

# **NIOSH**

## *Current Intelligence Bulletin 21*

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### **TRIMELLITIC ANHYDRIDE (TMA)**



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

The Current Intelligence Bulletin is the primary product of the Current Intelligence System. The purpose of the Current Intelligence System is to promptly review, evaluate, and supplement new information received by NIOSH on occupational hazards that are either unrecognized or are greater than generally known.

As warranted by this evaluation, the information is capsulized and disseminated to NIOSH staff, other government agencies, and the occupational health community, including labor, industry, academia, and public interest groups. With respect to currently known hazard information this system also serves to advise appropriate members of the above groups of recently acquired specific knowledge which may have an impact on their programs or perception of the hazards. Above all, the Current Intelligence System is designed to protect the health of American workers and to allow them to work in the safest possible environment.

#### Synonyms.

ANHYDROTRIMELLITIC ACID  
1,2,4-BENZENETRICARBOXYLIC ACID ANHYDRIDE  
1,2,4-BENZENETRICARBOXYLIC ACID, CYCLIC 1,2-ANHYDRIDE  
1,2,4-BENZENETRICARBOXYLIC ANHYDRIDE  
4-CARBOXYPTHALIC ANHYDRIDE  
CHEMICAL ABSTRACTS SERVICE NUMBER: 552-30-7  
CHEMICAL FORMULA:  $C_9H_4O_5$   
1,3-DIHYDRO-1,3-DIOXO-5-ISOBENZOFURANCARBOXYLIC ACID  
1,3-DIOXO-5-PHTHALANCARBOXYLIC ACID  
DIPHENYLMETHANE-4,4'-DIISOCYANATE-TRIMELLIC  
ANHYDRIDE-ETHOMID HT POLYMER  
NIOSH - RTECS DC20500  
TMA\*  
TMAN  
TRIMELLITIC ACID ANHYDRIDE  
TRIMELLITIC ACID 1,2-ANHYDRIDE  
TRIMELLITIC ACID CYCLIC 1,2-ANHYDRIDE

\*TMA is also an acronym for trimethylamine.

## TRIMELLITIC ANHYDRIDE (TMA)

The National Institute for Occupational Safety and Health (NIOSH) recommends that trimellitic anhydride (TMA) be handled as an extremely toxic agent in the workplace. Exposure to this compound may result in noncardiac pulmonary edema (apparently without benefit of a pulmonary irritation warning), immunological sensitization, and irritation of the pulmonary tract, eyes, nose, and skin. There is no current Occupational Safety and Health Administration (OSHA) exposure standard for trimellitic anhydride. The Amoco Chemicals Corporation, the sole domestic producer, suggests a limit of "0.05 mg/m<sup>3</sup> or less for susceptible individuals."<sup>(1)</sup>

NIOSH has prepared this Current Intelligence Bulletin to advise you of recent findings of toxic effects of trimellitic anhydride and to provide some precautions for handling trimellitic anhydride in the workplace. Attached are "Suggested Procedures for Minimizing Employees' Exposure to Trimellitic Anhydride."

### Potential Occupational Exposures

NIOSH estimates approximately 20,000 American workers are currently at risk of exposure to trimellitic anhydride in its various applications. TMA is used as a curing agent for epoxy and other resins, in vinyl plasticizers, paints and coatings, polymers, polyesters, agricultural chemicals, dyes and pigments, pharmaceuticals, surface active agents, modifiers, intermediates, and specialty chemicals. The sole domestic producer of trimellitic anhydride is Amoco Chemicals Corporation which has a 50 million pound-per-year plant at Joliet, Illinois.

