PRELIMINARY CONTROL TECHNOLOGY ASSESSMENT

OF

THE BELDEN BRICK COMPANY
Sugarcreek, Ohio 44681

Report Written by:
Robert D. Mahon

Survey Team

Robert D. Mahon, ECTB
Thomas C. Cooper, ECTB
Bill Jones, DRDS
John Gamble, DRDS

U.S. Department of Health and Human Services
Centers for Disease Control
National Institute for Occupational Safety and Health
Cincinnati, Ohio

March, 1982

Plants Visited:	The Belden Brick Company, Sugarcreek, Ohio
Date of Visit:	January 19, 1982
Persons Conducting Survey:	Robert D. Mahon, ECTB Thomas C. Cooper, ECTB Bill Jones, DRDS John Gamble, DRDS
Company Representatives Contacted:	John C. Jensen, Environmental Engineer, Wayne Schrock, Assistant General Superintendent, Robert Sclater, Safety Director
Employee Representatives Contacted:	None
Standard Industrial Classification Code of Plants:	3251 Brick and Structural Clay Tile

ABSTRACT

A walk-through control technology survey was conducted of several contiguous ceramic brickmaking facilities and operations of the Belden Brick Company, Sugarcreek, Ohio on January 19, 1982. These plans use a variety of clays and shales, from on-site company owned mines, plus color additives purchased from several different suppliers. The raw materials are crushed, blended, formed, dryed, fired, drawn, packaged, and shipped or placed in storage. A preliminary assessment of the control technology, including engineering controls, work pactices, monitoring, and personal protective equipment, was made during the survey. Based on the discussion of observations a detailed assement may be planned of at least some of the control technology in use in the facilities and operations.

INTRODUCTION

The manufacture of ceramic brick involves worker exposure to a variety of potentially harmful chemical and physical agents. Some of the agents of concern are; silica, numerous color additives, temperature extremes, and noise. Our literature review and contacts with people included, either directly or indirectly, with ceramic brickmaking, indicates that there is control technology in place in the industry to prevent the over exposure of workers to these agents.

The Enginering Control Technology Branch of the Division of Physical Sciences and Engineering, NIOSH is conducting a research study to assess and document the control technology being used to minimize worker exposure in the ceramics industry. Exposures to the above mentioned potentially harmful chemical and physical agents have been documented as a cause of a variety of health problems. This walk-thru survey was conducted to obtain information on the use of control technology, including engineering controls, work practices, monitoring, and protective equipment, when making ceramic bricks, and to determine the suitability of these plants for a detailed survey.

The primary contact was the companies Environmental Engineer, John C. Jensen. During our althrough survey, we met briefly with other management personnel and talked to a number of personnel physically involved in the manufacture of the bricks.

PLANT AND OPERATION DESCRIPTIONS

The manufacturing plants and operations occupy approximately 4,000 acres and produce approximately 250 million standard bricks per year. Several million specialty bricks are also produced. When at full production between 550 and 600 persons are employed. The newest plant was built in 1981 and the oldest in 1917.

The clay and shale mining operations and manufacturing facilities are contiguous. Drag lines, power shovels, front end loaders, drill rigs, pit trucks, and over-the-highway trailers are used to move the raw materials from the surface mine pits (see Figure 1) to the primary crushers. Water and surfactants are used to control the haulage roadway dusts. (See Figure 2).

The principal raw materials, clay and shale, are essentially alike except for the iron oxide content. Shale has 8-9% Fe_2O_3 and clay has 2-3% Fe_2O_3. Each is separately mined and processed to its final particle size. They are then mixed in predetermined proportions, depending on what color brick is desired. To this mixture other additives, for example: manganese dioxide and chrome oxide, may be used to obtain other shades and colors. The raw material process equipment varies from plant to plant. At Plant #8, for instance, primary crushing involves one crusher for shale and one for clay. Secondary grinding involves one rim discharge grinder for shale and two for clay. Screening for final particle size involves three screens for shale and seven screens for clay.

