Docket H054A
Ex. 46-53

ADDENDUM TO FINAL REPORT
CHAPTER 21 – GLASS PRODUCTION

INDUSTRY PROFILE, EXPOSURE PROFILE, TECHNOLOGICAL FEASIBILITY EVALUATION, AND ENVIRONMENTAL IMPACT FOR INDUSTRIES AFFECTED BY A PROPOSED OSHA STANDARD FOR HEXAVALENT CHROMIUM (GENERAL INDUSTRY, CONSTRUCTION, AND MARITIME SECTORS)

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21.0 Glass Production

21.1 Industry Profile

This industry sector includes producers of colored glass and other glass production (including fiber glass).

Other Glass Production

In addition to stained glass, hexavalent chromium is encountered in furnaces used for the production of other glass, including fiber glass, continuous glass filaments, flat glass, and container glass. Hexavalent chromium is not used as an ingredient in these products, but the refractories in the furnaces may contain trivalent chromium. During heating, the trivalent chromium is oxidized to hexavalent chromium, resulting in a potential for worker exposure at these plants.

The applicable SIC and NAICS codes for this industry are

SIC Code		NAICS Code	
3296	Mineral Wool	327993	Mineral Wool Manufacturing
3211	Flat Glass	327211	Flat Glass Manufacturing
3221	Glass Containers	327213	Glass Container Manufacturing

Fiber glass falls under the mineral wool industry category. Data on the number of establishments, employees, and firms for NAICS code 327993 are presented in Table 21-3.

Table 21-3. NAICS Code 327993 (Mineral Wool Manufacturing) Employment Data

Employment Size by Establishment	Establishments[a]	Employees[a]	Firms[b]
Total	304	19,318	185
1 - 19	171	1,088	100
20 - 499	129	15,514	63
500+	4	2,716	22

[a] 2002 U.S. Economic Census.
[b] 2001 Statistics of U.S. Businesses (Firms are classified according to enterprise size, not establishment size).

Data on the number of establishments, employees, and firms for NAICS codes 327211 and 327213 are presented in Table 21-4.

Table 21-4. NAICS Code 327211 (Flat Glass Manufacturing) and NAICS Code 327213 (Glass Container Manufacturing) Employment Data

Employment Size by Establishment	Establishments[a]	Employees[b]	Firms[c]
Total	101	26,716	77
1 - 19	9	91	44
20 - 499	86	22,201	17
500+	6	4,424	16

[a] 2002 U.S. Economic Census.
[b] Approximated from 2002 U.S. Economic Census.
[c] 2001 Statistics of U.S. Businesses (Firms are classified according to enterprise size, not establishment size).

Fibrous glass (including glass wool) accounts for approximately 80 percent of the production of synthetic vitreous fibers (fibrous glass, glass wool, and rock wool) in the United States (ATSDR, 2004). Approximately 54 percent of the Glass Manufacturing Industry Council members use chromium-rich refractories (GMIC, 2005).

Projecting that 80 percent of mineral wool manufacturing is composed of fiberglass manufacturing and that 54 percent of glass manufacturing facilities use chromium-rich refractories, there are an estimated 79 affected small glass manufacturing facilities [((171 x 0.80) + 9) x 0.54] and 107 affected large glass manufacturing facilities [((133 x 0.80) + 92) x 0.54] in NAICS Codes 327993, 327211, and 327213.

There are approximately 853 production workers at small mineral wool manufacturing facilities and approximately 14,935 production workers at large mineral wool manufacturing facilities (U.S. Economic Census, 2005). Approximately 84.6 percent of all employees at flat and container glass manufacturing establishments are production workers (U.S. Economic Census, 2004, 2005). Estimating that 80 percent of mineral wool manufacturing is composed of fiberglass manufacturing and 54 percent of glass manufacturing facilities use chromium-rich refractories, there are approximately 410 affected employees in small facilities [((853 x 0.80) +

(91 x 0.846)) x 0.54] and 18,615 affected employees in large facilities [((14,935 x 0.80) + (26,625 x 0.846)) x 0.54] for NAICS Codes 327993, 327211, and 327213.

