Diethylaminoethanol
Processing

Chemical Name(s):
2-Diethylaminoethanol

CAS Number:
100-37-8

Other Names:
2-hydroxytriethylamine; diethyl(2-hydroxyethyl)amine; 2-diethylaminoethanol; Diethylethanolamine; DEAE; N,N-diethyl-2-hydroxyethylamine; N,N-diethylethanolamine; N,N-diethylaminoethanol; n-diethylaminoethanol; beta-diethylaminoethanol; 2-N, N-diethylaminoethanol; N,N-diethyl-N-(beta-hydroxyethyl) amine; beta-hydroxytriethylamine.

Other Codes:
NIOSH Registry Number: KK5075000
UN/ID Number: UN2686

Summary of Advised Recommendation*

Synthetic / Non-Synthetic:	Allowed or Prohibited:	Suggested Annotation:
Synthetic	*Prohibited*	*None.*

Characterization

Composition:
$C_6H_{15}NO$

Properties:
Colorless liquid with a nauseating, weak, ammonia odor; hygroscopic; very soluble in water; soluble in alcohol, ether acetone, benzene, and petroleum ether; molecular weight 117.19; specific gravity 0.88-0.89 at 20/20° C; melting point -70° C; boiling point 163° C; flash point 60° C.

How Made:
Manufactured by action of diethylamine with either ethylene chlorohydrin (Budavari, 1996), or with ethylene oxide (Ashford, 1995).

Specific Uses:
DEAE is petitioned for use in boiler chemical systems to prevent carbonic acid corrosion in return lines. Other possible uses of concern to organic production and handling include use as an inert ingredient in pesticide formulations; as a chemical intermediate for production of emulsifiers, detergents, and solubilizers. DEAE is also an intermediate for manufacturing cosmetics; textile finishing agents, fabric softeners, and dyes; drugs and pharmaceuticals, and fatty acid. It is also used in antirust compositions, and acts as a curing agent for resins.

Action:
DEAE inhibits corrosion by neutralizing carbonic acid in steam and steam condensates, and by scavenging free oxygen.

Combinations:
Used in conjunction with cyclohexylamine, morpholine, and octadecylamine.

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* *This Technical Advisory Panel (TAP) review is based on the information available as of the date of this review. This review addresses the requirements of the Organic Foods Production Act to the best of the investigator's ability, and has been reviewed and commented on by experts on the TAP. The substance is evaluated against the criteria found in section 2119(m) of the OFPA (7 USC 6517(m)). The information and advice presented to the NOSB is based on the technical evaluation against that criteria, and is not intended to incorporate commercial availability, socio-economic impact, or any other factor that the NOSB and the USDA may want to consider in making their decisions.*

Status

OFPA

May be added to the National List as an equipment cleaner [7 USC 6517(c)(1)(B)(i)].

Regulatory

EPA/NIEHS/Other Appropriate Sources

EPA - DEAE is an EPA List 3 inert ingredient.

Under the provisions of Section 311 of the Clean Water Act, DEAE is designated a hazardous substance if discharged in navigable waters 40 CFR 116 and 117. The Reportable Quantity (RQ) for notification is 5,000 lb/2,270 kg.

EPA proposed a rule to require manufacturers and processors of DEAE to report production and exposure-related data, which will be used for ranking substances for investigation and for preliminary risk assessments (45 *Fed. Reg.* 13646, 29 Feb. 1980). Data call-ins were done in 1986 (51 *Fed Reg.* 27562) and 1987 (52 *Fed. Reg.* 16022).

DEAE, as a tertiary amine, is an Interagency Testing Committee Candidate (53 *Fed. Reg.* 5466, 24 Feb 1988).

NIEHS

Toxicity

Acute Toxicity: (abbreviations)

dose	mode	specie	amount	unit
LD50	ORL	RAT	1,300	MG/KG
LD50	IPR	RAT	1,220	MG/KG
LD50	IPR	MUS	308	MG/KG
LD50	SCU	MUS	1,561	MG/KG
LD50	IVN	MUS	188	MG/KG

AQTX/TLM96: Not available

Sax Toxicity Evaluation: THR=Moderate via oral and dermal routes.

Carcinogenicity: Not available

Mutation Data: Not available

Teratogenicity: Not available

Other Toxicity Data:
Skin and Eye Irritation Data:
skn-rbt 10 mg/24H
skn-rbt 500 mg open MLD
eye-rbt 5 mg SEV
Status: "NIOSH Manual of Analytical Methods" Vol 4 270, Vol 5, No. S140
EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule

Hazard Class: 3 Subsidiary Risk: None Packing Group: III

Labels Required: Flammable liquid

Packaging: Passenger: Pkg. Instr.: 309, Y309 Maximum Quantity: 60 L, 10 L
Cargo: Pkg. Instr.: 310 Maximum Quantity: 220 L

Special Provisions: None

Handling Procedures

Acute/Chronic Hazards:

This compound causes irritation on contact. When heated to decomposition it emits toxic fumes.

Minimum Protective Clothing: If Tyvek-type disposable protective clothing is not worn during handling of this chemical, wear disposable Tyvek-type sleeves taped to your gloves.

Recommended Glove Materials: P
The following gloves show the best resistance based on permeation testing. It is recommended that two different glove types be used for best protection. However, if this chemical makes direct contact with your glove, or if a tear, puncture or hole develops, remove them at once.

Suggested Gloves (RAD): Viton, Butyl rubber, Nitrile, PVA

Recommended Respirator:
Where the neat test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with an organic vapor/acid gas cartridge (specific for organic vapors, HCl, acid gas and SO_2) with a dust/mist filter. Splash proof safety goggles should be worn while handling this chemical. Alternatively, a full face respirator, equipped as above, may be used to provide simultaneous eye and respiratory protection.

Storage Precautions: You should store this chemical under refrigerated temperatures, and protect it from moisture.

Spills And Leakage: If you should spill this chemical, use absorbent paper to pick up all liquid spill material. Seal the absorbent paper, as well as any of your clothing which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Wash any surfaces you may have contaminated with a strong soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

Disposal And Waste Treatment: You should dispose of all waste and contaminated materials associated with this chemical as specified by existing local, state and federal regulations concerning hazardous waste disposal. It is suggested that your contaminated materials should be destroyed by incineration in a special, high temperature (>2000 degrees F), chemical incinerator facility.

Emergency Procedures

Skin Contact:
IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water.
IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop.
IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

Inhalation:
IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Respirator Recommendation.

Eye Contact:
First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center.
Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician.
IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

Ingestion:
DO NOT INDUCE VOMITING. Corrosive chemicals will destroy the membranes of the mouth, throat, and esophagus and, in addition, have a high risk of being aspirated into the victim's lungs during vomiting which increases the medical problems.

If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side

with the head lower than the body. DO NOT INDUCE VOMITING. Transport the victim IMMEDIATELY to a hospital.

Symptoms:
Symptoms of exposure to this compound may include irritation of the eyes, skin and respiratory tract, nausea and vomiting.

Firefighting:
This compound is not very flammable but any fire involving this compound may produce dangerous vapors. You should evacuate the area. All firefighters should wear full-body protective clothing and use self-contained breathing apparatuses. You should extinguish any fires involving this chemical with a dry chemical, carbon dioxide, foam, or halon extinguisher.

Source: National Toxicology Program (NTP, 2001)

Other sources –
NIOSH Recommended Exposure Limits (REL): 10 ppm (40 mg/m^3) Time Weighted Average (TWA), 15 ppm (60 mg/m3) STEL (Proposed)

OSHA Permissable Exposure Levels (PEL): 25 ppm, 100 mg/m^3 29 CFR 1910.1000 (1996).
Transitional Limit: PEL-TWA 10 ppm (skin) [610]
Final Limit: PEL-TWA 10 ppm (skin) [610]

US Department of Transportation - Contained on the DOT Hazardous Materials Table (59 *Fed. Reg.* 67395).