### Human Toxicity

The ability for trimellitic anhydride to cause pulmonary edema (excessive fluid in the lungs) has been demonstrated by Rice et al.<sup>(2)</sup> Two workers had been employed by the same company for only a short period of time (3 and 6 weeks). They received multiple inhalation exposures to an epoxy resin containing trimellitic anhydride when it was

sprayed on heated pipes. The levels of trimellitic anhydride were not available to the authors. No mention was made of severe irritation of the upper respiratory tract while they were receiving their exposures, suggesting little or no warning of subsequent damage to the lungs. The possibility that the pulmonary edema was the result of a hypersensitivity reaction must therefore be considered. Resins can be sensitizers (e.g., toluene diisocyanate or TDI), though most of the reported effects have been those of direct irritation. (3)

Sensitization to trimellitic anhydride was reported by Zeiss et al.(4) Respiratory symptoms were observed in fourteen workers employed in the synthesis of trimellitic anhydride. The authors suggest three distinct syndromes induced by inhalation of TMA. The first, rhinitis and/or asthma, developed over an industrial exposure period of weeks to years. After this period, the sensitized worker exhibited symptoms immediately following exposure to trimellitic anhydride dust or fume, which abated after the work exposure had stopped. The second syndrome, termed "TMA-flu" by the workers, also required a sensitization period of exposure and was characterized by delayed onset cough, wheezing, and labored breathing starting 4 to 8 hours after a work shift and peaking at night. These respiratory symptoms were usually accompanied by malaise, chills, fever, muscle and joint aches, and appeared to be associated with relatively high exposures to trimellitic anhydride during particular work shifts. The third syndrome, which followed initial high exposure to TMA, was primarily an irritant effect. It was characterized by a "running" nose without itching or sneezing, occasional nosebleed, cough, labored breathing, and occasional wheezing. Symptoms usually abated after 8 hours and rarely lasted into the night.

The above studies suggest harmful respiratory effects of trimellitic anhydride at relatively high concentrations, but even at lower concentrations some workers may develop an immunological sensitization over a period of time.

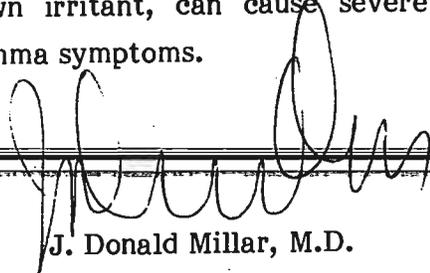
Fawcett et al. (5) also observed sensitization in a worker exposed to trimellitic anhydride in the production of tubular steel shop fittings coated with an epoxy resin. The chemical agent responsible for asthma symptoms of six workers was identified by careful inhalation challenge testing, simulating work exposure. Typical attacks which began one year after onset of TMA exposure consisted of cough and breathlessness

lasting for 30 minutes, which subsided, only to be followed the same evening by sneezing which persisted for about 24 hours. Subsequent attacks were prevented by avoiding exposure.

Data on occupational exposures to trimellitic anhydride were also obtained during a NIOSH Health Hazard Evaluation of a paint and varnish company during the manufacture of an epoxy paint.(6) The Health Hazard Evaluation was conducted at the request of employees who were concerned about possible harmful effects of trimellitic anhydride exposure during processing and decontamination operations. The occupational airborne exposure levels averaged  $1.5 \text{ mg/m}^3$  TMA (with a range from "none detected" to  $4.0 \text{ mg/m}^3$ ) during processing operations and  $2.8 \text{ mg/m}^3$  TMA (ranging from "none detected" to  $7.5 \text{ mg/m}^3$ ) during decontamination operations. A total of 13 employees (5 present and 8 former employees) were interviewed and briefly examined. Employees' symptoms and complaints were: eye irritation, nasal irritation, shortness of breath, wheezing, cough, heartburn, nausea, headache, skin irritation, and throat irritation. Three of the former workers stated that they had left that department for health reasons. Complaints subsided when non-TMA-containing products were being formulated.

The Occupational Health and Safety Division, Department of Labour, Alberta, Canada, has reported to NIOSH that they are aware of employee reactions in two plants using TMA-epoxy powder pipe coatings. The one plant, started in 1971, had a number of employees with an immediate reaction. After instituting engineering and administrative controls, there has been no further incidence. In the second plant, began in 1974, the first adverse reaction occurred in 1975. There have been 9 cases of adverse reactions reported to date. Most of these employees were kept in intensive care while they recuperated and were advised by their physicians to seek new jobs. However, some returned to their previous jobs and became ill again. Due to the unavailability of a good analytical method for trimellitic anhydride occupational levels could not be documented until November of 1977. The TMA concentrations found ranged from  $0.11 \text{ mg/m}^3$  to  $0.27 \text{ mg/m}^3$ .

