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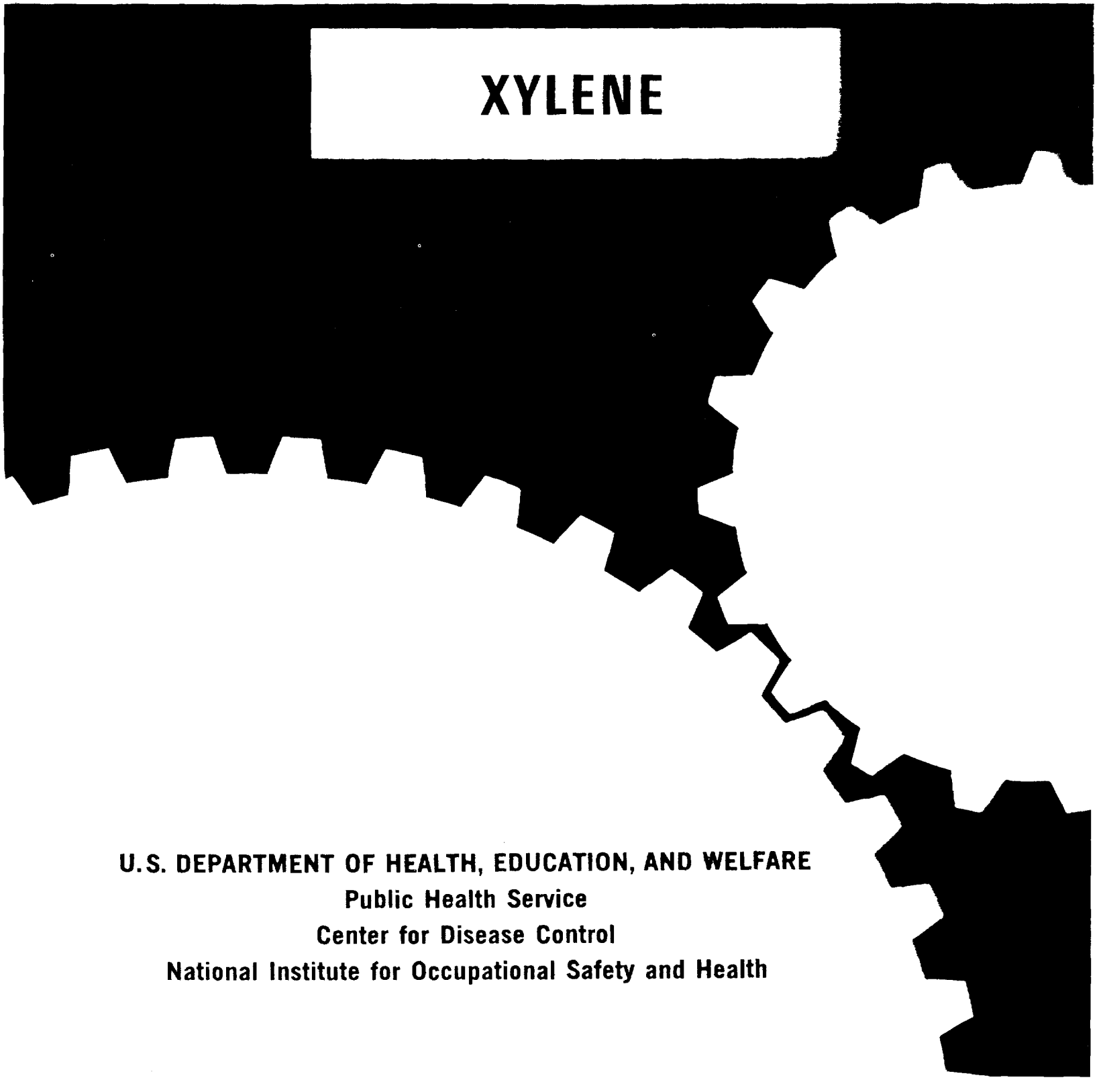
OCCUPATIONAL EXPOSURE TO



U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

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OCCUPATIONAL EXPOSURE TO XYLENE

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PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and safety of workers exposed to an ever-increasing number of potential hazards at their workplace. The National Institute for Occupational Safety and Health has projected a formal system of research, with priorities determined on the basis of specified indices, to provide relevant data from which valid criteria for effective standards can be derived. Recommended standards for occupational exposure, which are the result of this work, are based on the health effects of exposure. The Secretary of Labor will weigh these recommendations along with other considerations such as feasibility and means of implementation in developing regulatory standards.

