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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO Assistant Secretary of Labor
Occupational Safety and Health Administration

DATE: SEP 29 1978

FROM : Acting Director, National Institute
for Occupational Safety and Health

SUBJECT: Revised Recommendations for Occupational Health Standard for Ethylene Dichloride

Attached is a preprint of a report, "NIOSH Revised Recommendation for an Occupational Exposure Standard for Ethylene Dichloride (1,2-dichloroethane)." Final printed copies of this report will be provided as soon as possible.

In 1976, the National Institute for Occupational Safety and Health transmitted a complete criteria document to OSHA which recommended a reduction in permissible occupational exposures to ethylene dichloride (EDC). The recommendation was to limit worker exposure to 5 ppm, determined as a 10-hour time-weighted average and to a peak concentration of 15 ppm in any 15-minute sampling period. The proposed standard also recommended restricting nursing mothers from areas of potential exposure to EDC. In that document NIOSH expressed concern regarding the potential carcinogenicity of one possible metabolite of EDC and noted the on-going carcinogenic study of EDC being conducted by the National Cancer Institute (NCI).

This report reviews the NCI study and other recent reports on the carcinogenic and mutagenic effects of EDC. A status report on a study in rats which is being conducted by Professor C. Maltoni in Italy, has been submitted to NIOSH. In this report Professor Maltoni tentatively concludes that EDC is non-carcinogenic when administered by inhalation. The report and its limitations in assessing carcinogenic hazards are described in the review.

Based upon the NCI studies which present positive animal bioassay results in 2 animal species and upon mutagenicity in several different bacterial test systems, NIOSH concludes that EDC has carcinogenic potential for humans.

NIOSH now recommends worker exposure be limited to 1 ppm (4 mg/cu m), determined as a time-weighted average (TWA) exposure for up to a 10-hour workday, 40-hour workweek. This has been determined as the lowest reliably detected limit using the sampling and analytical method

recommended in the 1976 criteria document. It is further recommended that the ceiling concentration be revised downward to 2 ppm (8 mg/cu m) as determined over a 15-minute sampling period. This recommendation is designed to adequately protect the worker from the known effects of exposure to EDC and in addition to significantly reduce the potential for EDC-induced carcinoma. The recommendations place special emphasis on preventing worker exposures which occur from the use of open vats, such as has occurred in the fumigation of grains and seeds.

The Standards Completion Program (SCP) transmitted recommendations concerning EDC to OSHA in October 1975 to supplement the existing Federal standard of 50 ppm. The revised recommendations differ from the SCP and the criteria document recommendations in that they now place emphasis upon EDC's carcinogenic potential as opposed to general toxic reactions.

EDC has been an important industrial chemical for the past 3 decades, with production in 1977 estimated at nearly 5 million metric tons per year. NIOSH estimated on the basis of a 1972-1974 national survey that approximately 2 million workers are potentially exposed to EDC.

Should you or any of your staff wish to be briefed by NIOSH personnel on this report, please contact me to make the necessary arrangements.

J. Michael Lane

J. Michael Lane, M.D.

Attachment

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : The Assistant Secretary for Health and Surgeon General
Through: ES/PHS_____
Director, CDC_____

DATE: SEP 29 1978

FROM : Acting Director, National Institute for Occupational Safety and Health

SUBJECT: Special Hazard Review of Ethylene Dichloride -- INFORMATION MEMORANDUM

NIOSH has prepared a Special Hazard Review of Ethylene Dichloride (1,2-dichloroethane) (EDC) which provides a revised recommended standard based on recent information which supports EDC's potential for producing carcinogenic effects.

EDC is an important industrial chemical, with production in 1977 estimated at nearly 5 million metric tons per year. NIOSH estimated, on the basis of a national survey carried out from 1972 to 1974, that approximately 2 million workers were potentially exposed to EDC. It has long been recognized that EDC produces both acute and chronic effects, including central nervous system depression, cardiac arrhythmia, dermal irritation, and chronic effects to the liver and kidney. These hazards were described in a criteria document delivered to the Department of Labor in March 1976. The criteria document at that time referred to ongoing research at the National Cancer Institute (NCI) concerning the carcinogenic potential of EDC.

In December 1977, NCI released the results of its bioassay test which show that EDC is carcinogenic in rats and mice. Supporting evidence also is derived from positive results in several bacterial test systems where EDC was shown to have mutagenic properties. After review of these data, NIOSH concludes that EDC has carcinogenic potential for humans. The report recommends lowering of the earlier NIOSH recommended time-weighted average (TWA) limit of 5 ppm to 1 ppm, determined as a TWA exposure for up to a 10-hour workday, 40-hour workweek. It is also recommended that the peak concentration of 15 ppm be revised downward to a ceiling concentration of 2 ppm in any 15-minute sampling period. The revised standard includes recommendations on medical surveillance, labeling and posting, personal protection, informing employees of hazards, work practices, sanitation, and monitoring and recordkeeping.