21.2 Process Description

Other Glass Production

The following job descriptions are provided by the North American Insulation Manufacturers Association (NAIMA), the Glass Manufacturing Industry Council (GMIC), the Glass Packaging Institute (GPI), and select continuous glass filament manufacturers (NAIMA, 2005):

- Batch Operator – The batch operator monitors the transfer of raw material from storage silos to the batch mixer and to the batch holding tank, from which the mixed batch is fed into the furnace for melting. Although the batch operator primarily performs the majority of his/her tasks from a climate-controlled room, the batch operator regularly leaves the control room for short periods to monitor the batch process and other operations, to work near the furnaces, and to enter the batch house.
- Furnace Operator – Although the furnace operator primarily performs the majority of his/her tasks from a climate-controlled room, each worker has the potential for hexavalent chromium exposure when crossing the plant floor to and from the control room and when periodically leaving the control room for short periods to monitor operations in the furnace, channel, and forehearth areas. The furnace (melter) operator works in the immediate vicinity of the furnace and monitors the furnace temperature and general furnace functions. The furnace operator normally would not be involved with furnace rebuilds.
- Electrostatic Precipitator (EP)/Baghouse Operator – The EP/baghouse operator maintains and monitors the EP, which collects the dust created during the melting process. The EP/baghouse operator sometimes works near the furnaces.
- Forehearth Operator – Although the furnace operator primarily performs the majority of his/her tasks from a climate-controlled room, each worker has the potential for hexavalent chromium exposure when crossing the plant floor to and from the control room and when periodically leaving the control room for short periods to monitor operations in the furnace, channel, and forehearth areas. The forehearth operator monitors the transfer of molten glass through the forehearth into the glass fiberizing process.
- Hot End Repair/Maintenance – Routine operation of the furnace, forehearth, and EP/baghouse involve employees responsible for maintenance and repair that would place them in the immediate vicinity of different sources of hexavalent chromium.
- Furnace Rebuild – Periodic furnace rebuilds involve employees (or contractors) responsible for construction-type work, such as tearing out old refractories, replacing them with new refractories, hauling away waste refractories, cleaning out used refractory bricks for recycling, and cleaning melter/furnace control equipment.

The estimated number of workers exposed to hexavalent chromium in each job category is presented in Table 21-6.

Table 21-6. Number of Employees Exposed to Hexavalent Chromium by Job Category in the Glass Manufacturing Industry

Job Category	Estimated Number of Employees per Large Facility	Number of Employees in Large Facilities[a]	Estimated Number of Employees per Small Facility	Number of Employees in Small Facilities[b]	Total Number of Employees
Batch Operator	42	4,494	1	79	4,573
Furnace Operator	42	4,494	1	79	4,573
Electrostatic Precipitator (EP)/Baghouse Operator	8	856	1	79	935
Forehearth Operator	42	4,494	1	79	4,573
Hot End Repair/Maintenance[c]	30	3,210	1	79	3,289
Furnace Rebuild	10	1,070	0	0	1,070
Total	174	18,618[d]	395	395[d]	19,013[d]

a Number of employees per job category in large facilities is based on a model large facility whose average employment exposed to hexavalent chromium is 174.

b Number of employees per job category in small facilities is based on a model small facility whose average employment exposed to hexavalent chromium is 5.

c It is estimated that maintenance workers will perform furnace rebuilds when the plant is not operating.

d The number of affected employees in Table 21-6 differs from that estimated in Section 21.1 because of rounding differences (employees per facility)

21.3 Exposure Profile

Other Glass Production

As presented earlier in Section 21.1, an estimated 19,013 workers are exposed to hexavalent chromium from refractories used at 186 affected establishments. Workers in six job categories are potentially exposed to hexavalent chromium: batch operator, furnace operator, electrostatic precipitator (EP)/baghouse operator, forehearth operator, hot end repair/maintenance, and furnace rebuild. Exposure data for this industry are from NAIMA and the Occupational Safety and Health Administration (OSHA) Integrated Management Information System (IMIS) database.

DETAILED EXPOSURE DATA BY JOB CATEGORY (EXPECTED TO BE PROVIDED BY NAIMA) WILL BE INCLUDED IN THIS SECTION WHEN THE DATA IS PROVIDED

TO SHAW OR SUBMITTED TO THE OSHA HEXAVALENT CHROMIUM DOCKET. ONLY AVERAGE EXPOSURES FOR VARIOUS JOB CATEGORIES WERE INCLUDED IN THE PREVIOUS SUBMITTAL FROM NAIMA TO THE OSHA DOCKET.