It is intended to present successive reports as research and epidemiologic studies are completed and as sampling and analytical methods are developed. Criteria and standards will be reviewed periodically to ensure continuing protection of the worker.

I am pleased to acknowledge the contributions to this report on xylene by members of my staff, the valuable and constructive comments presented by the Review Consultants on Xylene, by the ad hoc committees of the American Industrial Hygiene Association and the American Medical Association, by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, and by William A. Burgess on respiratory protection. The

NIOSH recommendations for standards are not necessarily a consensus of all the consultants and professional societies that reviewed this criteria document on xylene. Lists of the NIOSH Review Committee members and of the Review Consultants appear on the following pages.

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The Office of Research and Standards Development, National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for xylene. Tabershaw-Cooper Associates developed the basic information for consideration by NIOSH staff and consultants under contract No HSM-99-73-39. Bryan D. Hardin had NIOSH program responsibility and served as criteria manager.

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CRITERIA DOCUMENT: RECOMMENDATIONS FOR AN OCCUPATIONAL EXPOSURE STANDARD FOR XYLENE

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I. RECOMMENDATIONS FOR A XYLENE STANDARD

The National Institute for Occupational Safety and Health (NIOSH) recommends that employee exposure to xylene in the workplace be controlled by adherence to the following sections. The standard is designed to protect the health and safety of workers over a working lifetime; compliance with all sections of the standard should therefore prevent adverse effects of xylene on the health and safety of workers. The standard is measurable by techniques that are valid, reproducible, and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standard. The criteria and standard will be subject to review and revision as necessary.

Regardless of the source of raw materials from which produced, "xylene" (also known as "xylol" or "dimethylbenzene") refers to any one of or combination of the isomers of xylene: ortho-, meta-, or para-dimethylbenzene. The term "xylene" will be used throughout this document. "Exposure to xylene" is defined as exposure above half the recommended time-weighted average environmental limit. If "exposure" to other chemicals also occurs, for example from contamination of xylene with benzene, provisions of any applicable standard for the other chemicals shall also be followed.

Section 1 - Environmental (Workplace Air)

(a) Concentration

Occupational exposure to xylene shall be controlled so that workers are not exposed to xylene at a concentration greater than 100 parts per million parts of air by volume (approximately 434 milligrams per cubic meter of air) determined as a time-weighted average (TWA) exposure for up to a 10-hour workday, 40-hour workweek, with a ceiling concentration of 200 parts per million parts of air by volume (approximately 868 milligrams per cubic meter of air) as determined by a sampling period of 10 minutes.

(b) Sampling, Collection, and Analysis

Procedures for collection and analysis of environmental samples shall be as provided in Appendices I and II or by any method shown to be equivalent in accuracy, precision, and sensitivity to the method specified.

Section 2 - Medical

Comprehensive preplacement and biennial (every 2 years) medical examinations should be provided for all workers subject to "exposure to xylene." The history and examination should be directed toward, but not limited to, the incidence of headaches, nausea or other gastrointestinal disturbance, dizziness, and of alcohol consumption. Particular attention should be focused on complaints and evidence of eye, mucous membrane, or skin irritation. Laboratory tests recommended at the time of the biennial examination include a complete blood count, a routine urinalysis, and appropriate liver function tests.