Food and Drug Administration - Approved by FDA 21CFR 173.310 not to exceed 15ppm in steam and not approved for contact with milk and milk products.

STANDARDS, REGULATIONS & RECOMMENDATIONS:
ACGIH: TLV-TWA 10 ppm (skin) [610]
NIOSH Criteria Document:
NFPA Hazard Rating: Health (H): 3
Flammability (F): 2
Reactivity (R): 0
H3: Materials extremely hazardous to health but areas may be entered with extreme care (see NFPA for details).
F2: Materials which must be moderately heated before ignition will occur (see NFPA for details).
R0: Materials which are normally stable even under fire exposure conditions and which are not reactive with water (see NFPA for details).

State Right-to-Know Lists: Illinois (1991), Massachussets (1994), New Jersey (1989), Pennsylvania (1989).

Status Among U.S. Certifiers
Not allowed by any U.S. Certifier. See the discussion regarding boiler water additives in the Steam Paper.

International
Canada – Not included in the list of permitted non-organic additives substances for organic food products (CGSB, 1999).

CODEX- Not in Annex 2, Table 4, 'Processing Aids' (FAO/WHO, 1999).

EU 2092/91 – Not in Annex VI, 'Processing Aids' (EU 2092/91).

IFOAM – Not on Appendix IV, approved processing aids and other products (IFOAM, 2000).

Japan — Not on the list of approved food additives (Woolsey, 2000).

OFPA 2119(m) Criteria

(1) *The potential of such substances for detrimental chemical interactions with other materials used in organic farming systems.*
As this is a processing material, the substance is not used in organic farming systems. Chemical interactions within a processing environment are discussed in the Steam Paper.

(2) *The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment.*
See processor criteria (3) below.

(3) *The probability of environmental contamination during manufacture, use, misuse or disposal of such substance.*
This is considered below under item (2).

(4) *The effect of the substance on human health.*
This is considered in the context of the effect on nutrition (3) below as well as the consideration of GRAS and residues (5) below.

(5) *The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*
As this is not released into the agroecosystem, there is no direct effect.

(6) *The alternatives to using the substance in terms of practices or other available materials.*
See discussion of alternatives in the Steam Paper.

(7) *Its compatibility with a system of sustainable agriculture.*
This is considered more specifically below in the context of organic handling in (6) below.

Criteria from the February 10, 1999 NOSB Meeting

A PROCESSING AID OR ADJUVANT may be used if;

1. *It cannot be produced from a natural source and has no organic ingredients as substitutes.*
DEAE cannot be produced from natural sources and has no organic ingredients as substitutes. When considering chemical means to condition steam lines in boiler systems, the additives to the steam lines must be volatile, so that they purposely travel along with the steam. There are no known non-synthetic boiler additives that can serve this purpose. However, steam can be produced from water without the addition of boiler water additives. A list of substances that are FDA approved for boiler water contact is attached. While these are not direct substitutes, these are available options. The NOSB has already recommended that several of these be listed. See the Steam Paper for more discussion.

2. *Its manufacture, use, and disposal do not have adverse effects on the environment and are done in a manner compatible with organic handling.*
Diethylaminoethanol is produced from the reaction of diethylamine and ethylene oxide. Diethylamine is produced from ammonia and ethanol. The production of ammonia is covered in the TAP review for ammonium hydroxide. Ethanol can be produced by fermentation or synthesized from ethylene and was also previously reviewed by the NOSB. Ethylene oxide is a highly reactive gas that is extremely toxic. It is produced from petroleum refining. In the case of dehydration of diethanolamine (diethylaminoethanol), the production of diethylaminoethanol requires energy input to drive the synthetic reactions needed to make the material. Diethylamine is produced from ammonia and ethanol, or from ethyl iodide and ammonia. Ethanol can be produced by microbial fermentation, synthesized from ethylene, or by other methods (Budavari, 1996). These processes appear to have varying degrees of hazard to the environment.

   Volatile amines are known to react in ways that produce carbamates and nitrosamines (Archer, 1996). These reactions are believed to be antagonistic to each other. Nitrosoamine formation and exposure via DEAE requires more study

(Torén, 1996). While DEAE is not itself on the CERCLA list of hazardous wastes, it may be necessary in some jurisdictions and under some circumstances to handle it as such (NJ Department of Health, 1996).

3. *If the nutritional quality of the food is maintained and the material itself or its breakdown products do not have adverse effects on human health as defined by applicable Federal regulations.*
DEAE is a poison by intraperitoneal (visceral) and intravenous routes (Lewis, 1989). Alkanolamines will decompose into aldehydes and ammonia. DEAE can revert to diethylamine (DEA) and ethanol. When DEA reacts with acidic periodates, it will convert to formaldehyde and ammonia (Bollmaier, 1993). Alkanolamines will also form nitrosoamines through nitrosanation. A number of nitrosoamines are known or suspected carcinogens (IARC, 1978). A study conducted for NIOSH and the Nordic Expert Group for Criteria Documentation of Health Risks from Chemicals (NEG) concluded that there was remarkably little exposure data for DEAE, and that, among other things, studies for exposure to nitrosoamines formed from DEAE, basic toxicology, and cancer studies should be conducted (Torén, 1996).

4. *Its primary purpose is not as a preservative or used only to recreate/improve flavors, colors, textures, or nutritive value lost during processing except in the latter case as required by law.*
The petitioned use is to prevent corrosion of boiler and steam line equipment. It does not serve as a preservative, or to recreate/improve flavors, colors, textures, or nutritive value lost during processing. It may have other functionalities, but the primary petitioned purpose does not have a functional effect on the food processed. The material does come into contact with organic foods though, which is the reason for the petition.

5. *Is Generally Recognized as Safe (GRAS) by FDA when used in accordance with Good Manufacturing Practices (GMP), and contains no residues of heavy metals or other contaminants in excess of FDA tolerances.*
The FDA does not recognize Diethylaminoethanol as Generally Recognized as Safe (GRAS). The FDA sets a threshold for its use in steam that is in contact with food at 15 ppm. It is not permitted for use in dairy processing.

6. *Its use is compatible with the principles of organic handling.*
Organic standards are precautionary when evaluating synthetic substances used in food. Volatile amines in general do not appear to be compatible with the principles of organic handling. They are synthetic, toxic, and are not necessary to produce any food. Given the environmental impacts of the manufacturing process and the adverse health effects from exposure, they do not fit within organic principles. Food processors generated and used steam for a long time without these chemicals. Many organic food processors have already adopted viable and practical ways to address corrosion. See the Steam Paper and reviewers' comments for further discussion.

7. *There is no other way to produce a similar product without its use and it is used in the minimum quantity required to achieve the process.*
Culinary steam can be produced without the use of this chemical.
See the Steam Paper and the reviewers comments for a further discussion.

TAP Reviewer Comments*

Reviewer 1 [Food Science and Nutrition Professor with inspection and certification experience]
Diethyl amino ethanol is a neutralizing amine boiler additive used generally in combination with other neutralizing amines such as morpholine. Diethyl amino ethanol (DEAE) acts as a volatile basic amine capable of neutralizing carbonic acid in the steam and thereby prevents corrosion in steam lines and removal of oxygen. From an environmental position DEAE is recognized by the EPA List of Hazardous Substances and it is considered a hazardous air pollutant under the clean air act. OSHA has limited exposure to 10 ppm over an eight hour period where levels at 100 ppm or more are considered immediately dangerous to life or health (IPCS, 1993). . . It is made by chemical synthesis of diethylamine with ethylene chlorohydrin or with ethylene oxide. Therefore it is clearly synthetic.

