

PRELIMINARY SURVEY REPORT:  
CONTROL TECHNOLOGY FOR NEW PLASTICS PROCESSES

AT

ZEFFLAMB INDUSTRIES, INC.  
FENTON, MICHIGAN

REPORT WRITTEN BY:

Dennis O'Brien

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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: Zefflamb Industries, Inc.

SIC CODE: 3079 (Miscellaneous Plastics Products)

SURVEY CONDUCTED BY: Dennis O'Brien  
William F. Todd

EMPLOYER REPRESENTATIVES CONTACTED: Jerry Froehlich, Manager, Manufacturing  
and Engineering  
Craig Muehlhauser, Production Manager

EMPLOYEE REPRESENTATIVES CONTACTED: None

## 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 processes, 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 survey report covers a walk through survey of the Zefflamb Industries plant in Fenton, Michigan. This survey was conducted to familiarize the investigators with the reaction injection molding process, to understand the potential of these operations for exposure to air contaminants, and to observe the control measures employed to prevent the overexposure of workers to these substances.

## II. PLANT AND PROCESS DESCRIPTION

Zefflamb Industries is a division of Durakon, a supplier of parts to the automotive aftermarket. The Zefflamb plant manufactures automobile fascia and similar parts primarily for the custom car and so-called "crash" markets using the reaction injection molding (RIM) process. Zefflamb employs approximately 40 persons, 25 of whom are engaged in production. The plant operates on a two-shift basis.

### Plant Description:

The manufacturing plant is a five year old, steel framed, steel sided structure covering about 20,000 square feet. The plant consists of a single open bay containing three RIM presses, associated resin and reactant pumps, trimming and rework stations, and a post-cure oven. Bulk isocyanate (in 55 gallon drums) is stored in a temperature controlled area separate from the main manufacturing bay.

### Process Description:

The RIM process makes use of the concept that an isocyanate and a polyol combine rapidly to produce a solid when contacted at a temperature above room temperature but below most processing temperatures. The two components are pumped under high pressure and an elevated temperature (95°F) from storage tanks to a mixing head via recirculating lines. For certain product lines, carbon black is added as a pigment to the polyol. The specific isocyanate and the mixing ratio used vary depending on the desired flexural modulus of the product, but all are MDI based. The mixing head, located at the mold, provides rapid intermixing as the material is injected into a closed mold where the reaction is completed. The molds are made of a low melting point alloy and heated with water to 140 - 160°F. RIM allows large parts to be fabricated with rapid cycle times and at lower injection and clamp pressures than are required for processing thermoplastic materials. Part sizes at this facility vary in thickness from about 1/8 to 1/4 inches and vary in weight from about 3 to 16 pounds.

A typical operation sequence follows: The press operator closes the mold, activating the automatic injection cycle. Material injection requires less than 2 seconds. The mold remains closed about 2 minutes, allowing the product to cure. The operator then opens the mold and removes, with the help of an assistant, the product from the mold. Removal requires about 30 seconds. Prior to initiating a new cycle the operator inspects the mold and if necessary, applies a mold release agent with an air atomized spray gun. The mold release consists of a wax in mineral spirits. The entire molding sequence takes from 4 to 6 minutes for complex fascias.

After molding the parts are trimmed by hand, and any imperfections removed by light sanding. The press operator assists in the trimming operations. The number of workers involved in trimming varies with the complexity of the part. A limited number of products require post curing in an oven.

#### Potential Hazards:

The major hazard associated with this process is exposure to isocyanates, specifically diphenylmethane diisocyanate. Diisocyanates irritate the respiratory tract and can act as respiratory sensitizers, producing asthma-like symptoms in sensitized individuals with exposure at very low concentrations. Exposure to diisocyanates may also result in chronic impairment of pulmonary function. NIOSH has recommended that employers should observe environmental limits for diisocyanates equivalent to a ceiling concentration of 20 ppb (parts per billion, volumetric basis) and an 8-hour time weighted average concentration of 5 ppb.

Other potential exposures include petroleum naphtha used in the mold release agent and for periodic mold cleanup and polyurethane plastic dust from the sanding operations. The mold release compound is sprayed using an air pressure higher than that needed for atomization. The resulting overspray caused a haze at times in the building. Eye, nose, and throat irritation, dermatitis, and effects on the nervous system have been found in workers exposed to some refined petroleum solvents. NIOSH has recommended that skin contact be minimized and suggested an environmental limit of 350 mg/m<sup>3</sup> for refined petroleum solvents. The hazards associated with the inhalation of dusts from polyurethane plastics are unknown.

### 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. 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 insure 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 are discussed below.

#### Engineering Controls:

The workers in the RIM molding process are effectively isolated from the isocyanate by the closed nature of the process. Exposures are limited to any residual isocyanate present when the mold is opened, pump or piping leaks and accidental releases from incomplete curing due to mixing failures. Exhaust ventilation is applied at floor level near the isocyanate pumps to remove vapors. This system was not operating at the time of the survey. The oven was observed to be exhausted to the outside but (the oven) was not used for the product currently scheduled. The presses relied on dilution for control of any air contaminants. Wall and roof fans were used for this purpose during warm weather. There are no provisions for makeup air. Use of the mold release agent resulted in a visible fog that persisted in the plant environment. Comfort heating was accomplished by gas fired infrared heaters running the length and width of the plant in a grid pattern.

The plant is planning to install plastic curtains around the presses with exhaust ventilation to reduce the fog associated with the mold release agent.

#### Work Practices:

Spills and leaks of resin or isocyanate are removed by use of what appeared to be a clay absorbent.

#### Monitoring:

The State of Michigan had recently completed an industrial hygiene survey of this plant and recommended it for inclusion in this study. A report has not yet been released to the company. The plant itself performs no routine air monitoring. Employees are given a pre-employment physical by a local clinic

which also provides first aid services to the plant. No routine physicals are administered.

**Personal Protection:**

One employee was observed to be wearing a nuisance dust mask (not NIOSH certified) during sanding of the molded product.

#### IV. CONCLUSIONS and RECOMMENDATIONS

It would appear that exposure to isocyanates in reaction injection molding is more likely to occur in brief, unplanned episodes rather than normal process emissions. Evaluation of this working environment in a follow-up visit by NIOSH should be considered using the improved sampling and analysis technique for total isocyanates now being finalized.

The following suggestions are offered to assist the plant in improving their work environment:

1. The plant should proceed with their plans to enclose and ventilate the RIM presses. The fog from the mold release compound can also be reduced by lowering the spray gun air and liquid pressures. Switching to an airless spraying system should also be considered.
2. Makeup air units should be purchased to prevent drafts and cold areas, especially if additional exhaust units are installed.
3. Enclosure of the pump area with connection of the floor exhausts to the enclosure would provide increase the protection afforded by the present system.
4. Pre-employment physical examinations should include pulmonary function testing. Consideration should be given to the provision of annual or biennial physical examinations.