In view of the employer's responsibility, "to furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees . . .," occupational exposure to trimellitic anhydride should be minimized. It appears evident that trimellitic anhydride, a known irritant, can cause severe pulmonary edema, immunological sensitization, and asthma symptoms.



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#### References

1. Amoco-Industrial Hygiene Toxicology and Safety Data Sheet, Environmental Health Services, Medical and Health Services Department, July 8, 1976.
2. Rice, D. L., Jenkins, D. E., Gray, J. M., and Greenberg, S. D., "Chemical Pneumonitis Secondary to Inhalation of Epoxy Pipe Coating," Archives of Environmental Health 32(4):173-8, July-August 1977.
3. Patty, F. A., ed. Industrial Hygiene and Toxicology, Second Revised Edition, Volume II, Fawcett, D. W., Irish, D. D., eds. John Wiley & Sons, Inc., New York.
4. Zeiss, C. R., Patterson, R., Pruzansky, J.J., Miller, M. M., Rosenberg, M., Levitz, D., "Trimellitic Anhydride-Induced Airway Syndromes: Chemical and Immunologic Studies", J. Allergy & Clinical Immunology 60(2):96-103, August 1977.
5. Fawcett, D. W., Taylor, A. J., Pepys, J. "Asthma Due to Inhaled Chemical Agents-Epoxy Resin Systems Containing Phthalic Acid Anhydride, Trimellitic Acid Anhydride and Triethylene Tetramine", Clinical Allergy 7(1):-14, January 1977.
6. National Institute for Occupational Safety and Health, Health Hazard Evaluation Determination Report No. 74-111-283.

## SUGGESTED PROCEDURES FOR MINIMIZING EMPLOYEE EXPOSURE TO TRIMELLITIC ANHYDRIDE (TMA)

### CONTROL OF OVEREXPOSURES

NIOSH recommends that trimellitic anhydride be handled in the workplace as an extremely toxic substance because it can cause noncardiac pulmonary edema, immunological sensitization, and severe respiratory irritation. Exposure to trimellitic anhydride should be limited to as few employees as possible, while minimizing workplace exposure levels. The area in which it is used should be restricted to those employees necessary to the process or operation. Furthermore, consideration should be given to isolating the trimellitic anhydride exposure area so that adjacent workers are not also exposed.

#### 1. Exposure Monitoring

The NIOSH Occupational Exposure Sampling Strategy Manual, NIOSH Publication #77-173, may be helpful in developing efficient programs to monitor employee exposures to trimellitic anhydride. The manual discusses determination of the need for exposure measurements, selection of appropriate employees for sampling, and selection of sampling times.

Exposure measurements should consist of 8-hour TWA (time-weighted average) exposure estimates calculated from personal or breathing zone samples (air that would most nearly represent that inhaled by the employees).

#### 2. Engineering Controls

Engineering and work practice controls should be used to minimize employee exposure to trimellitic anhydride.

To ensure that ventilation equipment is working properly, effectiveness (e.g., air velocity, static pressure or air volume) should be checked at least every three months.

System effectiveness should also be checked within five days of any change in production, process, or control which might result in significant increases in airborne exposures to trimellitic anhydride.

### 3. Respiratory Protection

Exposure to trimellitic anhydride should not be controlled with the use of respirators except:

- o During the time period necessary to install or implement engineering or work practice controls; or
- o In work situations in which engineering and work practice controls are technically not feasible; or
- o To supplement engineering and work practice controls when such controls fail to adequately control exposure to trimellitic anhydride; or
- o For operations which require entry into tanks or closed vessels; or
- o In emergencies.

Respirators should be approved by the National Institute for Occupational Safety and Health (NIOSH) or by the Mining Enforcement and Safety Administration (MESA). Refer to NIOSH Certified Equipment, December 15, 1975, NIOSH publication #76-145 and Cumulative Supplement June 1977, NIOSH Certified Equipment, NIOSH publication #77-195. The use of faceseal coverlets or socks with any respirator voids NIOSH/MESA approvals.

Quantitative faceseal fit test equipment (such as sodium chloride, dioctyl phthalate, or equivalent) should be used. Refer to A Guide to Industrial Respiratory Protection, NIOSH publication #76-189 for guidelines on appropriate respiratory protection programs.