* *OMRI's information is enclosed in square brackets in italics. Where a reviewer corrected a technical point (e.g., the word should be "intravenous" rather than "subcutaneous"), these corrections were made in this document and are not listed here in the Reviewer Comments. The rest of the TAP Reviewer's comments are edited for identifying comments, redundant statements, and typographical errors. Any text removed is identified by ellipses [. . .] Statements expressed by reviewers are their own, and do not reflect the opinions of any other individual or organization.*

Its status among US certifiers is a blanket "not allowed" and is not on the approved list of IFOAM and other international organizations. Disposal must comply with CERCLA. Therefore DEAE use, disposal or spill clean up as with other volatile amine boiler additives is not compatible with sustainable agricultural or processing systems. DEAE is not on the FDA Generally Recognized as Safe (GRAS) Listing and its use must not exceed 15 ppm based on toxicity studies. It is also not permitted in dairy processing. Overall use of DEAE as well as other volatile amines is not consistent with organic handling practices. Because of it toxicity, non-FDA GRAS approval and potential adverse effects on environmental and worker safety, I recommend that it be prohibited for all organic process operations where there is direct contact of steam to food.

There are many alternatives to the processing industry instead of using DEAE such as mechanical deaeration and ion exchange of incoming boiler feed water as well as deployment of high chromium, nickel and molybdenum stainless steel steam pipes (Moran and Natishan, 1993).

Advised Recommendation to the NOSB

In summary I recommend that diethyl amino ethanol be classified as:

1. Synthetic
2. Prohibited
3. Suggested annotation: For processing operations where there is direct steam to food contact.

Reviewer 2 [Consultant to organic certifiers]

. . . *[D]*iethylaminoethanol is considered a synthetic material. . . Diethylaminoethanol may also be used in food processing to obtain fatty-acid derivatives, as an emulsifying agent, and as a curing agent for resin (Winter, 1994). These uses will not be substantively covered in this review, as this is not the petitioners' request, but it could be deduced from the arguments below that these uses do not meet with acceptability under the OFPA and NOSB criteria for organic foods production.

Comments from the Criteria

Production of diethylaminoethanol requires energy input to drive the synthetic reactions needed to make the material. Diethylamine is produced from ammonia and ethanol, or from ethyl iodide and ammonia. Ammonia is produced by reacting nitrogen and hydrogen gases (also requires energy input). Ethanol can be produced by microbial fermentation, synthesized from ethylene, or by other methods; (Budavari, 1996). The hazards posed by these different processes may vary.

Diethylaminoethanol is a skin, eye, and respiratory irritant. [OSHA] recommends a variety of protective measures for persons working with this material, including skin and eye protection, and respirators (OSHA, 1978). Potential hazards of overexposure are nausea, vomiting, and irritation of the respiratory system, skin, and eyes (Budavari, 1996). It is immediately dangerous to life or health at 100 ppm, and its efects are felt at lower concentrations (Toxnet, 2001). These effects are observed in other mammals as well as humans (NTP, 2001). ACGIH recommends an upper limit of 2 ppm averaged over an 8-hour work period (NJ Dept. Health, 1996).

Diethylaminoethanol should be stored away from oxidizing agents and acids because of incompatibility. Contact with these chemicals gives a rapid exothermic reaction (Bollmaier, 1992). It is flammable when exposed to heat or flame, and can react with oxidizing materials (Lewis, 1989). Toxic gases and vapors may be released in a fire involving diethylaminoethanol; when heated to decomposition it emits toxic fumes of nitrogen oxides (Toxnet, 2001).

Diethylaminoethanol *[may be considered a hazardous waste]* (NJ Dept. Health, 1996), and is an EPA List 3 inert ingredient (EPA). . . *[D]*iethylaminoethanol raises significant concerns regarding its toxicological affects on humans, animals, and the environment.

The reaction of this synthetic material with organic foodstuffs may create a variety of synthetic by-products, the health implications of which are not completely known, especially over the long-term. There is no indication that addition of diethylaminoethanol to the processing stream has a beneficial affect on the nutritional quality of food. Mono- and dialkanolamines react readily with certain compounds to form carbamates; secondary amines give highly toxic nitrosoamines (Bollmaier, 1992). Diethylaminoethanol is a tertiary amine; interactions may be similar to these preceding categories, but this reviewer does not have references to cite for this. While it is possible that diethylaminoethanol may in some cases react with foodstuffs to create compounds otherwise normally found in the food during processing, such as browning compounds through the Maillard Reaction (Beattie, 1998), it is not known what all of the by-products of reactions of foodstuffs with diethylaminoethanol are or may be. . .

Historically, NOSB recommendations have been against the contact of any synthetic boiler additives with organic foods. All organic production and processing standards are in agreement that toxic substances should not contaminate organic

foods. Organic certifiers in the United States, if they take a position at all on this issue, are consistent in repeating the prohibition recommended by the NOSB.

Live steam can be and is produced in many processing systems without the use of any boiler additives that carry over onto the food products. Boiler water can be treated in advance of use in the system by a variety of methods to soften, deionize, filter, and otherwise purify it. These steps reduce the need for addition of synthetic materials not on the National List to the boiler system. In some applications, the steam or heating system for the food may be changed to one where live steam is not the active agent, but rather heating (of food contents directly, or of steam in contact with food) is done via a heat exchange system. The wide variety and individuality of processing systems which exist is indicative of the many ways in which the full range of processed food products can be made, without the need for toxic boiler additives to be used in contact with organic foods. This reviewer does not know of any food product type that absolutely requires diethylaminoethanol in steam which contacts organic food.

Justification of use of diethylaminoethanol by the petitioners is based on the constraints of their particular boiler and steam systems as they currently exist, and on the financial and/or logistical challenges involved with changing those systems so as to avoid contact of the organic food by the diethylaminoethanol. However, economic considerations are clearly not one of the criteria (either in OFPA or the final NOP rule) for determining the suitability of materials used in organic production systems.

History shows that quite often it has been the case that an organic operator (producer or handler) has had to make substantial changes to their system in order to be compliant with organic standards. These changes often involved redesigning of systems, practices, and techniques. In many cases, such changes resulted in the need for financial investment, as well as an investment in time. Some creativity on the part of the operator was often needed, to devise a new system. This has indeed been the case for certain processors, who made adjustments to their boiler systems or manufacturing practices in order to comply with the prohibition of contact of organic foodstuffs by synthetic boiler chemicals. The inconvenience of having to retool or readjust systems should not be the determining factor in whether or not such materials are added to the National List.

For certain processors, where organic processing events are not frequent, the boiler may be operated without the diethylaminoethanol for a limited time, without significant effect on the boiler or steam line system. For these operations, no retooling may be needed; instead, a procedure can be designed whereby it is verifiable that the volatile boiler chemical has been exhausted from the system prior to handling the organic goods.

For processors who intend to process frequently enough, or for long enough run times, redesigning of the system will be necessary, in one way or another. Prohibition on the use of volatile boiler chemicals can exist without consigning processors to premature deterioration of their equipment. It is often the case in industry that the creative process involved in redesigning systems has unpredicted benefits (short- and long-term) to the operator and the environment, in terms of long-term cost-effectiveness and sustainability; efforts in this direction should be encouraged, especially if not doing so results in a compromise of organic principles.

In fact, running boiler equipment designed for use with synthetic additives without the additives in place does lead to deterioration, and consequent lower efficiency of the system, which generally means greater energy consumption (Kohan, 1997). While greater efficiency of energy consumption seems undoubtedly to be desirable (both economically and ecologically), energy balance as a whole has not been considered as factor by the NOSB or certifiers when making determinations on the compatibility or allowability of materials or methods. To use such a factor as a criterion in the case for the volatile boiler additive is therefore inconsistent with the rest of the paradigm, and should not be a determining factor at this time.