This revised recommended standard is part of a continuing series of occupational health standards developed by NIOSH in accordance with the Occupational Safety and Health Act of 1970. The report is being transmitted to the Department of Labor for review and consideration in the

standard-setting process. The proposed standard is considered appropriate, and no additional information is now available that would affect the recommendations.

J. Michael Lane

J. Michael Lane, M.D.

Attachment

cc: Eula Bingham, OSHA

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : Assistant Secretary of Labor
Occupational Safety and Health Administration

DATE: September 26, 1978

FROM : Acting Director, National Institute
for Occupational Safety and Health

SUBJECT: Criteria for a Recommended Standard....Occupational Exposure to n-Alkane Mono Thiols, Cyclohexanethiol, and Benzenethiol

Attached are cited references, reviewer comments and accessory information (Tabs), an annotated complete search bibliography, and a reproduced copy of the document "Criteria for a Recommended Standard....Occupational Exposure to n-Alkane Mono Thiols, Cyclohexanethiol, and Benzenethiol." Printed copies of this document will be provided as soon as possible.

This is a complete criteria document containing recommendations for environmental limits, sampling and analysis, medical surveillance, labeling and posting, personal protective equipment and clothing, hazard information, work practices, and monitoring and recordkeeping. The recommendations apply to the C1 through C12 (methane-, through dodecane-), C16 and C18 (hexadecane-, octadecane-) n-alkane-thiols, and cyclohexanethiol, and benzenethiol. The criteria document contains recommendations for reductions in the present Federal standards (29 CFR 1910.1000) of 10 ppm as a ceiling concentration for methane- and ethanethiol and 10 ppm as a TWA concentration for butanethiol to a ceiling concentration not to exceed 0.5 ppm for the C1 through C12, C16, and C18 alkane-thiols, and cyclohexanethiol, or any combination of these thiols. The ceiling limit will ensure that acute exposure to n-alkane thiols, or cyclohexanethiol will protect against the development of irritative effects on mucosal surfaces as well as against the development of systemic effects. In addition, since benzenethiol exhibits a greater toxicity than these thiols, the criteria document contains the recommendation that exposure to this compound not exceed a ceiling concentration limit of 0.5 mg/cu m (0.1 ppm) in order to ensure that brief exposure to the substance will not result in damage to the eye and internal organs.

The Standards Completion Program (SCP) on November 11, 1976, transmitted recommendations to the Department of Labor to supplement the existing Federal Standards for methane-, ethane-, and butanethiol. There are differences between the SCP recommendations and the criteria document recommendations as regards requirements for personal protective equipment and medical surveillance.

Another difference between the two recommendations exists in the area of recordkeeping. The SCP recommendations call for retention of records of exposure measurements for one year or more with medical records to be retained for the duration of employment of each affected employee. The criteria document recommendations specify that medical records and records of environmental monitoring be kept for 30 years. Other differences in the recommendations, for example those dealing with the number of recommended work practices, arise from the fact that the criteria document presents a more comprehensive review of the literature and results from a more extensive use and evaluation of the knowledge and experiences of health professionals. NIOSH, therefore, recommends adoption of the standard recommended in the criteria document.

If you or your staff are interested in being briefed by NIOSH personnel on this document, please contact me directly to make the necessary arrangements.

J. Michael Lane

J. Michael Lane, M.D.

4 Enclosures

Tabs
Criteria Document
Photocopy of All Literature Cited as References
Annotated Complete Search Bibliography

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : The Assistant Secretary for Health and Surgeon General
Through: ES/PHS_____
Director, CDC_____

DATE: SEP 26 1978

FROM : Acting Director, National Institute for Occupational Safety and Health

SUBJECT: Criteria Document: Recommendations for an Occupational Exposure Standard for n-Alkane Mono Thiols, Cyclohexanethiol and Benzenethiol - INFORMATION MEMORANDUM

A complete criteria document for occupational exposure to n-alkane mono thiols, cyclohexanethiol, and benzenethiol has been prepared by the National Institute for Occupational Safety and Health (NIOSH). NIOSH recommends a reduction in the present Federal limits (29CFR 1910.1000) of 10 ppm as a ceiling concentration for methane-, and ethanethiol and 10 ppm as a TWA concentration for butanethiol to a ceiling concentration of 0.5 ppm for the C1 thru C12 (methane- thru dodecane-), and the C16, and C18 (hexadecane-, octadecane-) n-alkane thiols and cyclohexanethiol, or any combination of these thiols. Furthermore, NIOSH recommends that the concentration of benzenethiol in workplace air should not exceed 0.5 mg/cu m (0.1 ppm) as a ceiling concentration for any 15-minute period.

