PRELIMINARY SURVEY REPORT:

CONTROL TECHNOLOGY FOR NEW PLATICS PROCESSES

AT

FORD MOTOR COMPANY
SALINE INSTRUMENT AND PLASTICS PLANT
SALINE, MICHIGAN

REPORT WRITTEN BY:

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NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
Division of Physical Sciences and Engineering
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SIC CODE:	3711 (Motor Vehicles and Passenger Car Bodies)
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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. 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 instrument panel molding operations of the Ford Motor Company, Saline Instrument and Plastics Plant in Saline, 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

Plant Description:

The Saline plant is reported to be the world's largest molded plastics plant. The plant, constructed in the mid 1960's, contains 1,600,000 square feet of manufacturing space, and employs 2800 hourly and 400 salaried workers. The plant molds and plates grilles for automobiles and light trucks, and manufactures instrument panels, gauges, and other products. Instrument panels for the Escort/Lynx, Tempo/Topaz and Lincoln Mark VII are produced on three separate lines with a total of 24 presses using the reaction injection molding process. The estimated total number of workers potentially exposed is 50. The Escort/Lynx instrument panel lines were installed in 1980. The Tempo/Topaz and Mark VII lines were installed about a year and a half ago.

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 a slightly elevated temperature from storage tanks to a mixing head via recirculating lines. The isocyanate is a prepolymer based on diphenylmethane diisocyanate (MDI) and combined with a polyol at a weight ratio of two parts polyol to one part isocyanate. The mixing head, located at the mold, provides rapid mixing as the components are injected into a closed mold where the reaction is completed at an elevated temperature. 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.

Bulk polyol and isocyanate are stored in a secure, walled-off section of the plant bulk storage area. This area is kept warm to preclude crystallization of these components. Low pressure pumps located adjacent to the storage tanks deliver polyol and isocyanate to the secondary storage and high pressure recirculating systems at each of the instrument panel lines.

A typical operation sequence for an instrument panel press follows: The press operator inspects the mold, then hand fits a vinyl panel cover into the mold. He then inserts a molded plastic panel support, brushes wax on critical mold surfaces (sprays a water-based mold release on Mark VII using an airless sprayer), steps away from the machine, and initiates the cycle. A safety barrier drops (Escort/Lynx) or a light curtain is energized (Tempo/Topaz, Mark VII) as the automatic injection cycle is activated. Material injection requires less than 2 seconds. The mold remains closed for about 2 minutes allowing the product to foam and cure. The press then opens and the operator removes the instrument panel from the mold.

Potential Hazards:

The major hazard associated with this process is exposure to isocyanates, specifically MDI. 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. Ford maintains a corporate exposure standard for isocyanates of 2 ppb.

Other potential exposures include mold release agents used in the Mark VII instrument panel and glove box operations.

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 appear to be effectively isolated from the isocyanate by the closed nature of the process. Exposures are thus limited to: residual isocyanate present when the mold is opened; pump or piping leaks; and accidental releases from incomplete curing due to mixing failures. Local exhaust ventilation is used to supplement containment of the hazard at the the open mold in the event of an MDI release. Local exhaust of the Escort/Lynx presses is accomplished by side draft hoods (measuring about 1 foot by 4 feet) located immediately behind the mold. Exhaust is provided by a separate axial flow duct fan for each hood, thus allowing the exhaust to cycle with the opening of the mold. Flow was estimated from a duct velocity measurement to be approximately 4000 cfm. This resulted in a capture velocity of 100 fpm at the rear of the mold and 50 fpm at the front, a distance of about 3 feet from the hood face. (Measurements - Press No. 316). Observation of smoke released from a smoke tube along the front edge of an open mold revealed adequate control at all points. Local exhaust of the Tempo/Topaz and Mark VII presses was accomplished by enclosing the rear of the presses, which, together with the solid press sides, presents a booth-like structure. As before, exhaust is provided by a separate axial flow fan for each hood, allowing the exhaust to cycle with the opening of the mold. No total flow measurements were possible, but flow was estimated from the size of the exhaust duct to be significantly less than that measured in the Escort/Lynx presses. However, the better enclosure compensated for the lower flowrate as a capture velocity of 120 fpm was measured at the rear of the mold and 30 to 60 fpm at the front. (Measurements - Press No. 57).

Fresh make-up air is supplied to all areas of the plant.

Work Practices:

Spills and leaks of isocyanate, or a failure to cure resulting from a stoppage in polyol system (short-shot) may represent the highest exposure hazard and hence the greatest potential for sensitization. The Saline plant appears to have an effective system for dealing with these situations. In the case of a short-shot, the hazard is confined to a single machine by the local exhaust. The operator is instructed to step away from the equipment and notify the safety or security department. Specially trained personnel respond to neutralize the isocyanate with a solution consisting of an alcohol, ammonia, and water. In the event of a spill or leak, safety/security will determine the extent and severity of the hazard (they have direct reading instruments for this purpose). Small leaks or spills may be cleaned by a dry absorbent (a proprietary mixture of sawdust, Fuller's earth, an alcohol, and ammonia). Large spills (over about 4 feet in diameter) and continuous leaks will result in evacuation of the area and neutralization with the liquid cited above. Personnel involved in large scale decontamination operations don self-contained breathing apparatus, boots, gloves, and suits.

Monitoring:

Industrial hygiene services are provided by the Ford corporate hygiene staff. RIM operations at the Saline plant have been monitored for MDI using a Marcali analytical procedure. All sampling results for these operations were reported to be at or below the Ford corporate standard of 2 ppb. Plant safety personnel have direct reading instruments (MDA Scientific) for spot checks and area monitoring.

Employees are prescreened for work with isocyanates. This evaluation includes a medical history (with questions regarding allergies and smoking), chest x-ray, pulmonary function tests, and eosinophil count. This physical examination is repeated on a biennial basis.

IV. CONCLUSIONS AND RECOMMENDATIONS

Because of the closed nature of the process, exposure to isocyanates in reaction injection molding seems more likely to occur in brief, unplanned episodes rather than normal process emissions. Avenues of potential exposure appear to be well-controlled at this plant during everday operations, based on the reported sampling results. Evaluation of this working environment by NIOSH should be considered using the improved sampling and analysis technique for total isocyanates now being finalized. Such an evaluation might study exposure during deliberately staged process transients such as spills or short-shots, if arrangements with the company for such are possible.