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July 1, 2013

Jake Hes and Scott Bourdon University of California, Irvine EHS 4600 Health Sciences Road Irvine, CA 92697

Re: Integrated Nanosystems Research Facility (INRF) Fume Hood Assessment – EORM[®] Project No. 12.1165

Dear Mr. Hes and Mr. Bourdon:

Per University of California, Irvine (UCI)'s request, specifically Jake Hes and Alvin Samata, Environmental and Occupational Risk Management, Inc. (EORM®) conducted an assessment of the fume hoods in the Integrated Nanosystems Research Facility (INRF). The assessment was initiated due to a recent odor issue involving a mixture of hydrofluoric acid (HF) that contained acetic acid. People working in or near the clean room could smell the pungent, vinegar-like odor of acetic acid in the hallway. A separate inspection of the heating, ventilating, and air-conditioning (HVAC) system was conducted by Integral, an Environmental Engineering firm that specializes in industrial ventilation, but it was not within the scope of this assessment. Due to the odor concerns, EORM performed face velocity measurements at the fume hoods to determine if the exhaust air flow rate, in feet per minute (fpm), was adequate and met the Cal/OSHA requirements. In addition, EORM reviewed the chemicals and procedures performed in the fume hoods.

Fume Hood Assessment

Table 1			
Room #: Fume Hood ID	Results	Comments	
W2332: 56542AAZ	Face Velocity Range: 110-140 fpm Process: Resistor Bench	Based on MSDS information provided by UCI and the ventilation flow rate verification performed by EORM it is safe to perform processes in this fume hood according to the clean room procedures and PPE requirements.	
W2332: TSS#86187	Face Velocity Range: 40-50 fpm Process: Negative Photo Resist	Based on MSDS information and ventilation flow rate verification it is NOT safe to perform processes in this fume hood. Adjust flow settings to an average face velocity of 100 fpm with no point less than 70 fpm. Verify this requirement has been satisfied before performing operations.	

Table 1

W2332: 56694AAZ	Face Velocity Range: 140-150 fpm Process: Developing	Based on MSDS information provided by UCI and the ventilation flow rate verification performed by EORM it is safe to perform processes in this fume hood according to the clean room procedures and PPE requirements.
W2338: 56693	Face Velocity Range: 140-150 fpm Process: Acids, Solvents	Based on MSDS information provided by UCI and the ventilation flow rate verification performed by EORM it is safe to perform processes in this fume hood according to the clean room procedures and PPE requirements.
W2334: TSE86111	Face Velocity Range: 150-200 fpm Process: Acids, Solvents	Based on MSDS information provided by UCI and the ventilation flow rate verification performed by EORM it is safe to perform processes in this fume hood according to the clean room procedures and PPE requirements.
W2315: MB2-002	Face Velocity Range: 250-300 fpm Process: Acids, Solvents	Based on MSDS information provided by UCI and the ventilation flow rate verification performed by EORM it is safe to perform processes in this fume hood according to the clean room procedures and PPE requirements.
W2315A: MB2-003	Face Velocity Range: 250-300 (11"), 140-150 (18") Process: Acids, Solvents	Based on MSDS information provided by UCI and the ventilation flow rate verification performed by EORM it is safe to perform processes in this fume hood according to the clean room procedures and PPE requirements.

Table 2

Chemical Name	MSDS Information
Microposit S1813 Photo Resist	Propylene Glycol Monomethyl Ether Acetate (71-76%)
	Mixed Cresol Novolak Resin (10-20%)
	Diazo Photoactive Compound (1-10%)
	Fluoroaliphatic Polymer Esters (0.01-1%)
	Combustible, Irritant
	Not a Carcinogen (OSHA)
	30 ppm 8 hr. TWA; 90 ppm 15 min STEL
	NFPA: F2-H2-R0-None
AZ nLOF 2035 Photoresist	1-Methoxy-2-Propanol Acetate (65%)
	Cresol Novolak Resin (28%)
	Modified Melamine–Formaldehyde Resin (5%)
	Phenolic Polyol (2%)
	Irritant, Flammable
	Not a Carcinogen (OSHA)
	50 ppm 8 hr. TWA
	NFPA: F2-H2-R0-None