Methanethiol is used extensively in the manufacture of the essential amino acid, methionine. The lower-molecular-weight alkane thiols and benzenethiol are intermediates in the synthesis of pharmaceutical and pesticidal chemicals. Because of their penetrating, disagreeable odor at concentrations as low as 0.02 parts per billion, ethane-, propane-, and butanethiol are employed as warning agents for gas leaks in mines, gas lines, and refrigeration units. The higher-molecular-weight alkane thiols are used in the preparation of tin derivatives and thermal stabilizers for polyvinyl chloride (PVC) resins, PVC pipe, and in froth flotation procedures to increase the yield of copper from ore. NIOSH, from a survey conducted from 1972 to 1974, has estimated that as many as 180,000 workers in the United States are potentially exposed to thiols. The proposed standard would apply to the processing, manufacture, use, or other occupational exposures to thiols.

The major concern in occupational exposure to thiols is their potential for causing irritation to mucosal surfaces and possible effects on the central nervous system. Initial signs and symptoms from exposure to thiols are irritation of the eyes, nose and throat as well as headache, and nausea. Delirium has also been observed. The neurologic effects due to thiol poisoning are manifested as confusion, muscular weakness culminating in paralysis, respiratory changes leading to respiratory failure, mild to severe cyanosis, and changes in the central and autonomic nervous systems.

Since skin contact with these chemicals may result in systemic effects, NIOSH recommends that medical surveillance be made available to all employees working in an area where thiols are stored, produced, processed, or otherwise used, except when stored in sealed, intact containers. Engineering controls should be used wherever feasible to maintain airborne thiol concentrations below the prescribed limits, and respirators should be used only in nonroutine or emergency situations which may result in exposure at concentrations in excess of the exposure limits. Personal protective clothing is recommended for all workers occupationally exposed to thiols to further reduce the likelihood of skin contact with the substances.

The recommended standards are part of a continuing series of criteria documents developed by NIOSH in accordance with the Occupational Safety and Health Act of 1970. The document is being transmitted to the Department of Labor for review and consideration in the standard setting process. The criteria document was reviewed by six consultants, two professional societies, and government agencies having interest in and responsibility for occupational safety and health.

The recommended standards are considered appropriate, and no additional information that would affect the recommended standards is available at this time.

J. Michael Lane

J. Michael Lane, M.D.

cc:
Dr. Eula Bingham, OSHA

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : Assistant Secretary of Labor
Occupational Safety and Health Administration

DATE: September 28, 1978

FROM : Acting Director, National Institute
for Occupational Safety and Health

SUBJECT: Criteria for a Recommended Standard....Occupational Exposure to Antimony

Attached are reviewer comments and accessory information (Tabs) and a reproduced copy of "Criteria for a Recommended Standard....Occupational Exposure to Antimony." Printed copies of the document and copies of all cited references will be provided as soon as possible.

This is a complete criteria document, containing recommendations for medical examinations, work practices, labeling and posting, monitoring and recordkeeping, sampling and analytical procedures, an environmental limit of 0.5 mg/cu m as a time-weighted average (TWA) concentration which is the same as the present Federal standard, and an action level of one-half the recommended TWA. These recommendations are based on human and animal studies which have shown that exposure to antimony can cause adverse effects on the heart, lungs, skin, and mucous membranes.

The document cites one study which reported an increased incidence of reproductive problems in female antimony workers, and lower-than-normal weight gain in their infants. The same author reported similar findings with animal experiments. This single report is not considered by NIOSH t be conclusive evidence on which to base the recommended standard. The percentage of gynecologic problems reported in the control group was abnormally high (56%), and many procedural points were not discussed. A definitive interpretation of the study is not possible without further evidence; however, it is recommended that workers be advised of the existence of this report and the information contained therein.

The results of an epidemiologic study reported in 1973 from England raised the suspicion of an increased risk of lung cancer in antimony workers; however, the information provided by this report is severely deficient in experimental details and, therefore, it is impossible to attach any significance to the results at this time. Attempts by NIOSH to obtain more information from the authors have not been successful. A NIOSH supported study is currently in progress to determine any carcinogenic effect of antimony trioxide.

The Standards Completion Program (SCP) transmitted recommendations to the Department of Labor on November 3, 1976, to supplement the existing Federal standard. The recommendations contained in this document differ in some respects from those generated by the Standards Completion Program, particularly in the area of personal protective clothing and equipment. Since the criteria document represents a more extensive review and evaluation of the available information by health professionals, NIOSH recommends adoption of the recommendations contained in the criteria document in order to adequately protect the worker from the effects of exposure to antimony.

If you or any member of your staff are interested in being briefed by NIOSH personnel on this document, please contact me directly to make the necessary arrangements.