Section 3 - Labeling (Posting)

(a) Labeling

Containers of xylene shall carry a label stating:

XYLENE
(XYLOL, DIMETHYLBENZENE)

WARNING! FLAMMABLE
HARMFUL IF INHALED OR SWALLOWED
IRRITATING TO SKIN OR EYES

Keep away from heat, sparks, and open flame.
In case of fire, use foam, dry chemical, or CO2.
Avoid breathing vapor.
Avoid contact with eyes, skin, and clothing.
Keep container closed.
Use with adequate ventilation.
Do not use for washing hands, floors, or equipment.

First Aid: In case of eye or skin contact with liquid xylene, wash with plenty of water. If eye contact, call a physician. If swallowed, call a physician. Do not attempt to induce vomiting.

(b) Posting

Areas where there is occupational exposure to xylene shall be posted with a sign reading:

XYLENE

WARNING! FLAMMABLE
HARMFUL IF INHALED OR SWALLOWED
IRRITATING TO SKIN OR EYES

Keep out heat, sparks, or open flames.
No smoking permitted.
In case of fire, use fire extinguishers. (Give location)
Avoid breathing vapor.
Avoid contact with skin, eyes, and clothing.
Provide adequate ventilation.

This warning sign shall be printed both in English and in the predominant language of non-English-speaking workers, unless they are other-

wise trained and informed of the hazardous areas. All illiterate workers shall receive such training.

Section 4 - Personal Protective Equipment

(a) Protective Clothing

(1) Chemical safety goggles, face shields, or safety glasses with side shields shall be provided by the employer and shall be worn in any operation in which xylene may splash into the eyes.

(2) Appropriate protective clothing, including gloves, aprons, suits, boots, or face shields, shall be worn where needed to prevent repeated or prolonged skin contact.

(b) Respiratory Protection

(1) Engineering controls shall be used wherever feasible to maintain xylene concentrations below the prescribed limits. Such control equipment shall be sparkproof. Compliance with the permissible exposure limit may not be achieved by the use of respirators except:

(A) During the time period necessary to install or test the required engineering controls.

(B) For nonroutine operations such as a brief exposure to concentrations in excess of the permissible exposure limit as a result of maintenance or repair activities.

(C) During emergencies when air concentrations of xylene may exceed the permissible limit.

(2) When a respirator is permitted by paragraph (b)(1) of this Section, it shall be selected and used pursuant to the following requirements:

(A) For the purpose of determining the type of respirator to be used, the employer shall measure, when possible, the atmospheric concentration of xylene in the workplace initially and thereafter whenever process, worksite, climate, or control changes occur which are likely to increase the xylene concentrations; this requirement shall not apply when only atmosphere-supplying positive pressure respirators will be used. The employer shall ensure that no worker is being exposed to xylene in excess of the standard because of improper respirator selection, fit, use, or maintenance.

(B) A respiratory protection program meeting the requirements of 29 CFR 1910.134 as amended shall be established and enforced by the employer.

(C) The employer shall provide respirators in accordance with Table I-1 below and shall ensure that the employee uses the respirator provided.

(D) Respiratory protective devices described in Table I-1 shall be those approved under the provisions of 30 CFR 11 as amended.

(E) Respirators specified for use in higher concentrations of xylene may be used in atmospheres of lower concentrations.

(F) The employer shall ensure that respirators are adequately cleaned, and that employees are instructed on the use of respirators assigned to them, and on how to test for leakage.

(G) Where an emergency may develop which could result in employee injury from overexposure to xylene, the employer shall provide respiratory protection as listed in Table I-1.