Where respirators are needed and NIOSH recommendations allow their use to reduce employee exposure, the following types of respirators may be used. They are listed in order of increasing protection factors.

- o Protection factor of 50: any chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and high efficiency filter(s) (30 CFR 11.150 and 11.130); any gas mask with a chin-style organic vapor canister and high efficiency filter (30 CFR 11.90(a) and 11.130); any supplied-air respirator with a full facepiece, helmet, or hood (30 CFR 11.110(a)); any self-contained breathing apparatus with a full facepiece (30 CFR 11.70(a)).
  
- o Protection factor of 1000: any powered air purifying chemical cartridge respirator with full facepiece, organic vapor cartridge(s), and high efficiency particulate filter(s).
  
- o Protection factor of 2000: any type C supplied-air respirator with a full facepiece operated in positive pressure-demand or other positive pressure mode or with a full facepiece, hood, or helmet operated in continuous flow mode (30 CFR 11.110(a)).
  
- o Protection factor of 10,000+: self-contained breathing apparatus with a full facepiece operated in positive pressure-demand or other positive pressure mode (30 CFR 11.70(a)); any combination respirator which includes a type C supplied-air respirator with a full facepiece operated in positive pressure-demand or other positive pressure or continuous flow mode and an auxiliary self-contained breathing apparatus operated in positive pressure-demand or positive pressure mode (30 CFR 11.70(b)).

## PERSONAL PROTECTIVE EQUIPMENT

Employers should provide appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with trimellitic anhydride.

Employers should see that employees whose clothing may have become contaminated with trimellitic anhydride change into uncontaminated clothing before leaving the work premises.

Employers should see that non-impervious clothing which becomes contaminated with trimellitic anhydride be promptly removed and not reworn until the trimellitic anhydride is removed from the clothing.

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~~Employers should see that clothing contaminated with trimellitic anhydride is placed in~~  
closed containers for storage until it can be discarded or removed from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the trimellitic anhydride, the employer should tell the person performing the cleaning operation of the hazardous properties of trimellitic anhydride.

Employers should provide dust-resistant safety goggles where there is any possibility of trimellitic anhydride dust contacting the eyes.

## PREVIOUSLY ISSUED NIOSH CURRENT INTELLIGENCE BULLETINS

- \* 1. Chloroprene - January 20, 1975
- \* 2. Trichloroethylene (TCE) - June 6, 1975
- \* 3. Ethylene Dibromide (EDB) - July 7, 1975
- \* 4. Chrome Pigments - June 24, 1975  
- August 22, 1975  
- October 7, 1975  
- October 8, 1976
- \* 5. Asbestos - August 8, 1975
- \* 6. Hexamethylphosphoric Triamide (HMPA) - October 24, 1975
- \* 7. Polychlorinated Biphenyls (PCBs) - November 3, 1975  
- August 20, 1976
- 8. 4,4-Diaminodiphenylmethane (DDM) - January 30, 1976
- \* 9. Chloroform - March 15, 1976
- 10. Radon Daughters - May 11, 1976
- 11. Dimethylcarbamoyl Chloride (DMCC)  
Revised - July 7, 1976
- 12. Diethylcarbamoyl Chloride (DECC) - July 7, 1976
- 13. Explosive Azide Hazard - August 16, 1976
- 14. Inorganic Arsenic - Respiratory  
Protection - September 27, 1976
- \* 15. Nitrosamines in Cutting Fluids - October 6, 1976
- \* 16. Metabolic Precursors of a Known  
Human Carcinogen, Beta-Naphthylamine - December 17, 1976
- \* 17. 2-Nitropropane - April 25, 1977
- \* 18. Acrylonitrile - July 1, 1977
- \* 19. 2,4-Diaminoanisole - January 13, 1978
- \* 20. Tetrachloroethylene (Perchloroethylene) - January 20, 1978

NOTE: Bulletins #1 through #18 will soon be reprinted as a single publication for the convenience of those that desire a complete series of Current Intelligence Bulletins, since they are currently out of print. The availability of this publication will be announced in a future CIB. Distribution of the combined publication and single copies of Bulletins #19 and later will be through NIOSH Publications Dissemination, Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226

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