NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2004-0016-2971
Lehigh Portland Cement Company
Union Bridge, Maryland

June 2005

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Chandran Achutan of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Field assistance was provided by Ronald Hall and Brad King. Analytical support was provided by DataChem Laboratories Inc. Desktop publishing was performed by Shawna Watts. Editorial review was performed by Ellen Galloway.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Dust Exposures at Lehigh Portland Cement Company

On October 8, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Lehigh Portland Cement regarding possible exposures to dust, silica and metals at their facility in Union Bridge, MD.

What NIOSH Did

- We collected area and personal breathing zone air samples to measure dust, silica, and metals.
- We collected bulk samples of fly ash, clinker dust, raw mill dust, and limestone dust to measure silica and metal content.

What NIOSH Found

- Five workers had total dust exposures that exceeded the MSHA standard.
- Personal air sampling results for respirable dust and metals did not exceed exposure limits.
- Silica was not detected in any personal air samples.

What Lehigh Portland Cement Company Managers Can Do

- Use respirators to reduce workers' dust exposures when other controls are not feasible in the process areas, in conjunction with an appropriate respiratory protection program.

What the Lehigh Portland Cement Company Employees Can Do

- Wear proper personal protective equipment (such as respirators) in the new mill area and other areas where dust concentrations are high, as instructed by company officials.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2004-0016-2971

Health Hazard Evaluation Report 2004-0016-2971
Lehigh Portland Cement Company
Union Bridge, Maryland
June 2005

Chandran Achutan, Ph.D.

SUMMARY

On October 8, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the management of Lehigh Portland Cement Company in Union Bridge, Maryland, to conduct an evaluation of employee exposure to airborne dust. This request was made to ensure safe work conditions for employees after the company moved into a new facility. The evaluation was conducted on April 13 and 14, 2004.

Full-shift personal breathing air zone samples for total and respirable dusts were collected from 19 employees over a 2-day period. In addition to particulate weight, total dust samples were analyzed for metal content, and respirable dust samples were analyzed for silica content. Area air samples were collected in five locations throughout the facility. In addition, bulk samples representing various types of dusts present at the facility were analyzed for metal and silica content.

Five of the nineteen total dust samples exceeded the Mine Safety and Health Administration Permissible Exposure Limit of 10 mg/m^3. The respirable dust samples did not exceed any exposure limits. In the total dust samples, aluminum, calcium, manganese, magnesium, titanium, sodium, and iron were present in quantifiable amounts. None of these metals exceeded any recommended or regulatory standards. Silica (quartz and cristobalite) was not present in any of the personal air samples.

NIOSH investigators have determined that a health hazard exists at this facility due to overexposure to dust. This report contains recommendations to reduce worker exposure to the dust. This includes use of respirators in dusty areas.

Keywords: 3241 (Cement, Hydraulic), cement, total dust, respirable dust, metals, quartz, cristobalite, quarry, histoplasmosis

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INTRODUCTION

On October 8, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the management of Lehigh Portland Cement Company regarding an evaluation of employees' exposures to silica, fly ash, and cement. This request was made to ensure safe work conditions for employees after the company moved into a new facility. NIOSH conducted an HHE at the previous facility in 2000.[1]

Between April 12 and 14, 2004, NIOSH investigators conducted a site visit at Lehigh Portland Cement Company. On April 12, following an opening conference between NIOSH investigators; the Paper, Allied Industrial, Chemical and Energy Workers Union Local 2-0031; and management officials, a walk-through inspection of the facility was conducted to familiarize NIOSH investigators with the manufacturing process.

On April 13 and 14, 2004, area and personal breathing zone (PBZ) air samples were collected for total dust, respirable dust, crystalline silica, and elements. In addition, bulk samples were collected of fly ash, clinker dust, raw mill dust, and limestone dust found around the manufacturing area. A closing conference was held on April 14, 2004 to summarize NIOSH activities at the facility and to discuss preliminary findings.