J. Michael Lane, M.D.

2 Attachments
Criteria Document
Compiler Reviewer Comments and
and Accessory Information (Tabs)

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : The Assistant Secretary for Health and Surgeon General
Through: ES/PHS
Director, CDC

DATE: SEP 7 1978

FROM : Acting Director, National Institute for Occupational Safety and Health

SUBJECT: Special Occupational Hazard Review for DDT — INFORMATION MEMORANDUM

NIOSH has prepared a special occupational hazard review for DDT which focuses on evidence of the chemical's carcinogenic potential but also reviews all potential and documented health effects of DDT. This special occupational hazard review is an up-to-date and complete compilation of toxicological information on DDT.

This document, along with a companion document for aldrin/dieldrin and previous NIOSH recommendations for other pesticides, will form the basis for NIOSH recommendations for international standards for pesticides. A World Health Organization meeting for the purpose of setting such standards is anticipated in the near future. The document will also be transmitted to the Department of Labor for their information and action.

DDT is mainly produced in this country for export only, although it can still be used by the U.S. Public Health Service and the Department of Agriculture for certain specified applications. It can also be used for controlling body lice. Total number of workers exposed to DDT is probably restricted to those employees of the sole manufacturer who is located in Los Angeles County, California, and to those persons involved in application for restricted purposes described above.

This document discusses all health impacts of DDT, and recommendations contained in the summary are based on animal evidence, which indicates that DDT should be regarded as a suspected occupational carcinogen. The current Federal standard for DDT is 1 mg/cu m as a time weighted average for up to 8 hours. NIOSH recommends that occupational exposure to DDT not exceed the lower limit of detectability of a reliable sampling and analytical method. In the case of the NIOSH validated method, that level would be 0.5 mg/cu m.

This report and a companion report on aldrin/dieldrin are the fifth and sixth special occupational hazard reviews to be completed as part of a continuing series. Special occupational hazard reviews are disseminated to industry, labor, and professional organizations.

Should you or any of your staff wish to be briefed on this report, please contact me.

for J. Michael Lane, M.D.

cc:
Dr. Eula Bingham, OSHA

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : Assistant Secretary of Labor
Occupational Safety and Health Administration

DATE: SEP 7 1978

FROM : Acting Director, National Institute
for Occupational Safety and Health

SUBJECT: Special Occupational Hazard Review for DDT

Attached is a copy of "Special Occupational Hazard Review for DDT." Printed copies of this document will be provided as soon as possible.

DDT is mainly produced in this country for export only, although it can still be used by the U.S. Public Health Service and the Department of Agriculture for certain specified applications. It can also be used for controlling body lice. Total number of workers exposed to DDT is probably restricted to those employees of the sole manufacturer, who is located in Los Angeles County, California, and to those persons involved in application for restricted purposes described above.

This document discusses all documented and potential health impacts of DDT, and recommendations contained in the summary are based on animal evidence, which indicates that DDT should be regarded as a suspected occupational carcinogen. The current Federal standard for DDT is 1 mg/cu m as a time weighted average for up to 8 hours. NIOSH recommends that occupational exposure to DDT not exceed the lower limit of detectability of a reliable sampling and analytical method. In the case of the NIOSH validated method, that level would be 0.5 mg/cu m.

This document, along with a companion document for aldrin/dieldrin and previous NIOSH recommendations for other pesticides, will form the basis for NIOSH recommendations for international standards for pesticides. A World Health Organization meeting for the purpose of setting such standards is anticipated in the near future.

Should you or any of your staff wish to be briefed on this report, please contact me.

for J. Michael Lane, M.D.

Attachment

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : The Assistant Secretary for Health and Surgeon General
Through: ES/PHS_____
Director, CDC_____

DATE: September 28, 1978

FROM : Acting Director, National Institute for Occupational Safety and Health

SUBJECT: Criteria Document: Recommendations for an Occupational Exposure Standard for Antimony - INFORMATION MEMORANDUM

A criteria document and recommended standard for occupational exposure to antimony has been prepared by the National Institute for Occupational Safety and Health (NIOSH). NIOSH recommends that the present Federal standard be maintained and that workers not be exposed to antimony at concentrations greater than 0.5 mg/cu m as a time-weighted average (TWA) concentration for up to a 10-hour workshift in a 40-hour workweek. NIOSH recommends that occupational exposure to antimony in the workplace be minimized through the use of engineering controls, good work practices, medical surveillance, employee training programs, and other industrial hygiene practices.

NIOSH estimates that 1.4 million workers in the United States are potentially exposed to antimony and its compounds in their occupational environment. Exposures are largely to metal alloys and to the metal trioxide and trisulfide. The major use of antimony at this time is in the production of flame retardants. Antimony is also used in alloys for a variety of applications and in pigments, ceramics, glass, and plastics. Occupational exposures also occur in the mining, smelting, and refining of antimony.