A review of the OSHA IMIS database for the most recent 15-year period (1986 - 2001) showed that OSHA inspection files over that period contain a total of five full-shift hexavalent chromium personal exposures, and all of these exposures were collected prior to 1988 (for SIC Codes 3211– Flat Glass, 3221 – Container Glass, and 3296 – Mineral Wool). Two of these exposures are from the glass container industry (SIC Code 3221); however, one of the worker's tasks is not described in the database, and the other worker is listed as a "mold maker," which is not sufficiently descriptive to provide a job category. One exposure in the mineral wool industry is for a plater; this exposure will be included in Section 1, Electroplating. Hence, these three exposures from the IMIS database are not considered in the exposure profile. Two exposures are for the flat glass industry; each of these exposures is below the analytical detection limit. Table 21-13 presents these two full-shift IMIS full-shift exposures available for this industry.

Table 21-13. IMIS Full-Shift Hexavalent Chromium Monitoring Data Collected at Glass-Producing Facilities (1986 - 2001)

SIC Code[a]	Date	Facility ID	Job Category	Full-Shift Hexavalent Chromium Exposure ($\mu g/m^3$)[b]
3211	12/85	A	Batcher	ND
	12/85	A	Melter	ND[c]

[a]SIC Codes: 3229 = Flat Glass
[b]$\mu g/m^3$ = Micrograms per cubic meter.
[c]ND = Not detected.

21.4 Technological Feasibility

21.4.1 Baseline Controls

Other Glass Production

The following information is selected from information submitted to OSHA (NAIMA, 2005).

Batch House Area

The batch house area is where various raw materials are automatically weighed and blended to produce a precisely formulated batch. The batch house area includes the batch house, storage bin, scales, and mechanical and pneumatic conveying equipment. Although the batch operator primarily performs the majority of his/her tasks from a climate-controlled room, the batch

operator regularly leaves the control room for short periods to monitor the batch process and other operations, to work near the furnaces, and to enter the batch house.

Furnace and Forehearth Area

Although the furnace and forehearth operators primarily perform the majority of their tasks from a climate-controlled room, each worker has the potential for hexavalent chromium exposure when crossing the plant floor to and from the control room and when periodically leaving the control room for short periods to monitor operations in the furnace, channel, and forehearth areas.

Furnace and forehearth operators are likely exposed to hexavalent chromium at the two openings where hot air and volatiles are emitted from the furnace: (1) the exhaust opening at the top of the furnace that leads to the exhaust stacks (sometimes a 3- to 4-foot gap between the roof of the furnace and the bottom of the stack); and (2) the channel and the forehearth that cool the molten glass and transport it towards the fiberization process. The channel and forehearth are composed of refractory material and are either gas-fired or electrically heated. The channel and forehearth raise or lower the temperature of the glass while keeping a sufficiently hot flow to the bushings. The channel and forehearth are typically vented to the atmosphere or a particulate matter control device.

Varying degrees of general ventilation and local exhaust ventilation (LEV) already provide some protection to fiber glass insulation workers in the furnace and forehearth areas. Forehearths are designed to cool the molten glass on its way to the fiberizers. Adding additional exhaust ventilation to the forehearths and related channels would change the thermal operating parameters.

Furnace Rebuild Operations

Furnace rebuilds are typically performed every four to eight years and last 28 to 30 days. During furnace rebuilds, the plant is shut down and, in many respects, not operational. For example, some engineering controls that help to reduce hexavalent chromium exposure when the plant is operating do not function when the plant is shut down (i.e., the collection chamber, and the exhaust stack and related controls).

Maintenance

Bushing changeouts are similar to furnace rebuilds, but they occur more frequently and involve smaller areas. Replacement bushing set up is performed in a shop that uses LEV to minimize employee exposure to chromium dust. Removing an installed bushing, which involves chipping and grinding that leads to hexavalent chromium exposure, must be done on the manufacturing floor where the bushing is installed in the forehearth channel.

Considering the nature of bushing changeout jobs, it is virtually impossible to install engineering controls to minimize employee exposure. Effective dust collection is infeasible because space is crowded where the bushing is installed. The bushing has many other connections, such as a transformer, cooling water loops, etc., in a small space as part of the process requirement. Each bushing is a plate approximately 8-inches by 4-inches, and the bushings are set 1 – 2 feet away from each other. There are numerous bushings attached to the forehearth. The space constraints and the other connections to the bushings make it virtually impossible to install any dust collection mechanism.

21.5 References

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