Advised Recommendation to the NOSB

Diethylaminoethanol should be deemed a synthetic, prohibited material, and not be added to the National List for any purpose.

Reviewer 3 [University staff in Food Science with inspection, consulting, and certification experience]

General comments

Diethylaminoethanol (DEAE) is petitioned for use as a steam additive chemical to reduce corrosion in pipes. There could be direct food contact in many processing operations when steam is used to cook or heat food, such as in a blancher, cooker, canner, or other operations. DEAE has no functionality toward the food.

In the petition, page D-3 has the structure incorrect. It is only a 2 carbon chain to the right of the N, not a 3 carbon chain as drawn. . .

Comments based on the Criteria

There is sufficient evidence of potential adverse effects that precautionary action does not warrant allowing its use. . . The justification for use of *[DEAE]* is no different than trying to justify the use of a synthetic herbicide like Round-Up for organic farming, just because it provides a cheaper alternative to weed control and does not leave any detectable residue. Organic handling isn't about economics or end product testing, it's the process that's critical when evaluating compatibility with organic principles. Food processors generated and used steam for a long time without these chemicals. Many organic food processors have already adopted viable and practical ways to address corrosion without the use of DEAE.

There are other solutions that could be used to produce the desired result (no corrosion of piping). To summarize many of the citations reviewed, 'use of stainless steel piping completely solves the problem of corrosion.' The justification statement in the petition and the alternative control methods do not mention this as a possible solution. They do mention the costs of capital equipment and provide anecdotal evidence of the life expectancy and replacement needs should boiler water additives not be used, but provide no data to support this. There are numerous tests that can and should be performed periodically to determine the corrosion rates, (even with the use of inhibitors) to insure that equipment is being operated and maintained in a safe and efficient manner. Without confirming studies to show the differences in corrosion rates with and without the use of corrosion inhibitors, it appears that these petitioners are using anecdotal evidence to justify their continued use of cheap toxic chemicals instead of more expensive, but viable alternatives. There are several cited alternatives: stainless steel piping (suitable for all operations); discontinued use during organic processing (some operations); steam to steam heat exchanger (suitable for some operations); secondary boiler for food contact application only (suitable for all operations) that could be used. None of these are necessarily cheap, but all offer a viable alternative to the use of toxic chemicals.

Advised Recommendation to the NOSB

DEAE should not be approved for use as a boiler chemical for organic production.

Conclusion

The reviewers unanimously consider diethylaminoethanol (DEAE) to be synthetic, and unanimously advise the NOSB to not add it to the National List. Use should remain prohibited in organic handling.

References

See the Steam Paper.

DEAE

Occupational Health Guideline for Diethylamino Ethanol

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $(C_2H_5)_2NC_2H_4OH$
- Synonyms: 2-Diethylaminoethyl alcohol; N,N-diethylethanolamine; diethyl (2-hydroxytriethyl) amine; 2-diethylamino ethanol; 2-hydroxy-triethylamine
- Appearance and odor: Colorless liquid with a weak ammonia odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for diethylamino ethanol is 10 parts of diethylamino ethanol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 50 milligrams of diethylamino ethanol per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Diethylamino ethanol can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Liquid diethylamino ethanol splashes will cause skin irritation. Liquid splashes in the eye will cause irritation and damage. Diethylamino ethanol vapor may cause nausea and vomiting. It may also cause cough and shortness of breath. Splashes may cause eye and skin irritation.

2. Long-term Exposure: None known.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to diethylamino ethanol.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to diethylamino ethanol at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from diethylamino ethanol exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of diethylamino ethanol might cause exacerbation of symptoms due to its irritant properties.

—Skin disease: Diethylamino ethanol is a primary skin irritant and a probable skin sensitizer. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Eye disease: Diethylamino ethanol is a severe eye irritant and may cause tissue damage. Those with pre-existing eye problems may be at increased risk from exposure.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Diethylamino ethanol vapor is a skin, eye, and respiratory irritant. Rats exposed to 500 ppm 6 hours daily for 5 days exhibited marked eye and nasal irritation, and a number of animals had corneal opacity by the end of the third day; the mortality rate was 20%, and at autopsy there was acute purulent bronchiolitis and bronchopneumonia. Daily exposure at 200 ppm for up to 6 months was fatal in some rats, with death occurring during the first 30 days. An attempt by a laboratory worker to remove animals from an inhalation chamber containing approximately 100 ppm resulted in nausea and vomiting within 5 minutes after a brief exposure; no irritation of the eyes or throat was noted during this

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

brief exposure. Other persons in the same room also complained of a nauseating odor but showed no ill effects. The liquid is a severe skin irritant; in the guinea pig it is a skin sensitizer. It is also a severe eye irritant and may produce permanent eye injury. No systemic effects from human exposure have been reported.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 117.2
  2. Boiling point (760 mm Hg): 162 C (324 F)
  3. Specific gravity (water = 1): 0.89
  4. Vapor density (air = 1 at boiling point of diethylamino ethanol): 4.0
  5. Melting point: Data not available
  6. Vapor pressure at 20 C (68 F): 1 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Miscible in all proportions
  8. Evaporation rate (butyl acetate = 1): 0.17
- **Reactivity**
  1. Conditions contributing to instability: Heat.
  2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong acids will cause spattering.
  3. Hazardous decomposition products: Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving diethylamino ethanol.
  4. Special precautions: Liquid diethylamino ethanol will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: 52 C (126 F) (closed cup)
  2. Autoignition temperature: 320 C (608 F)
  3. Flammable limits in air, % by volume: Lower: 6.7; Upper: 11.7
  4. Extinguishant: Alcohol foam, carbon dioxide, dry chemical
- **Warning properties**
  1. Odor Threshold: Diethylamino ethanol has a weak ammoniacal odor, but no information is available concerning its odor threshold.
  2. Eye Irritation Level: The Pennwalt Corporation *Material Safety Data Sheet* states that diethylamino ethanol is irritating to the eyes. Deichmann and Gerarde (in *Toxicology of Drugs and Chemicals*, p. 216) state that 2-diethylamino ethanol as the "undiluted" compound is a severe eye irritant capable of producing permanent eye injury. No information is available, however, concerning air concentrations producing eye irritation.
  3. Other Information: Deichmann and Gerarde report that the vapors of diethylamino ethanol irritate the respiratory tract, but the concentrations producing this irritation are not given.
  4. Evaluation of Warning Properties: Since no quantitative information is available relating the warning properties of diethylamino ethanol to air concentrations, it is treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

An analytical method for diethylamino ethanol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with liquid diethylamino ethanol, where skin contact may occur.
- Clothing contaminated with liquid diethylamino ethanol should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of diethylamino ethanol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the diethylamino ethanol, the person performing the operation should be informed of diethylamino ethanol's hazardous properties.
- Where exposure of an employee's body to liquid diethylamino ethanol may occur, facilities for quick

drenching of the body should be provided within the immediate work area for emergency use.

• Non-impervious clothing which becomes contaminated with liquid diethylamino ethanol should be removed immediately and not reworn until the diethylamino ethanol is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where there is any possibility of solutions containing 5 percent or more of diethylamino ethanol by weight contacting the eyes and where solutions containing less than 5 percent diethylamino ethanol by weight may contact the eyes.

• Where there is any possibility that employees' eyes may be exposed to solutions containing 5 percent or more of diethylamino ethanol by weight, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

• Skin that becomes contaminated with liquid diethylamino ethanol should be immediately washed or showered to remove any diethylamino ethanol.