This standard is being recommended to prevent effects of antimony on the heart, lungs, skin, and mucous membranes. Recommended medical monitoring of these possible effects includes periodic tests of pulmonary and cardiac function. Blood profile alterations and liver involvement have been associated with exposure to antimony at very high concentrations. Present evidence is inconclusive regarding an increased risk of lung cancer and reproductive disorders from antimony exposure. While the environmental limit has not been based on these possible effects, it is recommended that employees be advised that one report has indicated possible hazards t reproduction in both humans and animals due to antimony exposure. Becaus of doubts about the available evidence relating to carcinogenicity of antimony and its implications, the initiation of animal research to obtain more definitive information regarding these effects is recommended. Research to evaluate the carcinogenic potential of antimony trioxide is currently in progress under a NIOSH supported study.

The recommended standard is part of a continuing series of criteria documents developed by NIOSH in accordance with the Occupational Safety and Health Act of 1970. The document is being transmitted to the Department of Labor for review and consideration in the standard setting process. The criteria document was reviewed by fourteen consultants, two professional societies, and by government agencies having interest in and responsibility for occupational safety and health. The proposed standard is considered appropriate and no additional information that would affect the recommended standard is available at this time.

J. Michael Lane, M.D.

cc: Dr. Eula Bingham, OSHA

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : The Assistant Secretary for Health and Surgeon General
Through: ES/PHS_____
Director, CDC_____

DATE: September 27, 1978

FROM : Acting Director, National Institute for Occupational Safety and Health

SUBJECT: Criteria Document: Recommendations for an Occupational Exposure Standard for Diisocyanates - INFORMATION MEMORANDUM

A complete criteria document for occupational exposure to diisocyanates has been prepared by the National Institute for Occupational Safety and Health (NIOSH). The standard recommended by NIOSH includes requirements for workplace environmental limits, sampling and analysis, medical surveillance, labeling and posting, personal protective clothing and equipment, hazard apprisal, work practices, sanitation, and monitoring and record-keeping. Specific environmental limits are recommended for toluene diisocyanate (TDI), diphenylmethane diisocyanate also known as methylene bisphenyl isocyanate (MDI), hexamethylenediisocyanate (HDI), naphthalene diisocyanate (NDI), isophorone diisocyanate (IPDI), and dicyclohexylmethane-4,4'-diisocyanate (hydrogenated MDI). The environmental limits recommended for these diisocyanates are equivalent to a time-weighted average (TWA) concentration of 5 ppb for up to a 10-hour workshift, 40-hour workweek and a ceiling concentration of 20 ppb over a 10-minute sampling period. Federal standards already exist for toluene-2,4-diisocyanate and methylene bisphenyl isocyanate (MDI). They are 20 ppb (0.14 mg/cu m), and 20 ppb (0.2 mg/cu m) as "ceiling values," respectively.

NIOSH, in a survey conducted from 1972 to 1974, estimated that 50,000-100,000 employees in the United States are potentially exposed to diisocyanates. Because this number does not include occasional use of diisocyanate products, such as polyurethane varnish, it may underestimate the total number of exposed workers.

Diisocyanates constitute the monomeric subunits in urethane polymerization. The versatility and relative low cost of urethane-polymers allows their use in a wide variety of applications. Flexible urethane foam products include cushions, mattresses, carpet underlay, and clothing. So called "rigid" foams serve as structural components and insulation. Polyurethanes can be spun to make elastomeric fibers and webbing. Certain adhesives contain polyurethanes. Coatings based on polyurethane are applied to hosts of products ranging from communications wiring, to airplanes, to wood floors. An equally impressive list of products and applications emerges when considering diisocyanates as used in mixed polymers such as urethane-acrylics.

In developing this criteria document on diisocyanates, NIOSH has concluded that recommendations based on a scientific evaluation of the toxicity of TDI and other diisocyanates are applicable to all diisocyanates and, thus, that diisocyanates should be considered a class of compounds with reasonably uniform effects on employee health.

The recommended standard applies to diisocyanate monomers only and not to higher polymers of these compounds. However, free monomeric diisocyanate may still be present in polymerized products and may constitute a hazard during manufacturing, foaming, spraying, and molding operations. Hazards to health arise primarily from exposure to diisocyanate vapor and to spray-generated aerosols. Although skin and eye irritation are known to occur with diisocyanate exposure, the primary adverse effects involve the respiratory tract. Bronchitis, chest tightness, nocturnal dyspnea, pulmonary edema, and death may result from exposure to diisocyanates at high concentrations. Of major concern is the development in certain individuals of diisocyanate sensitization. Sensitization may be manifested as a generalized skin disorder, but is usually experienced as a debilitating asthma-like response to diisocyanates at very low, often unmeasurable concentrations.