BACKGROUND

Lehigh Portland Cement

Lehigh Portland Cement Company, founded in 1897, is one of the largest cement producers in the United States. The Lehigh plant in Union Bridge, Maryland, employs approximately 130 people who work in seven departments: quarry, process, yard, repair, shops, electrical, and shipping. The quarry workers work two shifts (6:00 a.m to 2:30 p.m. and 2:00 p.m. to 10:30 p.m.), while the rest of the workforce work three 8-hour shifts starting at 7:00 a.m.

Cement Manufacturing Process

A conveyor brings limestone rock from a nearby quarry to a rock storage dome, where it is piled into layers in a circular pattern. A reclaimer within the dome sweeps across the surface of the pile to blend the different layers of material, ensuring a consistent feed to the kilns. From the dome, the limestone is sent to the raw mill, which produces raw material for the kiln. Sand and millscale (iron ore) are added to the limestone and ground on a rotating table. Next, the raw materials are pre-heated with the hot gases from the kiln, in the pre-heater/calciner tower. From the pre-heater/calciner tower, the raw material is introduced into the kiln. Raw material flows through the kiln in approximately 20 minutes. When the clinker (raw cement) exits the kiln, its temperature is over 2000ºF. Large fans cool it before storage. The clinker is stored in a clinker silo with an 85,000-ton capacity. A roll press in the clinker silo pre-grinds the clinker before it is fed to the finish mill. The clinker is fed to the roll press, which has two rolls facing each other and rotating inward towards one another. There is a centimeter gap between the rolls, and the clinker is crushed between the two rolls. The product from the roll press is a flat, powdery cake that passes through a disagglomerator to break up the cake and a separator to separate the oversized material from the product. The product is conveyed to the finish mill for further grinding and size reduction.

METHODS

Four bulk samples of clinker dust, limestone, fly ash, and raw mill dust were collected in glass vials and analyzed for metals and silica. Nineteen total dust and 19 respirable dust personal breathing zone air samples were collected over the 2-day period. In addition, five area samples (samples collected in fixed locations) each for total and respirable dusts were collected on the second day of sampling in

the fly ash silo, preblend area, clinker cooler area, crane cab area, and the baghouse.

Total and respirable dust samples were collected and analyzed per NIOSH Manual of Analytical Methods (NMAM) 0500[2] and NMAM 0600[2] respectively. Additionally, after the total dust samples were analyzed gravimetrically, they were analyzed for metal content per NMAM 7303[2], and the respirable dust samples were analyzed for silica content per NMAM 7500.[2]

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the general industry workplace are: (1) NIOSH Recommended Exposure Limits (RELs),[3] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[4] and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).[5] Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

The Lehigh Portland Cement Company is located at a quarry and therefore falls under the jurisdiction of the U.S. Department of Labor Mine Safety and Health Administration (MSHA). MSHA regulations (30 CFR §§ 56.5001) specify that the exposure to airborne contaminants shall not exceed, on the basis of a time-weighted average, the TLVs adopted by ACGIH in "Threshold Limit Values of Airborne Contaminants" (1973).[6]

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values that supplement the TWA where there are recognized toxic effects from higher exposures over the short term.

Particulates Not Otherwise Regulated

Often the chemical composition of the airborne particulate has no established occupational health exposure criterion. It has been the convention to apply a generic exposure criterion in such cases. Formerly referred to as nuisance dust, the preferred terminology for the non-specific particulate is *"not otherwise regulated"* (n.o.r.). The MSHA (1973 ACGIH TLV) PEL for total nuisance dust is 10 mg/m^3.

Metals

The toxicity of most trace elements (metals) depends on numerous factors including the chemical form of the metal, immune status and age of the worker, and lifestyle factors. Table 1 lists the detectable elements and their principal health effects.

RESULTS

Of the 19 personal samples collected for total dust, one sample was voided because the cassette was dislodged during the sampling period, and reattached improperly. Of the remaining 18 samples, the MSHA PEL of 10 mg/m^3 was exceeded on five occasions over the 2-day sampling period (concentrations of the 18 samples ranged from 0.57-59.69 mg/m^3). None of the 19 respirable dust samples exceeded any recommended or regulatory criteria. The concentrations of total and respirable dust area samples ranged from 0.17-3.9 mg/m^3 and below detection limit to 1.2 mg/m^3 respectively. The data are summarized in Table 2.

