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NITROSAMINES IN CUTTING FLUIDS

CURRENT INTELLIGENCE BULLETIN: NITROSAMINES IN CUTTING FLUIDS

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On September 17, 1976, the National Institute for Occupational Safety and Health (NIOSH) was informed by the National Science Foundation (NSF) that Dr. David H. Fine (Thermo Electron Corporation, Waltham, Massachusetts), one of its grantees, confirmed the presence of a nitrosamine, diethanolnitrosamine, in commercial cutting fluids produced by four randomly selected companies.

Historically, nitrosamines have been regarded as one of the most potent families of animal carcinogens. Although nitrosamines are suspected to be human carcinogens, their carcinogenic potential in man has not been proven.

In the past year, two developments have drawn attention to the issue of nitrosamines as an occupational health hazard. The first is the introduction of a new analytical method, thermal energy analysis (TEA), with a sensitivity for nitrosamines in the part per billion (ppb) range. The other development is the recognition of the potential for formation of nitrosamines in air and other non-acidic media by reaction of secondary and tertiary amines with nitrites or other oxides of nitrogen.

The formation of diethanolnitrosamine in cutting fluids was first postulated and reported by Zingmark and Rappe in Sweden (AMBIO, Vol. 5 No. 2, 80-81, 1976). They measured diethanolnitrosamine in a specifically formulated "grinding fluid" containing nitrite and triethanolamine. They concluded that the potential hazard of working with these types of products should not be underestimated. Dr. Fine's results of September 17, 1976 underscore the concern raised by Zingmark and Rappe. Dr. Fine initially reported finding from 400 to over 1,000 ppm diethanolnitrosamine in eight commercial cutting fluids produced by four different manufacturers. He has also provided NIOSH with results which indicate up to 3% diethanolnitrosamine in certain cutting fluids. In addition, Dr. Fine has reported a study conducted during an actual machining operation showing the presence of 1000 ppm diethanolnitrosamine in the diluted cutting fluid prior to use, and 384 ppm after use. This

finding strongly suggests that machine operators may be continuously exposed to nitrosamines.

Occupational exposure to cutting fluids, primarily among machine operators, has been studied for possible health effects. A recent published account by Decoufle (Ann. N.Y. Acad. Sci., 271:94-101, 1976) relates that a slight excess mortality (not statistically significant) from respiratory and digestive cancers was observed among male workers exposed to cutting fluids in metal machining jobs.

Nomenclature for cutting fluid is not standardized. The term generally applies to substances used in drilling, gear cutting, grinding, lathing, milling, and other machining operations, for the purpose of cooling, lubricating, and removing metal or plastic chips, filings, and cuttings from the contact area. These substances are variously referred to as cutting, cooling, grinding, industrial, lubricating, and synthetic oils or fluids.

Commercial cutting fluids can be divided into four categories:

- Cutting Oils or Straight Oils —— contain mineral oil, fat, and additives. These oils are water insoluble.
- Soluble Cutting Oils —— contain mineral oil, fat, emulsifiers (may include amines), additives (rarely nitrite*), and water.
- Semi-Synthetic Cutting Oils —— contain mineral oil, water, fat, a soluble base (usually including amines), emulsifiers (may include amines), and additives (usually including nitrite).
- Synthetic Cutting Fluids —— a soluble base (usually including amines), additives (usually including nitrite) and water.

Various proprietary cutting fluids are produced by over one thousand companies in the United States. NIOSH estimates that 780,000 persons are occupationally exposed in the manufacture and use of cutting fluids.

Synthetic cutting fluids, semi-synthetic cutting oils, and soluble cutting oils may contain nitrosamines, as found by Dr. Fine, either as contaminants in amines, or as products from the reaction of amines (e.g., triethanolamine) with nitrite. Straight oils do not contain

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*Some consumers may incorporate additives containing nitrite into the soluble cutting oil while preparing it for use.

nitrites or amines but may contain polynuclear aromatic compounds (recognized as having carcinogenic potential).

Since many of the proprietary ingredients of cutting fluids have not undergone complete toxicological evaluation, NIOSH would caution any user contemplating changing from one cutting fluid formulation to another to give full consideration to the potential hazards of the substitute.

Enclosed are some industrial hygiene practices which can help minimize dermal and respiratory exposures to cutting fluids.

The potential for nitrosamine exposure during the use of cutting fluids will be further assessed as part of a proposed NIOSH project to determine the levels of nitrosamines in a number of factory environments. Follow-up epidemiologic studies are also anticipated. Studies of cancer induction in laboratory animals exposed to cutting fluids or cutting fluid components are also planned. In addition, a Criteria for a Recommended Standard which will address the problem of cutting fluids is scheduled to be completed in 1977.

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INDUSTRIAL HYGIENE PRACTICES TO MINIMIZE DERMAL AND RESPIRATORY EXPOSURE TO CUTTING FLUIDS

The following are suggested good industrial hygiene practices that can help in minimizing exposure to cutting fluids. The recent detection of nitrosamines in certain cutting fluids has compounded the recognized problem of cutting oil control.

1. Engineering Control. The most effective control of any contaminant is control at the source of generation. Effective engineering measures include the use of local exhaust ventilation, with a suitable collector, or the use of electrostatic precipitator.

2. Substitution. The substitution of a cutting fluid that does not contain either nitrosamine contaminated amines, or the necessary ingredients (amines and nitrites) for nitrosamine formation, is another possible control measure. Since many of the proprietary ingredients of cutting fluids have not undergone complete toxicological evaluation, caution should be used when contemplating any change from one cutting fluid formulation to another, giving full consideration to the potential hazards of the substitute.

3. Respirators. Personal respiratory protective devices should only be used as an interim measure while engineering controls are being installed, for non-routine use and during emergencies. Considering the carcinogenic potential and the lack of a standard for nitrosamines as a group, the only available personal respiratory protective measure is the use of a positive pressure supplied air respirator or a positive pressure self-contained breathing apparatus.

4. Protective clothing. Impervious clothing should be provided and should be replaced or repaired as necessary. Non-impervious clothing is not suggested, but if used, it should be removed and laundered frequently to remove all traces of cutting fluids before being reworn. (Laundry personnel should be made aware of the potential hazard from handling contaminated clothing.)

5. Personal cleanliness. All exposed areas of the body and any area that becomes wet with cutting fluids should be washed with soap or mild detergent. Frequent showering is recommended.

6. Isolation. Where possible, any operations involved with cutting fluids should be placed in an isolated area to reduce exposure to employees not directly concerned with the operations.

7. Barrier creams. Barrier creams may provide protection against dermal irritation and skin absorption, however, the barrier cream should not contain secondary or tertiary amines (which may react to form nitrosamines in the presence of nitrites).

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