In 1973, NIOSH published a criteria document on toluene diisocyanate which recommended a TWA concentration limit of 5 ppb and a ceiling concentration of 20 ppb for any 20-minute air sampling time. NIOSH concluded that strict adherence to these limits and other provisions of the standard would prevent adverse health effects of exposure to TDI and the further development of sensitization. It is clear that in recent years improved technology, work practices and increased employee monitoring and education have reduced the incidence and extent of adverse effects of sensitization. There remains, however, a fraction of the population (approximately 5-15%) which demonstrates an increased risk toward diisocyanate sensitivity. NIOSH is unable to recommend means by which one can identify all individuals at increased risk before they are exposed to diisocyanates, or to define occupational exposure limits which will prevent sensitization, or to define occupational exposure limits which will prevent adverse reactions in all individuals already sensitized to diisocyanates.

The NIOSH recommendations for a standard should protect unsensitized workers from adverse effects on their health from exposure to diisocyanates, identify workers who exhibit signs of sensitization, and further reduce the incidence of diisocyanate sensitization.

NIOSH recommends that workers exposed to diisocyanates be thoroughly counselled on the known possible effects on their health from diisocyanate exposure and have comprehensive preplacement exams with special attention being given to respiratory functions. Subsequent examinations are advised where symptoms

of diisocyanates irritation or sensitization are present. Engineering contr ls should be used wherever feasible to maintain diisocyanate concentrations at r below the prescribed limits.

These criteria for a recommended standard are part of a continuing series of criteria documents developed by NIOSH in accordance with provisions of the Occupational Safety and Health Act of 1970. The document is being transmitted to the Department of Labor for review and consideration in the standard setting process. It was reviewed by six consultants, two professional societies, and governmental agencies having interest in and responsibility for occupational safety and health. The recommended standard is considered appropriate and no additional information that would affect it is available at this time.

J. Michael Lane MD

J. Michael Lane, M.D.

cc:
Dr. Eula Bingham, OSHA

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : Assistant Secretary of Labor
Occupational Safety and Health Administration

DATE: September 27, 1978

FROM : Acting Director, National Institute
for Occupational Safety and Health

SUBJECT: Criteria for a Recommended Standard....Occupational Exposure to Diisocyanates

Attached are cited references, reviewer comments and accessory information (Tabs), an annotated complete search bibliography, and a reproduced copy of the document "Criteria for a Recommended Standard....Occupational Exposure to Diisocyanates." Printed copies of this document will be provided as soon as possible.

The recommended standard in the criteria document includes requirements for workplace environmental limits, sampling and analysis, medical surveillance, labeling and posting, personal protective clothing and equipment, hazard apprisal, work practices, sanitation, and monitoring and recordkeeping. Specific environmental limits are recommended for toluene diisocyanate (TDI), diphenylmethane diisocyanate also known as methylene bisphenyl isocyanate (MDI), hexamethylenediisocyanate (HDI), naphthalene diisocyanate (NDI), isophorone diisocyanate (IPDI), and dicyclohexylmethane-4,4'-diisocyanate (hydrogenated MDI). The environmental limits recommended for these diisocyanates are equivalent to a time-weighted average concentration of 5 ppb for up to a 10-hour workshift, 40-hour workweek and a ceiling concentration of 20 ppb over a 10-minute sampling period. Federal standards already exist for toluene-2,4-diisocyanate and methylene bisphenyl isocyanate (MDI). They are 20 ppb (0.14 mg/cu m), and 20 ppb (0.2 mg/cu m) as "ceiling values," respectively.

In developing this criteria document on diisocyanates, NIOSH has concluded that recommendations based on a scientific evaluation of toxicity of TDI and other diisocyanates are applicable to all diisocyanates and, thus, that diisocyanates should be considered a class of compounds with reasonably uniform effects on employee health.

The recommended standard applies to diisocyanate monomers only and not to higher polymers of these compounds. However, free monomeric diisocyanate may still be present in polymerized products and may constitute a hazard during manufacturing, foaming, spraying, and molding operations. Hazards to health arise primarily from exposure to diisocyanate vapor and to spray-generated aerosols. Although skin and eye irritation are known to occur with diisocyanate exposure, the primary adverse effects involve the respiratory tract. Bronchitis, chest tightness, nocturnal dyspnea, pulmonary edema, and death may result from exposure to diisocyanates at high concentrations. Of major

concern is the development in certain individuals of diisocyanate sensitization. Sensitization may be manifested as a generalized skin disorder, but is usually experienced as a debilitating asthma-like response to diisocyanates frequently at very low, often unmeasurable concentrations.

The NIOSH recommendations for a standard should protect unsensitized workers from adverse effects on their health from exposure to diisocyanates, identify workers who exhibit signs of sensitization, and further reduce the incidence of diisocyanate sensitization.