Chemical Name	MSDS Information
AZ Developer 1:1	Sodium Metasilicate (1%)
	Irritant
	Not a Carcinogen (OSHA)
	NFPA: F0-H2-R0-None
PMGI 101 Developer	Tetraethyl Ammonium Hydroxide (5%)
	Irritant
	Not a Carcinogen (OSHA)
	SCAQMD Rule 443.1 VOC's: 0
	NFPA: F0-H2-R0-None
PG Remover	N-Methyl Pyrrolidinone (99%)
	SCAQMD Rule 443.1 VOC's: 1,026 g/L
	Not Established 8 hr. TWA
SU-8 2000 Series Resist	Epoxy Resin (3-75%)
	Cyclopentanone (23-96%)
	Hexafluoroantimonate Salt (0.3-5%)
	Propylene Carbonate (0.3-5%)
	Triarylsulfonium Salt (0.3-5%)
	Irritant
	Not a Carcinogen
	VOC's (% by wt.): 20-98% (285-960 g/L)
	NFPA: F3-H2-R0-None
SU-8 3000 Series Resist	Cyclopentanone (20-60%)
	Mixed Triarylsulfonium/Hexafluoroantimonate Salt (1-5%)
	Propylene Carbonate (1-5%)
	Epoxy Resin (35-80%)
	Formaldehyde Polymer (1-30%)
	Cycloaliphatic Epoxy Resin (1-30%)
	Proprietary (<8%)
	Irritant, Toxic, Flammable
	Not a Carcinogen (OSHA)
	VOC's (% by wt.): 22-52% (288-538 g/L)
	NFPA: F3-H2-R0-None
G Thinner	Cyclopentanone (80-90%)
	Propylene Glycol Monomethyl Ether (10-20%)
	100 ppm 8 hr. TLV; 150 ppm 15 min STEL (ACGIH)
	Irritant, Toxic, Flammable
	Not a Carcinogen (OSHA)
	SCAQMD Rule 443.1 VOC's: 950 g/L
	NFPA: F3-H2-R0-None

Chemical Name	MSDS Information
MF-319 Developer	Tetramethyl Ammonium Hydroxide (2.2%)
	Irritant
	Not a Carcinogen (OSHA)
	NFPA: F0-H3-R0-None
Microposit S1808 Photoresist	Propylene Glycol Monomethyl Ether Acetate (75-80%)
	Mixed Cresol Novolak Resin (10-20%)
	Diazo Photoactive Compound (1-10%)
	Fluoroaliphatic Polymer Esters (0.01-1%)
	Combustible, Irritant
	Not a Carcinogen (OSHA)
	30 ppm 8 hr. TWA; 90 ppm 15 min STEL (Manufacturer)
	5 ppm 8 hr. TWA (OSHA)
	NFPA: F2-H2-R0-None
AZ 300 MIF Developer	Tetramethyl Ammonium Hydroxide (0-2%)
	Irritant
	Not a Carcinogen (OSHA)
	NFPA: F0-H2-R0-None
Microposit S1805 Photo Resist	Propylene Glycol Monomethyl Ether Acetate (81-86%)
	Mixed Cresol Novolak Resin (10-20%)
	Diazo Photoactive Compound (1-10%)
	Fluoroaliphatic Polymer Esters (.01-1%)
	Combustible, Irritant
	Not a Carcinogen (OSHA)
	30 ppm 8 hr. TWA; 90 ppm 15 min STEL (Manufacturer)
	5 ppm 8 hr. TWA (OSHA)
	NFPA: F2-H2-R0-None
Microposit SC 1827 Positive Photo Resist	Propylene Glycol Monomethyl Ether Acetate (65-76%)
	Mixed Cresol Novolak Resin (10-30%)
	Diazo Photoactive Compound (1-10%)
	Fluoroaliphatic Polymer Esters (.01-1%)
	Combustible, Irritant
	Not a Carcinogen (OSHA)
	30 ppm 8 hr. TWA; 90 ppm 15 min STEL (Manufacturer)
	5 ppm 8 hr. TWA (OSHA)
	NFPA: F2-H2-R0-None

Conclusions

No significant issues were noted during the visual fume hood inspection that would contribute to the source of odor reported in the clean room.

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The fume hood face velocity data from the INRF clean room were indicative of normal fume hood conditions. Only one fume hood was below the required velocity for carcinogens and other hazardous chemicals. According to the clean room manager, this hood has a dampener that can be opened to obtain a higher face velocity.

Review of the chemicals used in these fume hoods did not present any information that was unusual or extraordinary.

Recommendations

Based on the results of sampling and observations described in this report, EORM recommends the following best management practices:

- Communicate the results of this survey to affected/concerned employees.
- Ensure that fume hoods have an average face velocity of 100 fpm, with no reading lower than 70 fpm, before performing procedures.
- Reinstitute the use of fume hoods in INRF for approved clean room procedures based on Table 1 ۲ of the report.
- In the event of more odors, perform an Industrial Hygiene survey to determine if TWA or STEL values are being exceeded. Odor levels may be below Cal/OSHA TWA or STEL values, but still cause nuisance odors.
- Continue to review new chemicals and procedures with lab management to ensure that ۲ ventilation and PPE requirements are being met.

Please call EORM at (949) 420-0662 with any questions you may have regarding this report.

Regards,	Reviewed by:
Michael Palazzola	Steve Riedman
Michael Palazzola	Steve Riedman, CIH
Consultant Specialist	Senior Consultant

Attachments

Attachment 1

INFR Facility Map



Attachment 2

Fume Hood Photos



Figure 1: Photo Resist Application



Figure 2: Photo Resist Application



Figure 3: Solvent List





Figure 6: Fume Hood



Figure 5: Fume Hood



Figure 7: Fume Hood