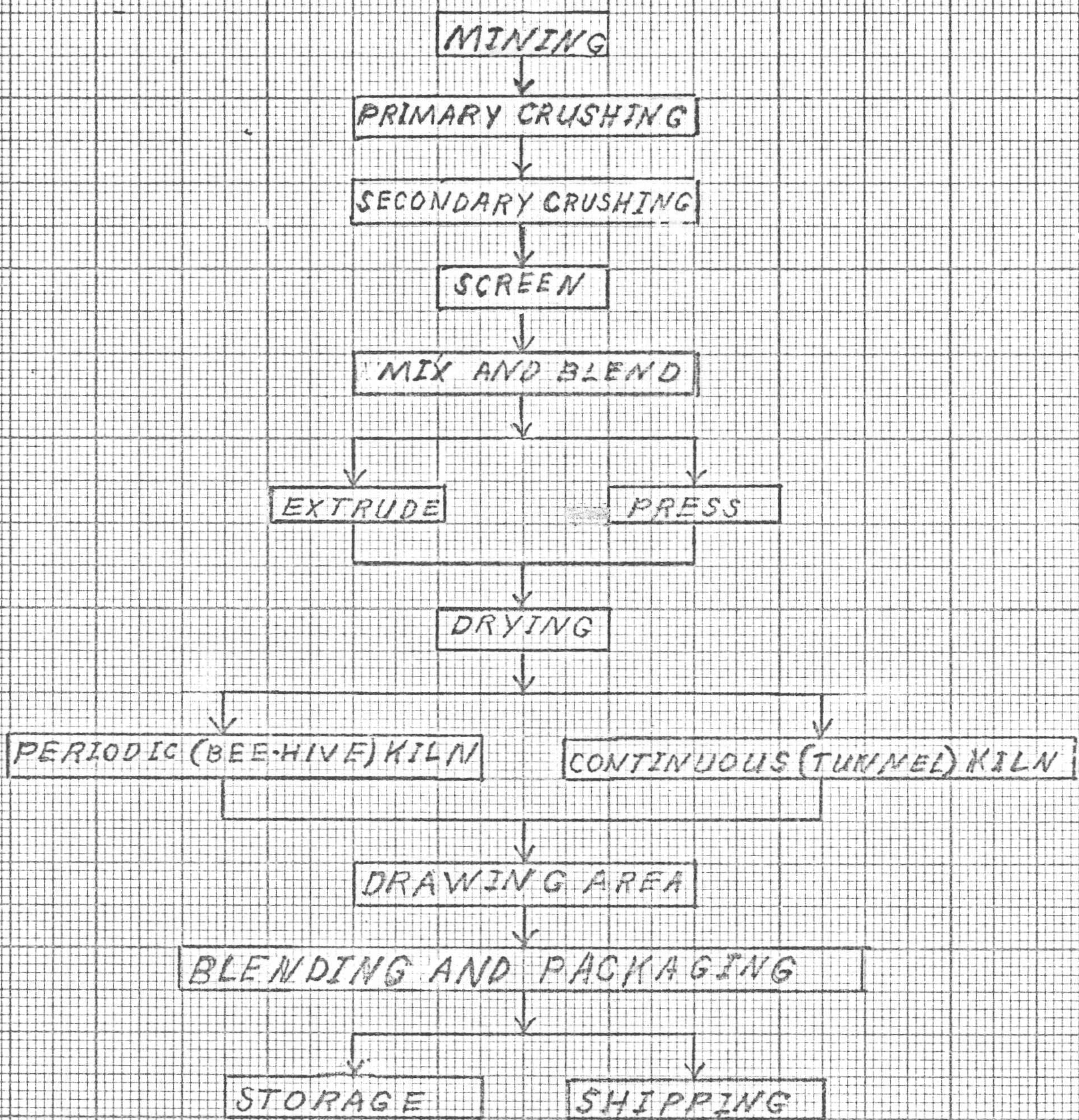

Figure 1. Belden Brick Flow Diagram

	TYPICAL THICKNESS	TYPICAL ELEVATION	
5A SHALE	20'	1230'	
5A COAL	1 '		
5 SANDSTONE	4 '		
5 SHALE	15'		
5 COAL	3'	1190'	LOWER KITTANNING COAL
5 FIRECLAY	15'		
SAWGRASS COAL	2 '		
4 SANDSTONE	8 '		
FLINT CLAY	4 '		
4 SHALE	25'		
VANPORT LIMESTONE	1 '		VANPORT LIMESTONE
SHALE	6 '		
4 LIMESTONE	1 '		PUTNAM HILL LIMESTONE
4 COAL	1 '	1124'	BROOKVILLE COAL
4 FIRECLAY	8 '		
SANDSTONE	2 '		
3A SHALE	20'		
3A COAL	3 '	1093'	TIONESTA COAL
3A FIRECLAY	4 '		