• Employees who handle liquid diethylamino ethanol should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to diethylamino ethanol may occur and control methods which may be effective in each case:

Operation	Controls
Use in preparation of medicinals and pharmaceuticals, pesticides, protective surface coatings for metals, emulsifying agents for polishes, resinous materials for treating fiber surfaces, fluorescent brightening agents, and in polymer production	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in organic synthesis to prepare compounds for surfactants, detergents, wetting agents, and yarn-treating	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use in synthetic fiber dyeing and vat dyes; use as photographic stabilizing solutions	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If diethylamino ethanol gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If diethylamino ethanol gets on the skin, immediately flush the contaminated skin with water. If diethylamino ethanol soaks through the clothing, remove the clothing immediately and flush the skin with water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of diethylamino ethanol, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When diethylamino ethanol has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If diethylamino ethanol is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Diethylamino ethanol should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explo-

sion. Sewers designed to preclude the formation of explosive concentrations of diethylamino ethanol vapors are permitted.

• Waste disposal methods:

Diethylamino ethanol may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

2. By atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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RESPIRATORY PROTECTION FOR DIETHYLAMINO ETHANOL

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Vapor Concentration	
500 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of diethylamino ethanol; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 500 ppm, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

A

Continued

ALKANOLAMINES

ALKANOLAMINES FROM OLEFIN OXIDES AND AMMONIA

Ethylene oxide [*75-21-8*], propylene oxide [*75-56-9*], or butylene oxide [*106-88-7*] react with ammonia to produce alkanolamines (Table 1). Ethanolamines, $NH_{3-n}(C_2H_4OH)_n$ (n = 1,2,3, mono-, di-, and tri-), are derived from the reaction of ammonia with ethylene oxide. Isopropanolamines, $NH_{3-n}(CH_2CHOHCH_3)_n$ (mono-, di-, and tri-), result from the reaction of ammonia with propylene oxide. Secondary butanolamines, $NH_{3-n}(CH_2CHOHCH_2CH_3)_n$ (mono-, di-, and tri-), are the result of the reaction of ammonia with butylene oxide. Mixed alkanolamines can be produced from a mixture of oxides reacting with ammonia.

Ethanolamines have been commercially available for over 50 years and isopropanolamines, for over 40 years. *sec*-Butanolamines have been prepared in research quantities, but are not available commercially. Primary butanolamines, eg, 2-amino-1-butanol [*96-20-8*] are made by a different chemical route (see ALKANOLAMINES FROM NITROALCOHOLS).

A variety of substituted alkanolamines are also available commercially, but have not reached the volume popularity of the ethanolamines and isopropanolamines (see Table 2).

Physical Properties

The freezing points of alkanolamines are moderately high as shown in Tables 1 and 2. The ethanolamines, monoisopropanolamine and mono-*sec*-butanolamine,

Structural formula	Freezing point, °C	Boiling point[a], °C	Water solubility[b], g/100 g	*n*-Heptane solubility[b], g/100 g	Viscosity[b], mPa·s (= cP)
$NH_2C_2H_4OH$	10	171	∞	0.06	19
$NH(C_2H_4OH)_2$	28	268	∞	0.01	54 (60°C)
$N(C_2H_4OH)_3$	21	340	∞	0.02	600
$NH_2CH_2CHOHCH_3$	3[c]	159	∞	0.4	23
$NH(CH_2CHOHCH_3)_2$	44[c]	249	1200	0.1	86 (54°C)
$N(CH_2CHOHCH_3)_3$	44[c]	306	>500	3.4	100 (60°C)
$NH_2CH_2CHOHC_2H_5$	3	169	∞	0.04	29
$NH(CH_2CHOHC_2H_5)_2$	68–70	256	∞	4.7	890
$N(CH_2CHOHC_2H_5)_3$	41–47	310	ca 7	>100	ca 6000

Alkanolamines have a mild ammoniacal odor and are extremely hygroscopic (1). The mono- and dialkanolamines have a basicity similar to aqueous ammonia; the trialkanolamines are slightly weaker bases.

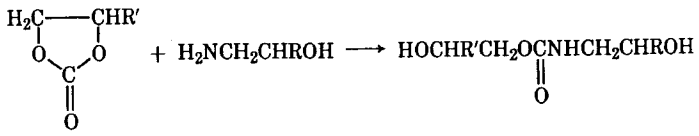
All the alkanolamines, except tri-*sec*-butanolamine, are completely miscible in water and polar solvents. Solubility in nonpolar solvents varies, as noted in Tables 1 and 2.

Chemical Abstracts name	Freezing point, °C	Boiling point[a], °C	Water solubility[b], g/100 g[a]	Viscosity[c], mPa·s (= cP)
2-dimethylaminoethanol	−59	135	∞	3
2-diethylaminoethanol		162	∞	4
2-(2-aminoethylamino)ethanol	−38[d]	244	∞	141
2-methylaminoethanol	−4.5	160	∞	13
2-butylaminoethanol	−2	199	∞	20
N-2-hydroxyethylacetamide	16	decompn	∞	203
2-anilinoethanol	11	285	4.6	101
2-dibutylaminoethanol	−75[e]	229	0.4	8
2-diisopropylaminoethanol	−39	191	1.2	8
2-*N*-ethylanilinoethanol	37[f]	decompn	0.2	
2,2′-(methylimino)diethanol	−21	247	∞	101
2,2′-(ethylimino)diethanol	< −44[e]	253	∞	87
2,2′-(phenylimino)diethanol	57[d]		2.8	119 (60°C)
1-dimethylamino-2-propanol	−85[e]	126		
1-(2-aminoethylamino)-2-propanol	−50[e]	155[g]	∞	112 (25°C)

With acrylonitrile, mono- and dialkanolamines undergo a Michael addition to give the β-aminonitrile.

$$NH(CH_2\underset{|}{C}HOH)_2 + CH_2{=}CHCN \longrightarrow (HO\underset{|}{C}HCH_2)_2NCH_2CH_2CN \quad (24)$$

Mono- and dialkanolamines react readily with ethylene or propylene carbonates to yield carbamates.



(25)

Alkanolamines can be oxidized with various oxidizing agents. With acidic potassium permanganate or excess potassium hydroxide, the potassium salts of the corresponding amino acid are obtained.

$$NH(CH_2CH_2OH)_2 \xrightarrow[200\text{–}300°C]{KOH} NH(CH_2COOK)_2 + 3\,H_2 \quad (26)$$

Mono- and diethanolamine are converted to formaldehyde and ammonia by acidic periodates.

Numerous patents exist for the production of nitrilotriacetic acid [*139-13-9*] and its salts from triethanolamine (14–16).

$$N(CH_2CH_2OH)_3 \xrightarrow{O_2} N(CH_2COOH)_3 \quad (27)$$

In certain cases, alkanolamines function as reducing agents. For example, monoethanolamine reduces anthraquinone to anthranols, acetone to 2-propanol, and azobenzene to aniline (17). The reduction reaction depends on the decomposition of the alkanolamine into ammonia and an aldehyde. Similarly, diethanolamine converts *o*-chloronitrobenzene to 2,2′-dichloroazobenzene and *m*-dinitrobenzene to 3,3′-diaminoazobenzene.