NIOSH provided recommendations for toluene diisocyanate in the 1973 criteria document on the same subject. Since that time, information generated on the toxicity of TDI has not indicated that the workplace environmental limits recommended in the 1973 document for that chemical should be changed, except that improvements in analytical methods have made possible a reduction in the sampling time from 20 to 10 minutes for determination of ceiling concentrations. In the medical recommendations of the 1973 criteria document it was indicated that eosinophil counts should be made. The application of this monitoring method, however, has not proved as useful as was originally anticipated. For this reason, monitoring of eosinophil counts is no longer recommended. Other recommendations applicable to TDI in the present document which differ from those in the 1973 document reflect current changes in the development of criteria documents. The Standards Completion Program (SCP) developed recommendations for TDI and MDI which were transmitted to the Department of Labor on November 3, 1976. The present recommendations for TDI, MDI, and other diisocyanates based on current information supplant both those in the 1973 criteria document on TDI and the SCP recommendations.

Should you or any member of your staff be interested in being briefed by NIOSH personnel on this document, please contact me directly to make the necessary arrangements.

J. Michael Lane MD

J. Michael Lane, M.D.

4 Attachments

Criteria Document
Compiled Reviewer Responses and Accessory Information (Tabs)
Photocopy of all literature cited as References
Annotated Complete Search Bibliography

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : Assistant Secretary of Labor
Occupational Safety and Health Administration

DATE: SEP 27 1978

FROM : Acting Director, National Institute
for Occupational Safety and Health

SUBJECT: Criteria for a Recommended Standard....Occupational Exposure to Nitriles

Attached are cited references, reviewer comments and accessory information (Tabs), an annotated complete search bibliography, and a reproduced copy of the document "Criteria for a Recommended Standard....Occupational Exposure to Nitriles." Printed copies of this document will be provided as soon as possible. The criteria and recommended standards apply to ten short-chain organic cyanides.

This criteria document contains recommendations for workplace environmental limits, sampling and analysis, medical surveillance, labeling and posting, personal protective equipment, hazard apprisal, work practices, sanitation, and monitoring and recordkeeping. The NIOSH recommended environmental limits, expressed as either a time-weighted average (TWA) concentration for up to a 10-hour workshift in a 40-hour workweek or a ceiling concentration (C) measured for a 15-minute sampling period, are presented in the following table.

Nitrile	NIOSH Recommended Limit (mg/cu m)
acetonitrile	34 (TWA)
n-butyronitrile	22 (TWA)
isobutyronitrile	22 (TWA)
propionitrile	14 (TWA)
malononitrile	8 (TWA)
adiponitrile	18 (TWA)
succinonitrile	20 (TWA)
acetone cyanohydrin	4 (C)
glycolonitrile	5 (C)
tetramethylsuccinonitrile	6 (C)

In order to protect the workers from potentially hazardous excursions of the acutely toxic tetramethylsuccinonitrile, NIOSH recommends that the current Federal standard be changed from a 10-hour time-weighted average concentration limit to a 15-minute ceiling concentration limit. NIOSH recommends a reduction in the current Federal Standard for acetonitrile from 70 mg/cu m as a TWA to 34 mg/cu m as a TWA. Since the mechanism underlying the acute toxicities of these compounds is thought to be mediated primarily through release of cyanide, the effects are expected to be additive, and application of the additive formula in 29 CFR 1910.1000

is recommended when concomitant exposures occur. However, compounds for which ceiling concentrations are recommended have somewhat faster toxic action than those for which TWA limits are recommended, and the formula should be used to add TWA or ceiling concentrations independently.

Individual cases of death or acute injury have been reported for acetonitrile, isobutyronitrile, glycolonitrile, acetone cyanohydrin, adiponitrile, and tetramethylsuccinonitrile exposures in the workplace. Deleterious side effects have been reported in patients given malononitrile and succinonitrile as treatment for psychiatric disorders. These cases share signs and symptoms indicating inhibition of oxygen use, with the nervous system and gastrointestinal tract most markedly affected. There is little evidence of residual effects after recovery. In addition to the effects attributed to cyanide, exposure to acetonitrile, propionitrile, n-butyronitrile, and acetone cyanohydrin has caused duodenal, gastric, and bronchial ulcers, and hepatic and renal lesions in animals. The acetonitrile environmental limit is based on irritation to the respiratory system during inhalation. Comparative acute toxicity data in animals were used to develop recommended limits for nine compounds, using acetonitrile, either directly or indirectly, as the common basis for comparison.

Engineering controls, work practices, and personal protective equipment are recommended to maintain air concentrations of nitriles below the recommended occupational exposure limits and to prevent direct contact with the skin that can result in systemic toxicity. NIOSH validated methods for sampling and analysis are only available for acetonitrile and tetramethylsuccinonitrile. Additional research is needed to test and validate methods for the eight remaining nitriles.