ALL PART OF PENNSYLVANIAN SYSTEM

ALLEGHENY FORMATION

POTTSVILLE FORMATION

<u>SHALES</u> - USED TO MANUFACTURE RED BRICK

<u>CLAYS</u> - USED TO MANUFACTURE BUFF BRICK

<u>LIMESTONE</u>- CRUSHED FOR ROAD MATERIAL IN OUR MINING OPERATIONS

<u>COAL</u> - SOLD AS BY-PRODUCT - COULD BE USED AS SOURCE OF FUEL NEEDED TO FIRE BRICK

Figure 2. Typical Cross Section of Belden Brick Surface Mine

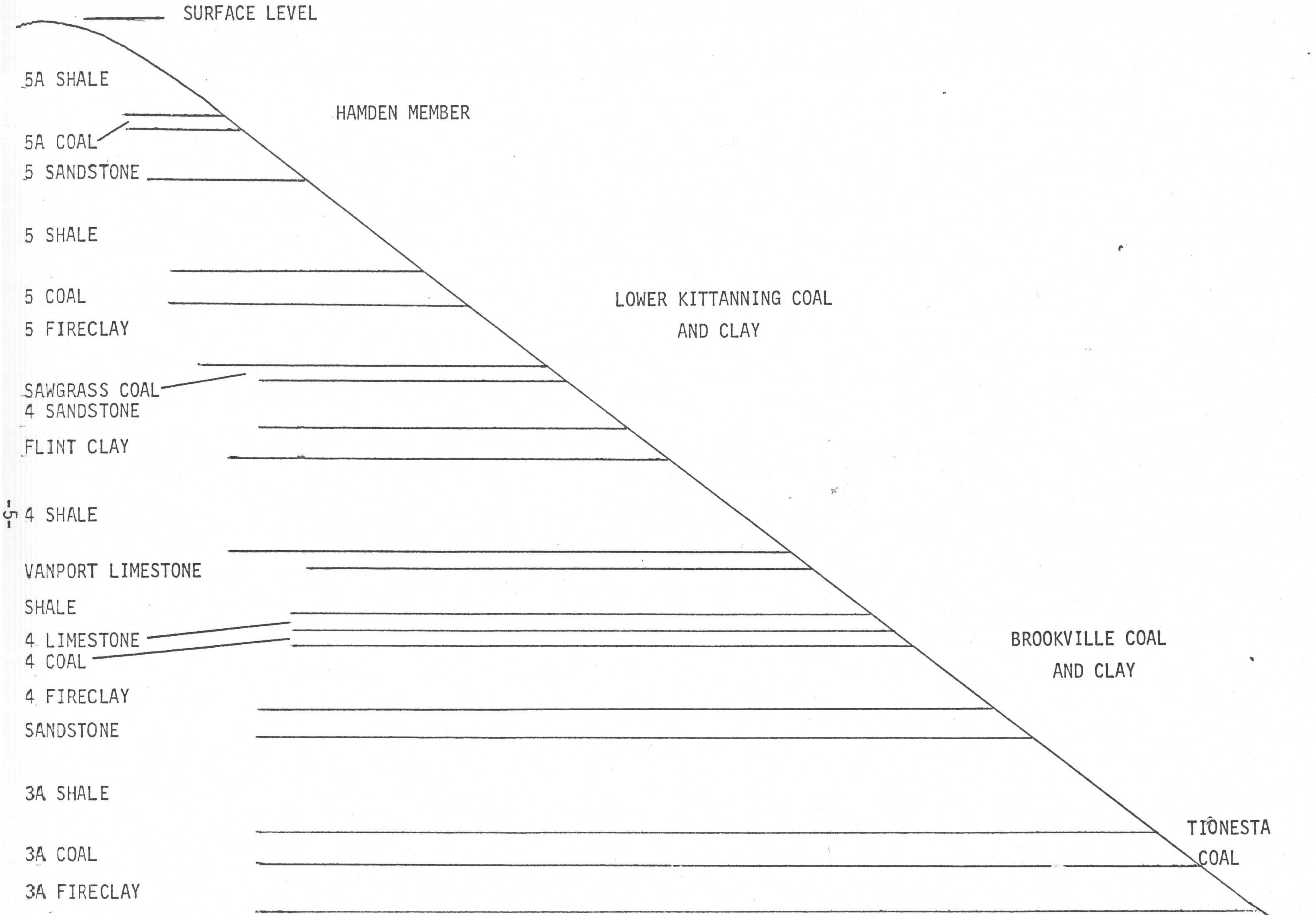

Figure 3. Typical Thicknesses and Evaluations of Belden Brick Surface Mine

The two methods of forming the mixture (ware) are extrusion and soft mud molding. Both methods were observed during this survey. In the extrusion process the pugged ware passes through a pug mill operation (pugged). It then passes through a deairing operation (deaired). The pugged and deaired ware is then forced through a die-opening in a column (extruded). The column surfaces may be textured if desired. The column then passes through a rotating wire cutter which cuts the brick into the desired dimensions. In the soft mud molding process the pugged ware is forced into mold cavities that are lined with a "parting sand."

The formed bricks are transferred by various methods to dryers which are heated by "waste heat" from the kilns. After drying over a period of about three days the bricks are fired in either periodic (beehive) or continuous (tunnel) kilns. After the desired colorations are obtained the bricks are cooled through a very critical cooling curve, so as not to fracture the glass-like structure of the body.

After cooling the bricks are transferred by various means to a drawing area. Here they are unloaded, inspected, classified and placed on pallets for storage and/or blending. The classified brick of various shades and colors are delivered to blending and packaging machines. Various colors, are then mechanically blended and placed in strapped packages. They may then be placed in storage or shipped by rail and trucks.

PROCESS DESCRIPTION AND RELATED CONTROLS

In Belden Bricks newer plants the clay and shale unit processes, through the screening operations, are highly automated. The processes are controlled and monitored by personnel in isolated control rooms (pulpits). Under normal operating conditions, only maintenance and housekeeping personnel are routinely exposed to the contaminated atmospheres. Personal protective equipment (respirators, safety glasses, safety shoes, and hard hats) are provided for their protection.

