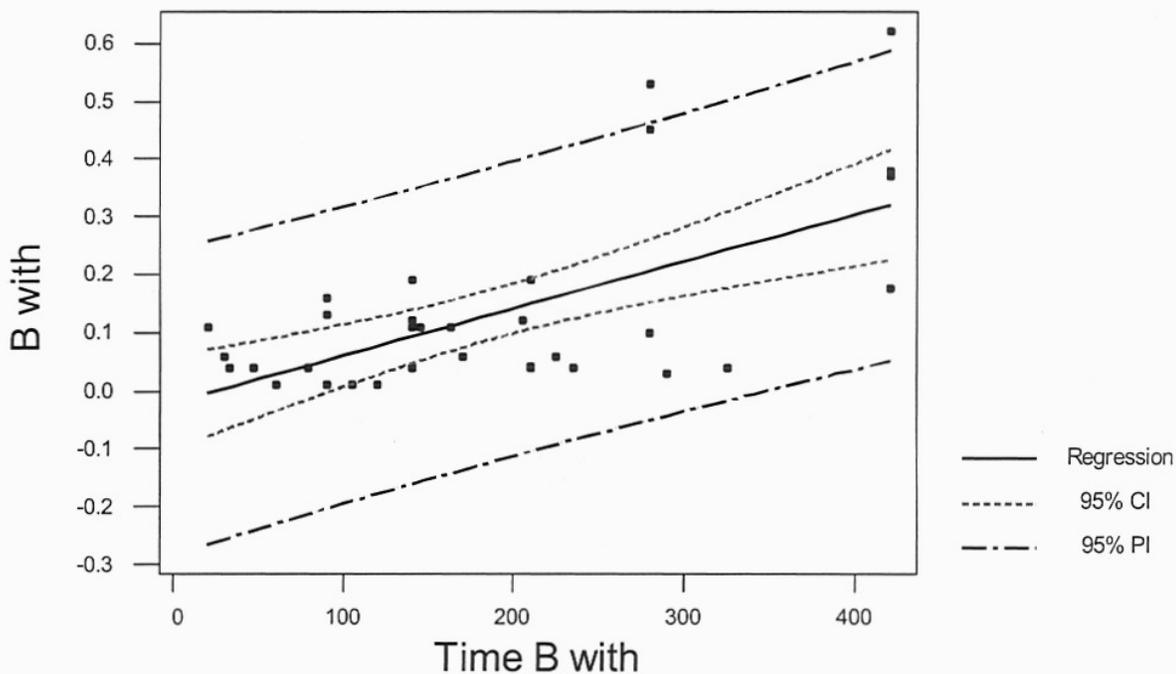
Attachment B:

Regression analysis using benzene concentration and sampling time data in Attachment A

Benezene / Minutes with >.5TWA

$$B \text{ with} = -0.0201351 + 0.0008089 \text{ Time B with}$$

S = 0.123186 R-Sq = 37.8 % R-Sq(adj) = 35.9 %



Benzene ppm

Attachment C:

Sentry benzene exposure data compared with xylene exposure data.

SAMPLE ID	TYPE OF WORK	LOCATION	MINUTES	Benzene	Xylene
				Conc.(ppm)	Conc.(ppm)
10522L040503-01	brush painting	sand filter basin	180	0.01	2.9
10522L040503-04	brush painting	sand filter basin	20	<1.72	2.9
10522L040503-05	brush painting	sand filter basin	165	<0.21	12.9
10522L040503-06	brush painting	sand filter basin	170	<0.20	14.6
10522L040504-01	brush painting	sand filter basin	270	0.035	7.9
10522L040504-04	brush painting	sand filter basin	30	<1.15	1.9
10522L040504-05	brush painting	L sand filter	225	<0.15	1.4
10522L040504-06	brush painting	sand filter basin	145	<0.24	7.6
105L030821-01	brush painting	Reactor Building	90	0.1	42.8
105L030909-02	brush painting	Reactor Building	60	0	9.3
105L030909-06	brush painting	Reactor Building	60	0.1	11.5
2642H041012-01	brush painting	H Area	210	0.04	0.6
7171N031223-01	brush painting	Boilermaker Shop	290	0.06	3.6
7173N031202-01	brush painting	Boilermaker Shop	120	<0.07	2.45
7251N031106-01	brush painting	Sand Blast Shed	90	0.1	1
748A030919-01	brush painting	maintenance bldg.	280	0.22	1.1
748A030919-02	brush painting	maintenance bldg.	280	1.13	6.34
235F040818-01	Roller Painting	vestibule floor	210	0.04	4.2
235F040818-02	Roller Painting	vestibule floor	140	0.13	3.6
235F040818-03	Roller Painting	vestibule floor	210	0.04	8.9
235F040818-04	Roller Painting	vestibule floor	140	0.76	19.9
235F040818-05	Roller Painting	vestibule floor	205	0.04	6.8
235F040818-06	Roller Painting	vestibule floor	140	0.44	20.6
235F040818-07	Roller Painting	vestibule floor	140	0.5	21.7
7252N031022-1A	spay paint	paint shed	47	0.56	12.6
7252N031028-1A	spay paint	paint shed	33	<0.8	5.5
AVERAGE			151.9231	0.239167	9.022692

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References

Sentry Query, *Substance Monitoring Report*, December 21, 2004

Attachment B Graph, Steve Foster –Six Sigma Black Belt, SFP, 3/15/05.

ESH-IH-2003-00100, *Air Sampling During Painting Evolution in 749-A*, G.N. Smoland, Nov. 6, 2003

OBU-NMM-2003-00421, *Industrial Hygiene Report, Occupational Exposure to Paint Solvent*, D.S. Glover, Sept. 23, 2003