PRELIMINARY SURVEY REPORT:

CONTROL TECHNOLOGY FOR THE CERAMIC INDUSTRY

AT

Acme Brick Company
Malvern, Arkansas

REPORT WRITTEN BY:
Frank W. Godbey

REPORT DATE:
June 1983

REPORT NO.:
110-27a

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
Division of Physical Sciences and Engineering
Engineering Control Technology Branch
4676 Columbia Parkway
Cincinnati, Ohio 45226

PLANT SURVEYED:	Acme Brick Company Grigsby Ford Road Malvern, Arkansas 72104
SIC CODE:	325
SURVEY DATE:	June 1, 1983
SURVEY CONDUCTED BY:	Frank W. Godbey
EMPLOYER REPRESENTATIVES CONTACTED:	Roland Adams, Regional Manager, (501) 332-6991 Ron Gallagher, Plant Manager, (501) 332-6991
EMPLOYEE REPRESENTATIVES CONTACTED:	No Employee Representatives

I. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) is the primary Federal agency engaged in occupational safety and health research. Located in the Department of Health and Human Services (formerly DHEW), it was established by the Occupational Safety and Health Act of 1970. This legislation mandated NIOSH to conduct a number of research and education programs separate from the standard setting and enforcement functions carried out by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards. The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering has been given the lead within NIOSH to study the engineering aspects of health hazard prevention and control.

Since 1976, ECTB has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial process, or specific control techniques. Examples of these completed studies include the foundry industry; various chemical manufacturing or processing operations; spray painting; and the recirculation of exhaust air. The objective of each of these studies has been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures.

These studies involve a number of steps or phases. Initially, a series of walk-through surveys is conducted to select plants or processes with effective and potentially transferable control concepts or techniques. Next, in-depth surveys are conducted to determine both the control parameters and the effectiveness of these controls. The reports from these in-depth surveys are then used as a basis for preparing technical reports and journal articles on effective hazard control measures. Ultimately, the information from these research activities builds the data base of publicly available information on hazard control techniques for use by health professionals who are responsible for preventing occupational illness and injury.

This study of the ceramics industry is being undertaken because there are approximately 100,000 employees potentially exposed to various chemical and physical agents. Other NIOSH studies have indicated that the handling of dry material, such as pesticides and silica flour, is an important source of airborne dust generation in the workplace. The latter, silica flour, study revealed that as much as one-half of the environmental silica dust problems may be effectively controlled by good work practices and effective housekeeping practices. The problem of dust dispersion during material handling spans many industries and can be a major source of chemical exposure. Although several industries may have devised successful methods of dust control, our literature review revealed that there is presently no centralized information base making the solutions universally available. The results of this study will help overcome this shortcoming.

Health hazard evaluations (HHE's) of ceramics industry workplaces have shown the importance of effective engineering controls. Three Health Hazard Evaluations attribute the existence of unhealthful conditions at the time of the surveys to inadequate ventilation. In all of these studies where high workroom-air contamination and adverse health effects were documented or suspected, inadequate ventilation was identified as a contributing factor. In addition to improved local exhaust ventilation, other control measures recommended in the reports include modified work practices, better worker education about occupational hazards, and the appropriate use of personal protective equipment. In total, these studies show a need for continuing activity in control technology development.

During the period July 1974 through June 1979, the Occupational Safety and Health Administration (OSHA) reported that 83% of the silica tests they conducted in the ceramics industry exceeded the permissible exposure level (PEL). Our preliminary surveys and contacts with industry personnel seem to indicate that there are now controls in place that prevent these excesses. This study will document the existence and usage of these controls.

NIOSH's major goal in undertaking this study is to identify and promote the use of cost effective health hazard control technology strategies in the ceramics industry. The primary focus will be on the control of airborne dust concentrations during the raw materials crushing and grinding operations. The control methods assessed will be documented in sufficient detail so that the information can be used in similar industrial situations.

II. PLANT AND PROCESS DESCRIPTION

PLANT DESCRIPTION

The Acme Brick Company, a subsidiary of Justin Industries Incorporated, produces structural brick from alluvial clay, fire clay, weathered and nonweathered shale, and aggregate or grog (brick rejects). The Ouachita Plant employs approximately 32 workers and operates one shift a day, five days a week. The clay preparation area employs two workers and is in a separate sheet metal building of approximately 5,000 square feet. The production building was built in 1981 of sheet metal and contains approximately 80,000 square feet of floor space. The plants production capacity is approximately 121,000 bricks per day.