There are many dust sources associated with the crushing and screening processes. Those common to belt conveyors transfer points seem to be pretty well controlled. The exhaust system pick-up heads are at least twice as long as the belt is wide. When the belt speeds are less than 200 feet per minute a capture velocity of 350 CFM per foot of belt width is used. A number of these control system applications were noted during the survey. An in-depth evaluation and documentation of some of them would seem to be a valuable part of this CTA final report.

In the older plants there is considerable manual handling of the blending additives (manganese dioxide, chrome oxide, and barium carbonate). In the newer plants this process is more mechanized and the exposures have been greatly reduced.

During the forming process, whether it be by extrusion or pressing, there is much dust generated. Although the press (soft mud molding) line in Plant 8 was not operating, Mr. Jensen gave us a detailed explanation of how he had incorporated engineering controls such as; exhaust ventilation, operation enclosure, and scrap handling to solve the dust problems. Belden Brick spent nine years and $53,000 on the project and although we did not see the system in operation it appears much innovative and effective control technology has been employed that warrants documentation in this study.

In the soft mud molding process (which is wiedly used in the US & Europe) a clay and shale body containing 28% moisture is pressed into a mold that has been coated with a "parting sand." The mold is then covered with a board, turned over and removed, leaving the sand mold brick on the board. These operations are mechanized but the entire process is dirty and dusty. The parting sand is a particular problem. It is extremely fine and is fed under the press directly from a sand dryer. It is then thrown upward into the wet inverted molds.

After the bricks are formed, they are dried (see Figure 2). Another potential dust problem begins when the dried bricks are slid off the boards. The local exhaust system developed to capture the airborne dust, as well as, a system for collecting broken brick appears to be very innovative and will warrant documentation in this study.