The bulk samples were analyzed for 27 metals. Of the 27, 19 metals were detected in quantifiable levels in at least one of the bulk samples (Table 3). The personal total dust samples contained aluminum, calcium, iron, magnesium, manganese, sodium, and titanium in quantifiable amounts (Table 4). None of the samples exceeded any regulatory or recommended criteria.

Quartz was detected in the limestone, fly ash, and raw mill bulk dust samples. Cristobalite was not present in any of the bulk samples. Neither quartz nor cristobalite was present in any of the personal samples.

DISCUSSION

The highest total dust exposures were to the yard workers, millwright and silo operators, and the lab technician. The exposures to the yard workers and operators were consistent with their work in dusty parts of the facility. On the day of sampling, the lab technician spent a considerable amount of time in the mill room. During the NIOSH visit, the crusher and the crusher helper were not crushing stone to full capacity. Thus, this survey may underestimate their typical exposures. The plant's cleaning stations used pressurized air to blow dust off work clothing. These cleaning stations were primarily located outdoors to reduce the possibility of creating a dust source indoors.

MSHA Standard 56/57.5001(a) requires that a miner's exposure not exceed the permissible limit of any substance on the TLV list. When the TLV is exceeded, Standard 56/57.5005 mandates that operators install all feasible engineering controls to bring the exposure down to the TLV. Respiratory protection is required when controls are not feasible, while controls are being established, and during occasional entry into hazardous atmospheres to perform short-term maintenance or investigations. Whenever respirators are required, operators must establish a respirator program containing all elements of the standard, which incorporates American National Standards Institute (ANSI) Z88.2-1969. The MSHA inspector must evaluate the effectiveness of the respiratory protection to determine whether miners are protected from overexposure.[6,7]

Engineering controls should be used to reduce worker exposures wherever feasible. Administrative controls and personal protective equipment such as respirators are designed to protect workers from airborne exposures when engineering controls are infeasible or ineffective in reducing air contaminants to acceptable levels. For respirators to be effective and protect workers from harmful exposures they must be selected, inspected, and maintained properly. Workers should inspect respirators for defects before and after each use. Respiratory protective equipment should also be cleaned and disinfected after each use. Respiratory protective devices should not be worn unless a satisfactory face seal can be obtained. Many conditions may prevent a good seal between the worker's face and the respirator. Some of these conditions include facial hair, glasses, or an unusually structured face. All workers required to wear a respirator must be properly trained on the selection, use, limitations, and maintenance of the respirator and also be fit-tested to assure a proper seal between the worker's face and the respirator prior to performing work tasks in a contaminated area. All workers should receive annual fit-testing with a quantitative testing device. When not in use, respirators must be

stored in a clean environment away from any source of contamination.[7,8]

CONCLUSIONS AND RECOMMENDATIONS

Employee exposures to respirable dust, silica, and metals were below all regulatory and recommended standards. Employees in the raw mill and yard operations were exposed to high levels of total dust.

The following recommendations are provided to help reduce worker exposures to total dust in the cement manufacturing process areas:

1. Use respirators in the cement process areas (raw mill and yard department) to reduce worker exposures to total dust. Respirators must be carefully selected to protect against the specific hazard and properly maintained.

2. Continue setting up cleaning stations with compressed air outdoors. The air pressure must be less than 30 pounds per square inch (psi).[9]

3. Continue using vacuum trucks to clean areas and help keep dust levels down. Other dry clean-up methods such as brooms and shovels may stir up dust and should be avoided.

REFERENCES

1. Hall RM, Gwin KK [2001]. Health hazard evaluation report: Lehigh Portland Cement Company, Union Bridge, MD. Cincinnati, OH: US Department of Health and Human services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH Report No. 2000-0309-2857.

2. NIOSH [1994]. Cassinelli, ME and O'Connor, PF, eds. NIOSH Manual of Analytical Methods. 4th ed. Cincinnati, OH: US Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH). Publication No. 94-113.