TABLE I-1

RESPIRATOR SELECTION GUIDE FOR PROTECTION AGAINST XYLENE

Multiples of TWA Limit	Respirator Type
Less than 10x	Chemical cartridge respirator with full facepiece and organic vapor cartridge(s).
Less than 50x	Gas mask (full facepiece) with a chin-style organic vapor canister.
Less than 100x	(1) Gas mask (full facepiece) with front or back mounted organic vapor canister. (2) Type C supplied air respirator with a full facepiece operated in the demand (negative pressure) mode. (3) Type C supplied air respirator with a full facepiece operated in the pressure-demand (positive pressure) or continuous flow mode. (4) Self-contained breathing apparatus with a full facepiece operated in the demand (negative pressure) mode. (5) Combination Type C supplied air respirator with full facepiece operated in the demand (negative pressure) or continuous flow mode and an auxiliary self-contained air supply operated in the demand (negative pressure) mode.
100x or more CAUTION! The lower explosive limit is approximately 11,000 ppm	(1) Self-contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode. (2) Combination Type C supplied air respirator with full facepiece operated in the pressure-demand (positive pressure) or continuous flow mode and an auxiliary self-contained air supply operated in the pressure-demand (positive pressure) mode.
Unknown concentration	Self-contained breathing apparatus with a full facepiece operated in the pressure-demand (positive pressure) mode.
Escape	(1) Gas mask (full facepiece) with chin style or front or back mounted organic vapor canister. (2) Self-contained breathing apparatus with full facepiece operating either in the demand (negative pressure) or pressure demand (positive pressure) mode.

Section 5 - Informing Employees of Hazards from Xylene

(a) Each employee exposed to xylene shall be informed at the beginning of his employment or assignment to a xylene area of the hazards, relevant symptoms, appropriate emergency procedures, and proper conditions and precautions for safe use or exposure. Each employee shall be instructed as to the availability of such information which shall be kept on file. Information kept on file shall include that prescribed in (b) below and shall be accessible to the worker at each place of employment where xylene is involved in unit processes and operations.

(b) Information as specified in Appendix III shall be recorded on US Department of Labor Form OSHA-20, "Material Safety Data Sheet," or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor.

Section 6 - Work Practices

(a) Emergency Procedures

For all work areas in which there is a reasonable potential for emergencies, procedures as specified below, as well as any other procedures appropriate for a specific operation or process, shall be formulated in advance and employees shall be instructed in their implementation.

(1) Procedures shall include prearranged plans for obtaining emergency medical care and for necessary transportation of injured workers.

(2) Firefighting procedures shall be established and implemented. These shall include procedures for emergencies involving release of xylene vapor. In case of fire, xylene sources shall be shut off

or removed. Containers shall be removed or cooled with water spray. Chemical foam, carbon dioxide, or dry chemicals should be used for fighting xylene fires, and proper respiratory protection and protective clothing shall be worn.

(3) Approved eye, skin, and respiratory protection as specified in Section 4 shall be used by personnel essential to emergency operations.

(4) Nonessential employees shall be evacuated from exposure areas during emergencies. Perimeters of areas of hazardous exposures shall be delineated, posted, and secured.

(5) Personnel properly trained in the procedures and adequately protected against the attendant hazards shall shut off sources of xylene, clean up spills, and immediately repair leaks.

(b) Engineering controls such as process enclosure or local exhaust ventilation shall be used to maintain xylene concentrations within the recommended environmental limits. All such control equipment shall be sparkproof. Ventilation systems shall be designed to prevent the accumulation or recirculation of xylene in the workplace and to effectively remove xylene from the breathing zones of exposed workmen. Exhaust ventilation systems discharging to outside air must conform with applicable local, state, and federal air pollution regulations. Ventilation systems shall be subject to regular preventive maintenance and cleaning to ensure maximum effectiveness, which shall be verified by periodic airflow measurements.

(c) Containers of xylene shall be kept tightly closed at all times when not in use. Containers shall be stored in accordance with the

provisions of 29 CFR 1910, and shall be protected from heat, corrosion, mechanical damage, and sources of ignition.

(d) Washing of hands, equipment, or structures with xylene shall be prohibited.

(e) Any spills of xylene shall be promptly cleaned up.

(f) Prior to maintenance work, sources of xylene and xylene vapor shall be eliminated to the extent feasible. If concentrations below the workplace air limit cannot be assured, respiratory protective equipment shall be used during such maintenance work.

(g) All metal dispensing containers shall be properly grounded.