The more advanced technology associated with the firing process (periodic or continuous) kiln is found in the tunnel type. It should be noted that there are a great many of the periodic (beehive) type kilns still in use in the ceramics industry. Belden Brick operates approximately 50 of them.

In the continuous kiln firing process, the dried brick on kiln cars are fed in by an automatic car moving and transfer system. As the bricks pass through the tunnel kiln many physical and chemical changes are brought about. The following occurs in the firing cycle:

- o At 212^{O}F mechanical water is removed. At 400^{O}F, hygroscopic water is removed.
- o Between 750^{O}F and 1000^{O}F, chemically combined water is removed.
- o Between 1000^{O}F and 1475^{O}F, the last traces of water are removed.

The atmosphere within the more modern tunnel kiln may be made either oxidizing or reducing. These specially designed kilns are the only ones in the world specifically built to simulate the coal fired atmospheres previously obtained in hand-fired periodic (beehive) kilns. Either gas or pulverized coal is introduced into the kiln to obtain a reducing atmosphere. Salt may also be added to obtain a desired color and/or surfact texture.

Belden Brick has designed and built a number of noise attenuation mufflers for the forced draft blowers used on and around the kilns. They seem to be effective and to warrant evaluation.

The work in the drawing area is physically very demanding. The process is labor intensive. Fork lift trucks and other mechanical equipment are widely used. Various devices have been developed to give the workers a mechanical advantage when handling several 4 1/2 lb. bricks at a time. However, a worker may manually handle as many as 18000 bricks in an 8-hour shift.

At the time of this survey the indoor ambient temperature, away from the kilns' and dryers, was estimated to be in the 50°F to 70°F range, so the workers doing the heaviest labor did not appear to be uncomfortable. Salamanders were being used for heat in the break and lunch room areas.

The dust collectors in use throughout the plants and processes ranged from Sly baghouses capable of handling 7400 CFM (Plant 8) to a hugh Griffin Environmental baghouse powered with a 200 HP blower (Plant 3). The latter was estimated to handle 80,000 CFM.

Some other examples of innovative control technology noted was; the use of a "tailings" conveyor under the main transfer conveyor, the use of rubber lined diaphram valves in the water classifier system, and the use of close tolerance scrap hoppers on tracks beneath conveyors and at points where high breakage occurs.

HEALTH AND SAFETY PROGRAM

The Belden Brick Company is self insured for workers compensation (WC). When they started underwriting their own WC exposures they had a zero reserve. So it seems apparent that this health and safety program has been effective.

The Company has a full-time Safety Engineer (R. Sclater) who reports to Mr. Jensen. In addition to Messers Jensen and Sclater there is another management person with safety and health responsibilities in each plant. Mr. Sclater spends part of each work day making health and safety surveys of the facilities and operations. He conducts in-depth surveys of all facilities and operations quarterly. Sometimes Mr. Jensen accompanies him on these surveys.

Safety meetings are held in each plant every two months. A different safety and/or health topic is the subject of each meeting. In the event of an accident the report is signed by the immediate foreman and the safety person assigned to the area where the accident occurred. Many of the employees are trained in CPR and First Aid. There is no control First Aid room or attendent. Any health complaint is immediately investigated by Messrs. Jensen and Sclater. If medical attention is needed the injured employee(s) are referred to designated physicians. In the event of a silicosis complaint, referral is made to a specialist in Columbus, Ohio.

Because of the vast amount of rotating and moving equipment in the facilities and operations a strigent lock-out procedure is in place and enforced. The use of closed circuit TV to monitor critical processes and operations plus a CB radio network helps the workers keep track of each other and to immediately respond to any emergency request for assistance.

CONCLUSIONS AND RECOMMENDATIONS

The personnel at the Belden Brick Company were very cooperative. Some of the control technology they use to control potentially harmful physical and chemical agents will warrant an in-depth evaluation and documentation in this study.

In addition to the apparently effective and efficient engineering controls observed, such as; exhaust ventilation, operation enclosures, scrap handling, noise attenuation, and vibration dampening some of their usage of monitoring, work practices, and personal protective equipment as controls may also warrant in-depth evaluation and documentation. Any in-depth studies should be scheduled when the controls to be evaluated and documented are in a full production mode.