3. NIOSH [1992]. Recommendations for occupational safety and health: compendium of policy documents and statements. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 92-100.

4. ACGIH [2004]. 2004 TLVs® and BEIs®: threshold limit values for chemical substances and physical agents. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

5. CFR [2003]. 29 CFR 1910.1000. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

6. CFR [2003] 30 CFR 56.5001.700. Code of Federal Regulations. Washington, DC. US Government Printing Office, Office of the Federal Register.

7. Mine Safety and Health Administration Program Policy Manual-Volume IV. 56/57.5005 Respiratory Protection Metal and Non-metal mines. MSHA internet address, accessed December 27, 2004: http://www.msha.gov/REGS/COMPLIAN/PPM/PMVOL4C.HTM#36.

8. CFR [2003] 29 CFR 1910.1934. Code of Federal regulations. Washington, DC: US Government Office, Office of the Register.

9. NIOSH [2005]. A New Method to Clean Dust From Soiled Work Clothes. US Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH). Publication No. 2005-136.

Table 1
Trace Elements Evaluation Criteria
Lehigh Cement Company, Union Bridge, MD
April 2004

	NIOSH REL (mg/m^3)	MSHA PEL (mg/m^3)	ACGIH TLV (mg/m^3)	Principal Health Effects
Aluminum	10	NE	10	irritant
Calcium carbonate	10	NE	10	irritant
Iron oxide dust	5	10	5	siderosis
Magnesium oxide	10	NE	10	irritant, metal fume fever
Manganese	1	5	0.2	chemical pneumonitis, CNS effect
Titanium dioxide	0.2	10	10	irritant

NE: non existent

Table 2
Concentrations of Total and Respirable Dust Samples
Lehigh Cement Company, Union Bridge, MD
April 2004

Sample ID	Job title/Location	Total particulates		Respirable dust	
		Sampling duration (min)	Concentration (mg/m^3)	Sampling duration (min)	Concentration (mg/m^3)
Employee-1	Crusher operator	411	2.82	412	0.25
Employee-2	Crusher helper	408	2.31	408	ND
Employee-3	Silo laborer	408	59.69	393	0.96
Employee-4	Silo laborer	405	4.01	406	0.27
Employee-5	PUP	434	2.64	444	0.17
Employee-6	PUP	431	4.82	430	0.68
Employee-7	Laborer	437	3.88	317	0.09
Employee-8	Material handler	407	6.83	406	0.11
Employee-9	Laborer	403	9.47	402	0.72
Employee-10	Millwright	375	36.95	373	0.5
Employee-11	Electrician	252	1.53	253	0.09
Employee-12	Oiler	471	1.59	472	0.06
Employee-13	Repairman	459	8.93	432	0.69
Employee-14	Yard worker	475	57.84	475	0.8
Employee-15	Yard worker	464	44.22	460	0.95
Employee-16	Lab technician	623	53.44	623	0.53
Employee-17	PUP	370	1.49	412	0.03
Employee-18	PUP	224	0.57	426	0.08
Employee-19	Material handler	NA	VOID	356	0.34
Area-I	Fly ash silo	364	2.12	364	0.05
Area-II	Pre blend	371	0.17	371	ND
Area-III	Clinker cooler	207	0.31	347	ND
Area-IV	Crane cab area	480	3.03	479	1.17
Area-V	Baghouse	310	3.89	310	0.62

PUP: Process Utility Person
ND: Not Detected
NA: Not Available

Table 3
Concentrations (µg/g) of Metals in Bulk Dust Samples
Lehigh Cement Company, Union Bridge, MD
April 2004