Monoethanolamine can also be reduced catalytically with hydrogen and ammonia over Raney nickel at 200°C and 20.7 MPa (3000 psig) to produce ethylenediamine [*107-15-3*] (18,19).

$$NH_2CH_2CH_2OH + NH_3 \xrightarrow[\text{Raney Ni}]{H_2} NH_2CH_2CH_2NH_2 + H_2O \quad (28)$$

Manufacture

Alkanolamines are manufactured from the corresponding oxide and ammonia. Anhydrous or aqueous ammonia may be used, although anhydrous ammonia is

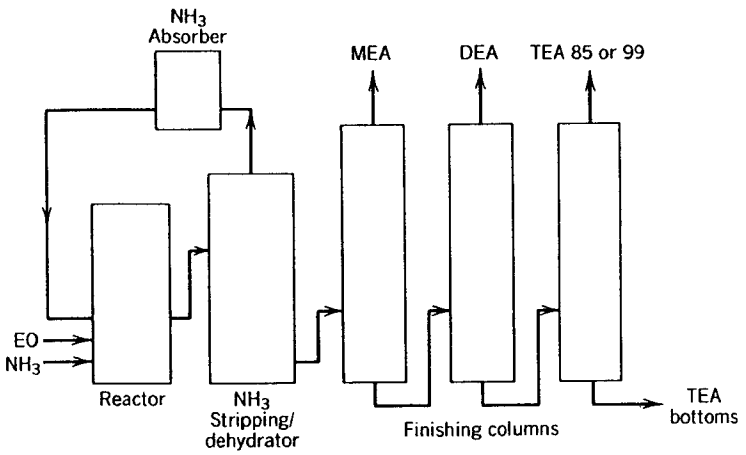
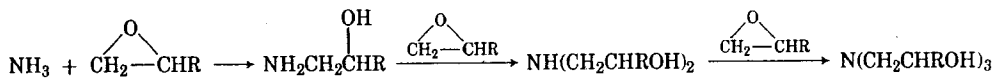


Fig. 2. Flow sheet for ethanolamine production. EO = ethylene oxide; MEA, DEA, and TEA are defined in Table 1.

typically used to favor monoalkanolamine production and requires high temperature and pressure (20). Mono-, di-, and trialkanolamines are produced in the reactor and sent to downstream columns for separation (Fig. 2).



where R = H, CH_3, C_2H_5

The reaction is exothermic; reaction rates decrease with increased carbon number of the oxide (ethylene oxide > propylene oxide > butylene oxide). The ammonia–oxide ratio determines the product split among the mono-, di-, and trialkanolamines. A high ammonia to oxide ratio favors mono- production; a low ammonia to oxide ratio favors trialkanolamine production. Mono- and dialkanolamines can also be recycled to the reactor to increase di- or trialkanolamine production. Mono- and dialkanolamines can also be converted to trialkanolamines by reaction of the mono- and di- with oxide in batch reactors. In all cases, the reaction is run with excess ammonia to prevent unreacted oxide from leaving the reactor.

A variety of substituted alkanolamines (Table 2) can also be made by reaction of oxide with the appropriate amine. Aminoethylethanolamine is made from the reaction of ethylenediamine [*107-15-3*] and ethylene oxide. Methyldiethanolamine is made from the reaction of ethylene oxide and methylamine [*74-89-5*]. Diethylethanolamine is made by the reaction of diethylamine [*109-87-7*] and ethylene oxide.

Economic Aspects

U.S. capacity of the ethanolamines in 1989, almost one-half of global capacity, was estimated to be 379,000 t. Global capacity for 1989 was estimated at 692,000 t.

films are characterized by improved performance, particularly salt-spray resistance and gloss (see ALKYD RESINS; COATINGS, SPECIAL PURPOSE, HIGH PERFORMANCE).

Other oxazolines synthesized from alkanolamines are useful as surface-active agents and corrosion inhibitors. Synthetic oxazoline waxes promote lubricity and mar resistance of coatings.

Oxazolidines, formed by reaction of alkanolamines with aldehydes, are useful as leather tanning agents and are effective curing agents for proteins, phenolic resins, moisture-cure urethanes, etc. They also find use as antimicrobial agents.

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of ulceration associated with alkali burns. Examples are cysteine (0.2M in 0.9 per cent NaCl), three drops four to five time daily, and calcium EDTA (0.2M), one drop every two hours while awake.[6, 7]

Medical Control: Preplacement questionnaire with emphasis on detecting a history of chronic respiratory or eye disease. Such persons may be at increased risk from exposure.

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DIETHYLAMINOETHANOL

$(C_2H_5)_2NCH_2CH_2OH$ 1977 TLV 10 ppm

Synonyms: Diethyl ethanolamine; DEAE
Physical Form: Colorless liquid
Uses: Chemical intermediate for the production of emulsifiers, detergents, solubilizers, cosmetics, drugs, and textile finishing agents
Exposure: Inhalation; skin absorption
Toxicology: Diethylaminoethanol is an irritant of the eyes, mucous membranes, and skin in animals, and it is expected that severe exposure will cause the same effects in humans.

An attempt by a laboratory worker to remove animals from an inhalation chamber containing approximately 100 ppm resulted in nausea and vomiting within five minutes after a fleeting exposure; no irritation of the eyes or throat was noted during this brief exposure.[1] Other persons in the same room also complained of a nauseating odor but showed no ill effects.

The liquid is a severe skin irritant; in the guinea pig it is a skin sensitizer.[2] It is also a severe eye irritant and may produce permanent eye injury.[2] No systemic effects from industrial exposure have been reported.

Rats exposed to 500 ppm six hours daily for five days exhibited marked eye and nasal irritation, and a number of animals had corneal opacity by the end of the third day; the mortality rate was 20 per cent, and, at autopsy, findings were acute purulent bronchiolitis and bronchopneumonia.[1]

The TLV is set at a level to prevent irritation.[3]

Diagnosis: Signs and symptoms include nausea and vomiting; may produce respiratory irritation; severe skin or eye irritation from liquid splashes.

Differential Diagnosis: Differentiate from other causes of conjunctivitis and mucous membrane irritation such as viral infections of the upper respiratory tract and allergies.

Special Tests: None is specific.

Treatment: Institute appropriate procedures, such as removal from exposure and immediate flushing of eyes and skin with water. If dermatitis occurs, see section in Chapter 5 on Treatment of Contact Dermatitis.

Medical Control: Preplacement screening questionnaire with emphasis on detecting a history of chronic respiratory or skin disease. Such persons may be at increased risk from exposure.

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Supplemental

A.C.G.I.H.: Diethylamino Ethanol (diethyl ethanolamine) Documentation of the TLVs for Substances in Workroom Air. ed. 3, p. 85. Cincinnati, 1976.

DIFLUORODIBROMOMETHANE

CF_2Br_2 1977 TLV 100 ppm

Synonyms: Halon 1202; Freon 12–B2
Physical Form: Colorless liquid or gas
Uses: Fire-extinguishing agent
Exposure: Inhalation
Toxicology: Difluorodibromomethane causes respiratory irritation and narcosis in animals, and severe exposure is expected to produce the same effects in humans.

No effects have been reported from industrial exposures.

Rats exposed to 4000 ppm for 15 minutes showed pulmonary edema, while 2300 ppm daily for six weeks resulted in the death of more than half the animals.[1] At 2300 ppm dogs showed rapid and progressive signs of intoxication after a few days of exposure, with weakness and loss of balance followed by convulsions.[2] These dogs at autopsy had pulmonary congestion, centrolobular necrosis of the liver, and evidence of central nervous system damage. However, other dogs tolerated daily exposures of 350 ppm for seven months without signs of intoxication.[2] The TLV was set to prevent any toxic effects.[3]

Diagnosis: Signs and symptoms of severe exposure, by analogy with effects caused in animals, may include CNS depression or pulmonary irritation.

Differential Diagnosis: Differentiate from other causes of a "confused" state, such as hypoglycemia, hyperglycemia, cerebrovascular accident, transient ischemic episodes, head injury, postepileptic confusion, hysteria, heat stroke, drug abuse, toxic encephalopathy, meningitis, or encephalitis.

If the tracheobronchial tree becomes involved, the symptoms and signs must be differentiated from cardiogenic pulmonary edema and from viral or bacterial pneumonia.

Special Tests: If signs or symptoms of central depression occur, obtain blood glucose and rectal temperature and perform a complete neurologic examination and further specialized neurologic examinations as indicated. If severe exposure is suspected, diagnostic studies should include electrocardiogram, spinal tap, gram stain and culture, and differential white blood cell count. If pulmonary edema occurs, there should be analysis of arterial blood gases.