PROCESS DESCRIPTION

Locally mined alluvial clay, fire clay, and shale are brought to the plant by truck and stored under roof adjacent to the clay preparation building. The process observed involves the preparation (crushing and grinding) of these materials, along with aggregate, for production use. The material preparation building operates two separate preparation lines, one on each side of the building, that use a common conveyor for transporting the finished material to the production building. A cab-enclosed frontend loader is used to move the alluvial clay and fire clay from the storage piles to the crushing circuit on the south side of the building. The bulk clays are dumped in separate Meco feeders where they are fed by gravity into a common McClanahan 24-inch by 48-inch Shave Master twin roll precrusher. The blended coarse-crushed clays are transported by conveyor to a Pas-Co TRR 832 claypactor hammer mill for fine crushing. The finely crushed material is transported by conveyor to three banks of 5-foot by 10-foot Simplicity screens where the properly sized (9-mesh) material passes through the screen and the oversized is returned for further crushing. The production size finished product is transported by an overhead covered conveyor approximately 200 feet to one of six 100-ton capacity storage silos in the production building.

The cab-enclosed frontend loader is used to move the aggregate and shale to the grinding circuit on the north side of the building. These materials are dumped into a Meco feeder where they are fed by gravity to a Pas-Co 584 rim discharge grinder for fine grinding. The finely ground material is transported by conveyor to two banks of 5-foot by 8-foot Leahy concentrator vibrating screens where the properly sized material (9-mesh) passes through the screen and the oversized is returned for further grinding. The finished product is transported by the overhead conveyor to the storage silos in the production building.

POTENTIAL HAZARDS

The primary raw material involved in the crushing and grinding operation in this plant is locally mined ball clays. These clays are known to contain approximately 20% quartz, a crystalline form of silica (based on sampling data obtained from an in-depth study).

Exposure to silica can produce silicosis, a debilitating respiratory disease, caused by inhalation of fine crystalline silica dust that is retained in the lungs. The amount of dust inhaled, the percentage of free or uncombined silica in the dust, the size of the dust particles, and the length of exposure all affect the onset and severity of silicosis. The inhaled dust, deposited in the bronchioles and alveoli, reacts within the lung tissue to form silicotic nodules.

The OSHA standard, or Permissible Exposure Limit (PEL), for respirable crystalline silica (quartz) is determined by the equation:

$$PEL = \frac{10}{\%\ \text{silica} + 2} \text{ milligrams per cubic meter of air } (mg/m^3).$$

For 100% silica dust (respirable), this calculated PEL is approximately equivalent to 0.1 mg/m^3 or 100 ug/m^3. Although the PEL pertains specifically to the 8-hour time-weighted average (TWA) exposure to employees, in this research, it will be used as an environmental criterion to evaluate the effectiveness of the control technology used to control dust emissions from material transfer points.

III. CONTROLS

PRINCIPLES OF CONTROL

Occupational exposures can be controlled by the application of a number of well-known principles, including engineering measures, work practices, personal protection, and monitoring. These principles may be applied at or near the hazard source, to the general workplace environment, or at the point of occupational exposure to individuals. Controls applied at the source of the hazard, including engineering measures (material substitution, process/equipment modification, isolation or automation, local ventilation) and work practices, are generally the preferred and most effective means of control both in terms of occupational and environmental concerns. Controls which may be applied to hazards that have escaped into the workplace environment include dilution ventilation, dust suppression, and housekeeping. Control measures may also be applied near individual workers, including the use of remote control rooms, isolation booths, supplied-air cabs, work practices, and personal protective equipment.

In general, a system comprised of the above control measures is required to provide worker protection under normal operating conditions as well as under conditions of process upset, failure and/or maintenance. Process and workplace monitoring devices, personal exposure monitoring, and medical monitoring are important mechanisms for providing feedback concerning effectiveness of the controls in use. Ongoing monitoring and maintenance of controls to ensure proper use and operating conditions, and the education and commitment of both workers and management to occupational health are also important ingredients of a complete, effective, and durable control system.

These principles of control apply to all situations, but their optimum application varies from case-to-case. The application of these principles at the crushing and grinding operation in this plant is discussed below. The entire material particle size reduction process is completely automated from the time the material is dumped into the Meco feeders until it is received in the production building storage silos. The clay preparation building and raw material storage area are isolated from the production building by about 200 feet and use only two workers to perform the entire operations. The bulk storage area is located under roof separate from the clay preparation building. Material transfer points are covered with removable covers and a water mist spray on one conveyor of each line. The entire operation is monitored from a totally enclosed air-conditioned control room. Head and eye protection are required in this area.

IV. CONCLUSIONS AND RECOMMENDATIONS

The efforts reported in the control section of this report may be effective in preventing hazardous exposure to the workers in this area. The control room appeared to be effective as indicated by the absence of any dust accumulation on horizontal surfaces inside the room. However, the control room would not protect workers from exposure when outside the room performing maintenance, housekeeping, and other associated duties. Therefore, this plant is not recommended for an in-depth evaluation of their existing controls.