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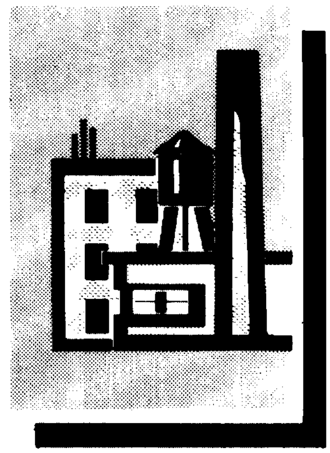
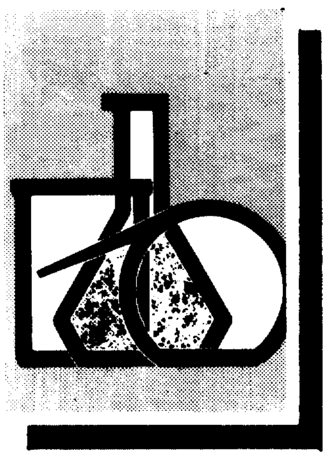
SPECIAL OCCUPATIONAL HAZARD REVIEW and CONTROL RECOMMENDATIONS





CHRYSENE

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

SPECIAL OCCUPATIONAL HAZARD REVIEW AND CONTROL RECOMMENDATIONS FOR CHRYSENE

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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 in their workplace. To fulfill this need, the National Institute for Occupational Safety and Health (NIOSH) has developed a program to assist employers in protecting the health of workers exposed to substances considered to have carcinogenic, mutagenic, or teratogenic potential. This program involves the development of Special Occupational Hazard Reviews which serve to support and complement the other major standards development or hazards documentation activities of the Institute. It is the purpose of a Special Occupational Hazard Review to analyze and document the industrial health and safety problems associated with a given chemical or process, and to recommend the implementation of engineering controls and work practices designed to ameliorate these problems. While Special Occupational Hazard Reviews are not intended to supplant the more comprehensive NIOSH Criteria Documents, nor the brief NIOSH Current Intelligence Bulletins, they are nevertheless prepared in such a way as to be amenable to regulatory application if so desired. Special Occupational Hazard Reviews are made available to the occupational health community, trade associations, labor unions, industries, and the general scientific community for their evaluation and consideration for use in developing and implementing preventive measures and identifying areas for additional research.

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The DCDSD review staff for this document consisted of Richard A. Rhoden, Ph.D. (Chairman), Howard L. McMartin, M.D., and Frank L. Mitchell, D.O.

Valuable and constructive comments were also provided by Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine.

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SUMMARY AND CONCLUSIONS

Exposure to chrysene as an isolated chemical presently occurs only in specific occupations, i.e., chrysene synthesis, laboratory experimentation, and possibly in the synthesis of anthraquinone vat dyes. However, chrysene and its derivatives, e.g., certain methylchrysene isomers, along with hundreds of other polycyclic aromatic hydrocarbons (PAH's), are formed during the pyrolysis of organic matter and can occur in any occupational environment where this process takes place. While it has been suggested that 700 C is the optimum pyrolytic temperature for PAH-formation, other factors such as the chemical and physical nature of the pyrolyzed material, the presence or absence of oxygen, and the period of time during which the compound is pyrolyzed also determine the amounts and mixtures of various PAH's formed. Chrysene has been detected in many materials which result from, or are used in, industrial processes. Chrysene also has been detected in the ambient atmosphere and in certain food products.

A number of experimental animal studies have been conducted for the purpose of assessing the carcinogenicity of chrysene, with varying results. When three 100(u)g doses of chrysene were administered by subcutaneous (s.c.) injection to newborn mice, an increased incidence of liver tumors was observed. The increase, however, was not statistically significant. Marginal results were obtained when mice were injected (s.c.) with 1 mg chrysene in arachis oil, once a week, for 10 weeks. This treatment resulted in the development of injection-site tumors in 2 of 20 animals.

Tumors also developed after chrysene (1% solution in acetone) was applied to the shaved backs of mice. Chrysene appears to exert a stronger carcinogenic effect when used as a tumor initiator than when used as a "complete" carcinogen, e.g., when the shaved backs of each of 20 mice were painted with ten doses of 0.1 mg chrysene (each in 0.1 ml acetone), followed by treatment with tetradecanoyl phorbol acetate (TPA), 11 of the 18 surviving mice had tumors (total of 19 tumors) after 20 weeks. Similar results were obtained using chrysene (total dose of 4.4 micromoles) either as an initiator with TPA, or when chrysene (1.0 mg in 0.4 ml acetone) was painted on the shaved backs of mice prior to treatment with croton resin. Chrysene also has produced positive results in mammalian cell transformation tests and in the "Ames" test for mutagenicity.

Certain methylchrysene isomers have also been shown to possess carcinogenic potential: 5-methylchrysene has been reported to be a strong "complete" carcinogen as well as a stronger tumor initiator than chrysene. Epidemiologic evidence for the carcinogenicity of chrysene as an isolated chemical was not located. However, certain industry-related materials which contain many PAH's, including chrysene and its methyl derivatives, have been linked with cancer induction in humans. A historical review of these occurrences can be found in the preamble of International Agency for Research on Cancer (IARC) Monograph, Volume 3 (1973).

While the evidence is not conclusive, the positive results obtained in certain animal studies, coupled with the demonstrated biochemical activity of chrysene and its presence in materials which have been found to be carcinogenic to humans, indicate that chrysene should be regulated as a potential occupational carcinogen.

Control measures recommended in this report are designed for chrysene work areas, i.e., areas where the isolated chemical is manufactured, used, or stored. These control measures include: primary emphasis on engineering controls, e.g., process enclosure and local exhaust ventilation, where technologically feasible; use of personal protective equipment, e.g., coveralls, rubber gloves, and appropriate respirators; posting of warning signs; provision for medical surveillance; institution of spill-disposal procedures; and recordkeeping.

Chrysene may be generated inadvertently in numerous industrial processes which involve the pyrolysis of organic matter. Further, conditions which are favorable for the formation of chrysene also are likely to be favorable for the formation of methylchrysenes and numerous other PAH's whose carcinogenic potencies range from greater than to less than that of chrysene. While the aforementioned control measures may be applied to the general class of PAH's, NIOSH recognizes that under certain circumstances of PAH-exposure, they will be neither appropriate nor feasible.

While no workplace environmental limit for chrysene is recommended at this time, information on analytical methodology is included in this review. Most methods for the identification and quantitation of chrysene involve various forms of chromatography and spectrometry.