Treatment: Institute appropriate procedures, such as removal from exposure and flushing of eyes with water. If exposure is severe, hospitalization and observation for 48 hours for delayed onset of severe pulmonary edema are advisable. Refer to Therapeutic Maneuvers in Treatment of Respiratory Irritants, Chapter 6. Treat central nervous system effects symptomatically.

Medical Control: Preplacement questionnaire with emphasis on detecting a history of liver, kidney, or chronic respiratory disease. Such persons may be at increased risk from exposure.

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DIGLYCIDYL ETHER

$C_6H_{10}O_3$ 1977 TLV 0.5 p

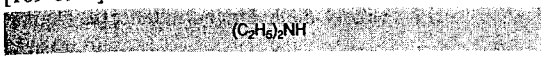
Synonyms: Bis (2,3–epoxy propyl) ether; DGE; Di (2,3–epoxy) propyl ether
Physical Form: Colorless liquid

Production:
• diketene + diethylamine (condensation)
Derivatives:
phosphamidon

diethylaluminium chloride
DEAC; [96-10-6]

$C_4H_{10}Al_1Cl_1$. M: 120.55. Colourless liquid. Spontaneously flammable in air, emitting dense smoke. BP: 214°C. FP: -74°C. d: 0.97 kg/l (25°C). Reacts violently with water.
Production:
• aluminium + ethyl chloride (reaction; coproduced with ethylaluminium dichloride)
Uses: Ziegler catalyst component (ethylene-propylene rubber production)

diethylamine
[109-89-7]



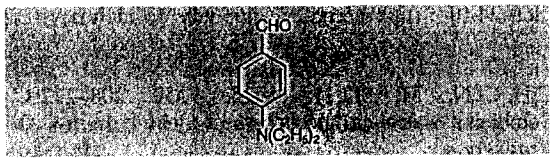
$C_4H_{11}N_1$. M: 73.14. Liquid. BP: 56°C. MP: -50°C. d: 0.71 kg/l (4°C). Miscible with water forming alkaline solutions. Miscible with oxygenated solvents.
Production:
• ethanol + ammonia (amine formation; coproduced with ethylamine/triethylamine)
Derivatives:
amfepramone; 7-(4-amino-6-diethylaminotriazin-2-yl)-amino-3-phenylcoumarin; 7-(4-chloro-6-diethylamino-triazin-2-yl)amino-3-phenylcoumarin; denatonium benzoate; *N,N*-diethylacetoacetamide; diethylamine borane; diethylaminoethanol; *N,N*-diethyl-3-amino-4-methoxybenzenesulphonamide; 3-diethylaminopropylamine; diethylcarbamoyl chloride; *N,N*-diethylethylenediamine; diethylhydroxylamine; *N,N*-diethyl-*m*-toluamide; dinitramine; lidocaine; napropamide; nikethamide; pirimiphos-ethyl; pirimiphos-methyl; propanidid; sodium diethyldithiocarbamate; thiobencarb; tolycaine; trietazine

diethylamine borane

$C_4H_{14}B_1N_1$. M: 86.97.
Production:
• diethylamine + sodium borohydride + boron trifluoride (complex formation)
Uses: reducing agent (electrodeless coatings)

1-diethylamino-4-aminopentane
See: 4-amino-1-diethylaminopentane

***p*-diethylaminobenzaldehyde**
N,N-diethyl-4-aminobenzaldehyde; [120-21-8]
$C_{11}H_{15}N_1O_1$. M: 177.25. Solid. MP: 37–40°C. BP: 174°C (2.3 kPa). Soluble in water, oxygenated and aromatic solvents.



Production:
• *N,N*-diethylaniline + dimethylformamide (Vilsmeier reaction)
Derivatives: Acid Blue 104; Acid Violet 17; Basic Violet 16

diethylaminoethanol
2-diethylaminoethanol; *N,N*-diethyl-2-aminoethanol; *N,N*-diethylethanolamine; DEAE; [100-37-8]

$C_6H_{15}N_1O_1$. M: 117.20. Liquid. BP: 161–163°C. MP: -70°C. Soluble in water. Miscible with most organic solvents.
Production:
• diethylamine + ethylene oxide (epoxidation)
Derivatives:
dicycloverine; 2-diethylaminoethyl acrylate; 2-diethylaminoethyl chloride hydrochloride; 2-diethylaminoethyl methacrylate; *N,N*-diethylethylenediamine; nicametate; oxybuprocaine; pentoxyverine; procaine
Uses:
pigment dispersant (paints); solvent (gas sweetening processes); textile/leather/paper auxiliary; corrosion inhibitor (boiler water treatment)

2-diethylaminoethyl acrylate

$C_9H_{17}N_1O_2$. M: 171.25.
Production:
• diethylaminoethanol + acrylic acid (esterification)
Uses:
acrylic resin comonomer

2-(diethylamino)ethyl 4-aminobenzoate
See: procaine

diethylaminoethyl cellulose

R = cellulose-.
Production:
• alkali cellulose + 2-diethylaminoethyl chloride hydrochloride (ether formation)
Uses:
weakly basic ion-exchange resins (food, chemical, pharmaceutical purification)

DEAE

DIZ100 CAS: 1609-47-8
DIETHYL DICARBONATE

mf: $C_6H_{10}O_5$ mw: 162.16

PROP: Viscous liquid; fruity odor. D: 1.12, visc (20°): 1.97 cp. Soluble in alcohols, esters, ketones, hydrocarbons.

SYNS: BAYCOVIN ◇ DEPC ◇ DICARBONIC ACID DIETHYL ESTER ◇ DIETHYL ESTER of PYROCARBONIC ACID ◇ DIETHYL OXYDIFORMATE ◇ DIETHYL PYROCARBONATE ◇ DIETHYL PYROCARBONIC ACID ◇ DKD ◇ ETHYL PYROCARBONATE ◇ OXYDIFORMIC ACID DIETHYL ESTER ◇ PIREF ◇ PYROCARBONATE d'ETHYLE (FRENCH) ◇ PYROCARBONIC ACID, DIETHYL ESTER ◇ PYROKOHLENSAEURE DIAETHYL ESTER (GERMAN)

USE IN FOOD:

Purpose: Ferment inhibitor, fungicide.

Where Used: Prohibited from alcoholic beverages, prohibited from foods.

Regulations: FDA - 21CFR 189.140. Prohibited from direct addition or use in human food. Legal for use in wine in other countries.

SAFETY PROFILE: Poison by ingestion and intraperitoneal routes. Concentrated DEPC is irritating to eyes, mucous membranes and skin. When heated to decomposition it emits acrid smoke and fumes.

TOXICITY DATA and CODEN

orl-rat LD50:850 mg/kg FAONAU 51A,69,72
ipr-rat LD50:100 mg/kg ZLUFAR 114,292,61
orl-mus LD50:2027 mg/kg ZLUFAR 139,287,69

XEAE

DJH600 CAS: 100-37-8
N,N-DIETHYLETHANOLAMINE

DOT: 2686

mf: $C_6H_{15}NO$ mw: 117.22

PROP: Colorless, hygroscopic liquid. Bp: 162°, flash p: 140°F (OC), d: 0.8851 @ 20°/20°, vap press: 1.4 mm @ 20°, vap d: 4.03.