	LOD	LOQ	Bulk 1-CD	Bulk 2-LS	Bulk 3-FA	Bulk 4-RM
Aluminum	4	10	23000	1300	7500	1400
Arsenic	6	20	50	ND	44	9
Beryllium	0.06	0.2	0.90	ND	2.3	ND
Calcium	100	400	480000	330000	18000	310000
Cadmium	2	6	ND	ND	ND	ND
Cobalt	5	20	Trace	ND	Trace	ND
Chromium	2	7	80	ND	32	11
Copper	1	3	62	8.4	43	30
Iron	10	30	21000	1700	7300	3800
Lithium	0.3	1	25	2.5	20	3.3
Magnesium	3	10	12000	5900	1800	8000
Manganese	0.1	0.3	1100	540	160	670
Molybdenum	2	7	Trace	ND	13	Trace
Nickel	1	4	47	1	18	15
Lead	6	20	Trace	ND	Trace	ND
Phosphorous	10	50	510	380	270	290
Platinum	40	100	Trace	ND	Trace	ND
Selenium	20	60	ND	ND	ND	ND
Silver	0.7	2	ND	ND	ND	ND
Sodium	5	20	470	7	390	69
Tellurium	8	30	ND	ND	ND	ND
Thallium	20	50	Trace	ND	Trace	Trace
Titanium	0.4	1	1300	6.7	370	54
Vanadium	0.4	1	44	2.4	58	9.3
Yttrium	0.2	0.6	16	4.1	12	4.6
Zinc	1	3	31	16	510	21
Zirconium	0.5	2	67	1	11	3.0

CD: Clinker dust
LS: Limestone
FA: Fly ash
RM: Raw mill

Table 4
Concentrations of Metals in Total Dust Samples
Lehigh Cement Company, Union Bridge, MD
April 2004

Sample ID	Concentration (mg/m^3)						
	Aluminum	Calcium	Iron	Magnesium	Manganese	Sodium	Titanium
Employee-1	0.04	0.65	0.03	0.03	ND	0.01	ND
Employee-2	0.02	0.44	0.02	0.02	ND	0.01	ND
Employee-3	0.46	3.73	0.22	0.13	0.01	0.01	0.02
Employee-4	0.06	1.05	0.08	0.04	ND	0.01	ND
Employee-5	0.04	0.63	0.06	0.02	ND	ND	ND
Employee-6	0.07	1.41	0.07	0.05	ND	0.01	0.01
Employee-7	0.31	6.28	0.44	0.22	0.01	ND	0.02
Employee-8	0.05	0.96	0.06	0.03	ND	0.01	ND
Employee-9	0.1	1.72	0.1	0.06	ND	0.01	0.01
Employee-10	0.61	11.09	0.81	0.38	0.03	0.02	0.04
Employee-11	0.03	0.5	0.05	0.02	ND	0.01	ND
Employee-12	0.02	0.4	0.02	0.01	ND	ND	ND
Employee-13	0.06	1.18	0.09	0.04	ND	0.01	ND
Employee-14	0.67	15.41	0.60	0.49	0.03	0.04	0.05
Employee-15	0.48	11.14	0.45	0.35	0.02	0.02	0.03
Employee-16	0.92	17.73	0.96	0.56	0.04	0.04	0.07
Employee-17	0.02	0.34	0.03	0.01	ND	ND	ND
Employee-18	0.02	0.08	0.02	ND	ND	0.01	ND
Area-I	0.1	0.06	0.07	0.01	ND	0.01	0.01
Area-II	ND	0.05	ND	ND	ND	0.01	ND
Area-III	ND	0.02	ND	ND	ND	ND	ND
Area-IV	0.07	1.25	0.07	0.04	ND	0.01	ND
Area-V	0.08	1.61	0.09	0.06	ND	0.01	0.01

ND: Not Detected

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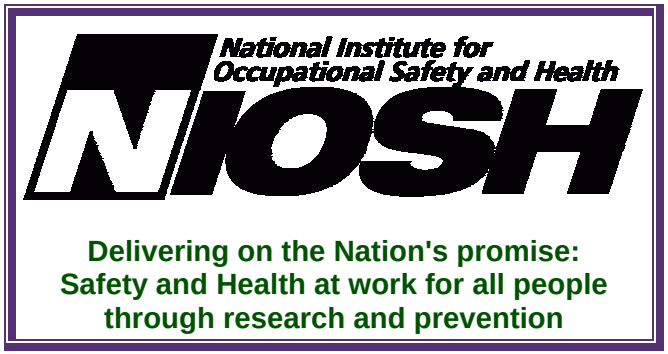

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