The Standards Completion Program (SCP) recommendations for acetonitrile and tetramethylsuccinonitrile were transmitted to the Department of Labor on February 13, 1976, and May 27, 1976, respectively. An availability notice for acetonitrile was published in the Federal Register on April 27, 1976. Some of the NIOSH recommendations contained in the criteria document for these two compounds are more restrictive than those recommended by the SCP. Differences in the recommendations relating to the areas of respiratory protection, and medical surveillance arise from the fact that the criteria document presents a more comprehensive review and evaluation of the literature. In addition, eight compounds are presented for which there are no current Federal occupational exposure

limits. NIOSH, therefore, recommends adoption of recommendations contained in the criteria document on nitriles in order to protect employees from the effects of exposure to these nitriles.

Should you or any member of your staff be interested in being briefed by NIOSH personnel on this document, please contact me directly to make the necessary arrangements.

J. Michael Lane

J. Michael Lane, M.D.

4 Attachments
Criteria Document
Compiled Reviewer Comments and Accessory Information (Tabs)
Photocopy of All Literature Cited as References
Annotated Complete Search Bibliography

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

TO : The Assistant Secretary for Health and Surgeon General
Through: ES/PHS_____
Director, CDC_____

DATE: SEP 27 [illegible]

FROM : Acting Director, National Institute for Occupational Safety and Health

SUBJECT: Criteria Document: Recommendations for an Occupational Exposure Standard for Nitriles - INFORMATION MEMORANDUM

A complete criteria document for occupational exposure to 10 selected nitriles has been prepared by the National Institute for Occupational Safety and Health (NIOSH). NIOSH recommends environmental limits for each compound, expressed either as a time-weighted average (TWA) concentration for up to a 10-hour workshift in a 40-hour workweek or as a ceiling (C) concentration measured for a 15-minute sampling period. They are listed in the following table.

Nitrile	NIOSH Recommended Limit (mg/cu m)
acetonitrile	34 (TWA)
n-butyronitrile	22 (TWA)
isobutyronitrile	22 (TWA)
propionitrile	14 (TWA)
malononitrile	8 (TWA)
adiponitrile	18 (TWA)
succinonitrile	20 (TWA)
acetone cyanohydrin	4 (C)
glycolonitrile	5 (C)
tetramethylsuccinonitrile	6 (C)

Nitriles are used primarily as organic intermediates in the manufacture of nylon, methyl methacrylate, and drugs and as solvents. NIOSH estimated in a 1972-1974 survey that 26,000 workers in the United States are potentially exposed to these selected nitriles.

Individual cases of death or acute injury have been reported for acetonitrile, isobutyronitrile, glycolonitrile, acetone cyanohydrin, adiponitrile, and tetramethylsuccinonitrile exposures in the workplace. Deleterious side-effects have been reported in patients given malononitrile and succinonitrile as treatment for psychiatric disorders. These cases share signs and symptoms indicating the inhibition of oxygen utilization by cyanide, with the nervous system and gastrointestinal tract most markedly affected. In addition to the effects attributed to cyanide, exposure to acetonitrile, propionitrile, n-butyronitrile, and acetone cyanohydrin has induced duodenal, gastric, and bronchial ulcers, and hepatic and renal lesions in animals.

The acetonitrile environmental limit is based on irritation to the respiratory system during inhalation. Comparative acute toxicity in animals is used to develop recommended workplace air limits for the other compounds. Ceiling concentration limits are recommended for the compounds which induce rapid intoxication.

Since the mechanisms for acute toxicity of these compounds are thought to be mediated primarily through release of cyanide, concomitant exposures to two or more nitriles or other cyano compounds are expected to be additive. Application of the additive formula in the current Federal Standard (29 CFR 1910.1000) is recommended when combined exposures occur, but the formula should be applied separately for sets of compounds with recommended TWA concentrations and for sets of compounds with recommended ceiling concentrations.

The NIOSH recommendation includes medical surveillance, emergency procedures, work practices, and methods for sampling and analysis of workplace atmospheres. Engineering controls, work practices, and personal protective equipment are recommended to maintain air concentrations of nitriles below the recommended occupational limits and to prevent direct contact with the skin that can result in systemic toxicity. NIOSH validated methods for sampling and analysis are only available for acetonitrile and tetramethylsuccinonitrile. Additional research is needed to test and validate methods for the eight remaining nitriles.

The recommended standard is part of a continuing series of criteria documents developed by NIOSH in accordance with the Occupational Safety and Health Act of 1970. The document is being transmitted to the Department of Labor for review and consideration in the standard setting process. The criteria document was reviewed by seven consultants, a professional society, and government agencies having interest in and responsibility for occupational safety and health. The proposed standard is considered appropriate based on information that is now available.

J. Michael Lane

J. Michael Lane, M.D.

cc:
Dr. Eula Bingham, OSHA