Section 7 - Sanitation

(a) Food Facilities

Food preparation, dispensing (including vending machines), and eating should be prohibited in xylene work areas.

(b) Smoking

Smoking shall not be permitted in areas where xylene is used, transferred, stored, or manufactured.

Section 8 - Monitoring and Recordkeeping

Workroom areas shall not be considered to have xylene exposure if environmental levels, as determined on the basis of a professional industrial hygiene survey or by the judgment of the compliance officer, do not exceed half of the recommended time-weighted average limit. Records of these surveys, including the basis for concluding that air levels are at or

below half of the time-weighted average limit, shall be maintained until a new survey is conducted. Surveys shall be repeated when any process change indicates a need for reevaluation or at the judgment of the compliance officer. Requirements set forth below apply to areas in which there is xylene exposure.

Employers shall maintain records of environmental exposures to xylene based upon the following sampling and recording schedules:

(a) In all monitoring, samples representative of the exposure in the breathing zone of employees shall be collected. An adequate number of samples shall be collected to permit construction of a time-weighted average (TWA) exposure for every operation or process. The minimum number of representative TWA determinations for an operation or process shall be based on the number of workers exposed as provided in Table I-2.

TABLE I-2

SAMPLING SCHEDULE

Number of Employees Exposed	Number of TWA Determinations
1-20	50% of the total number of workers
21-100	10 plus 25% of the excess over 20 workers
over 100	30 plus 5% of the excess over 100 workers

(b) The first environmental samples shall be completed within 6 months of the promulgation of a standard incorporating these recommendations.

(c) Environmental samples shall be taken within 30 days after installation of a new process or process change.

(d) Samples shall be collected at least quarterly in accordance with Appendix I for the evaluation of the work environment with respect to the recommended standard.

(e) Environmental monitoring of an operation or process shall be repeated at 30-day intervals when the xylene concentration has been found to exceed the recommended environmental standard. In such cases, suitable controls shall be initiated and monitoring shall continue at 30-day intervals until two consecutive surveys indicate the adequacy of these controls.

(f) Sampling records shall be maintained so that exposure information is available for individual employees and shall indicate the type of personal protective devices, if any, in use at the time of sampling. Each employee shall be able to obtain information on his own environmental exposure.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon which were prepared to meet the need for preventing occupational diseases arising from exposure to xylene. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 20(a)(3) of the Occupational Safety and Health Act of 1970 to "...develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The National Institute for Occupational Safety and Health (NIOSH), after a review of data and consultation with others, formalized a system for the development of criteria upon which standards can be established to protect the health of workers from exposure to hazardous chemical and physical agents. It should be pointed out that any recommended criteria for a standard should enable management and labor to develop better engineering controls resulting in more healthful work practices and should not be used as a final goal.

These criteria for a standard for xylene are part of a continuing series of criteria developed by NIOSH. The proposed standard applies only to the processing, manufacture, use of, or other occupational exposure to xylene as applicable under the Occupational Safety and Health Act of 1970. The standard was not designed for the population-at-large, and any extrapolation beyond occupational exposures is not warranted. It is intended to (1) protect against development of systemic effects, and

against local effects on the skin and eyes, (2) be measurable by techniques that are valid, reproducible, and available to industry and governmental agencies, and (3) be attainable with existing technology.

For many years, myelotoxicity (toxicity to the blood and blood-forming organs) has been attributed to xylene, primarily because of the close structural similarity which exists between xylene and benzene and the established effects of benzene on the blood and blood-forming organs. Xylene has been contaminated frequently with benzene. Current scientific evidence obtained from human and animal studies indicates that alkylation of the benzene ring, such as exists with xylene (dimethylbenzene), results in a loss of these blood effects. Benzene appears to be unique among the monocyclic aromatic hydrocarbons in these myelotoxic properties. Therefore, the major problem of xylene toxicity concerns its narcotic effects on workers, causing symptoms and signs such as muscular weakness, incoordination, and mental confusion which may pose a risk to both the worker and others.