SYNS: DEAE ◇ DIAETHYLAMINOAETHANOL (GERMAN) ◇ DIETHYLAMINOETHANOL ◇ β-DIETHYLAMINOETHANOL ◇ N-DIETHYLAMINOETHANOL ◇ 2-(DIETHYLAMINO)ETHANOL ◇ 2-N-DIETHYLAMINOETHANOL ◇ 2-DIETHYLAMINOETHANOL (ACGIH) ◇ DIETHYLAMINOETHANOL (DOT) ◇ β-DIETHYLAMINOETHYL ALCOHOL ◇ DIETHYLETHANOLAMINE ◇ N,N-DIETHYL-N-(β-HYDROXYETHYL)AMINE ◇ 2-HYDROXYTRIETHYLAMINE

USE IN FOOD:

Purpose: Boiler water additive.

Where Used: Various.

Regulations: FDA - 21CFR 173.310. Limitation of 15 ppm in steam and excluding use of such steam in contact with milk and milk products.

OSHA PEL: TWA 10 ppm (skin) ACGIH TLV: TWA 10 ppm (skin) DOT Classification: Flammable or Combustible Liquid; Label: Flammable Liquid

SAFETY PROFILE: Poison by intraperitoneal and intravenous routes. Moderately toxic by ingestion, skin contact, subcutaneous, intramuscular, and possibly other routes. Human systemic effects by inhalation: nausea or vomiting. A skin and severe eye skin irritant. Combustible liquid. Flammable when exposed to heat or flame; can react with oxidizing materials. To fight fire, use alcohol foam, CO_2, dry chemical. When heated to decomposition it emits toxic fumes of NO_x.

TOXICITY DATA and CODEN

skn-rbt 500 mg open MLD UCDS** 6/11/63
eye-rbt 5 mg SEV UCDS** 6/11/63
ihl-hmn TCLo:200 ppm:GIT 34ZIAG -,216,69
orl-rat LD50:1300 mg/kg JIHTAB 26,269,44
ihl-rat LCLo:4500 mg/m^3/4H GTPZAB 14(11),52,70
ipr-rat LD50:1220 mg/kg TXAPA9 12,486,68

DJL000 CAS: 577-11-7
DI-(2-ETHYLHEXYL) SODIUM SULFOSUCCINATE

mf: $C_{20}H_{38}O_7S \cdot Na$ mw: 445.63

PROP: White, waxlike, plastic solid; octyl alcohol odor. Sol in hexane, glycerin, alc; sltly sol in water.

SYNS: AEROSOL GPG ◇ ALCOPOL O ◇ ALPHASOL OT ◇ BEROL 478 ◇ BIS(ETHYLHEXYL) ESTER of SODIUM SULFOSUCCINIC ACID ◇ BIS(2-ETHYLHEXYL)SODIUM SULFOSUCCINATE ◇ BIS(2-ETHYLHEXYL)-S-SODIUM SULFOSUCCINATE ◇ 1,4-BIS(2-ETHYLHEXYL) SODIUM SULFOSUCCINATE ◇ 1,4-BIS(2-ETHYLHEXYL)SULFOBUTANEDIOIC ACID ESTER, SODIUM SALT ◇ CELANOL DOS 75 ◇ CLESTOL ◇ COLACE ◇ COMPLEMIX ◇ CONSTONATE ◇ COPROL ◇ DEFILIN ◇ DIOCTLYN ◇ DIOCTYLAL ◇ DIOCTYL ESTER of SODIUM SULFOSUCCINATE ◇ DIOCTYL ESTER of SODIUM SULFOSUCCINIC ACID ◇ DIOCTYL-MEDO FORTE ◇ DIOCTYL SODIUM SULFOSUCCINATE (FCC) ◇ DIOCTYL SULFOSUCCINATE SODIUM SALT ◇ DIOMEDICONE ◇ DIOSUCCIN ◇ DIOTILAN ◇ DIOVAC ◇ DOCUSATE SODIUM ◇ DOXINATE ◇ DOXOL ◇ DSS ◇ DULSIVAC ◇ DUOSOL ◇ 2-ETHYL-

HEXYL SULFOSUCCINATE SODI
◇ KONLAX ◇ KOSATE ◇ LAXIN
◇ MERVAMINE ◇ MODANE SOF
◇ MOLOFAC ◇ MONAWET MD
◇ NEVAX ◇ NIKKOL OTP 70 ◇ I
◇ RAPISOL ◇ REGUTOL ◇ REQU
◇ SANMORIN OT 70 ◇ SBO ◇ SC
ETHYLHEXYL) SULFOSUCCINAT
HEXYL) SULFOSUCCINATE ◇ SC
SUCCINATE ◇ SODIUM DIOCTYL
◇ SODIUM-2-ETHYLHEXYLSULF
SULFODI-(2-ETHYLHEXYL)SULF
◇ SOLIWAX ◇ SOLUSOL-75% ◇
◇ SULFIMEL DOS ◇ TEX WET 1
◇ VATSOL OT ◇ VELMOL ◇ WA

USE IN FOOD:

Purpose: Emulsifier, hog
scald agent, processing ai

Where Used: Beverage mi
(shell), fruit juice drinks,
gum, hog carcasses, milk

Regulations: FDA - 21C
of 9 ppm in finished food.
163.117, 172.520, and 17
75 ppm in finished bevera
Limitation of 15 ppm in ge
in finished beverage or fru
molasses; 0.5 percent in
colloids; 10 percent in fur
fruit juice drinks. USD
381.147. Sufficient for pu

SAFETY PROFILE: Poi
route. Moderately toxic by
peritoneal routes. A skin a
When heated to decompo
fumes of SO_x and Na_2O.

TOXICITY DATA and C

eye-rbt 250 µg MLD AR
eye-rbt 1% SEV JAPMA8
orl-rat LD50:1900 mg/kg
ipr-rat LD50:590 mg/kg

DJX000
DIETHYL-o-PHTHALAT

mf: $C_{12}H_{14}O_4$ mw: 22

PROP: Clear, colorless l
bp: 302°, flash p: 325°F
d: 7.66.

SYNS: ANOZOL ◇ 1,2-BENZEN
DIETHYL ESTER ◇ DIETHYL PH

International Chemical Safety Cards

1,2-DIETHYLAMINOETHANOL

ICSC: 0257

1,2-DIETHYLAMINOETHANOL
N,N-Diethylethanolamine
Diethylaminoethyl alcohol
$(C_2H_5)_2NC_2H_4OH$
Molecular mass: 117.2

CAS # 100-37-8
RTECS # KK5075000
ICSC # 0257
UN # 2686
EC # 603-048-00-6

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ SYMPTOMS	PREVENTION	FIRST AID/ FIRE FIGHTING
FIRE	Flammable. Gives off irritating or toxic fumes (or gases) in a fire.	NO open flames.	Powder, alcohol-resistant foam, water spray, carbon dioxide.
EXPLOSION	Above 52°C explosive vapour/air mixtures may be formed.	Above 52°C closed system, ventilation.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE			
INHALATION	Cough. Laboured breathing. Nausea. Shortness of breath. Sore throat. Vomiting.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention.
SKIN	MAY BE ABSORBED! Redness. skin burns. Pain.	Protective gloves. Protective clothing.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
EYES	Redness. Pain. Blurred vision.	Face shield.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
INGESTION	Abdominal pain. Diarrhoea (further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give plenty of water to drink. Refer for medical attention.

SPILLAGE DISPOSAL	STORAGE	PACKAGING & LABELLING
Collect leaking and spilled liquid in sealable containers as far as possible. Wash away remainder with plenty of water (extra personal protection: A/P2 filter respirator for organic vapour and harmful dust).	Separated from oxidants, acids, acid chlorides, isocyanates. Dry.	Xi symbol R: 36/37/38 S: 28 UN Haz Class: 3 UN Pack Group: III

SEE IMPORTANT INFORMATION ON BACK

ICSC: 0257

International Chemical Safety Cards

1,2-DIETHYLAMINOETHANOL

ICSC: 0257

IMPORTANT DATA

PHYSICAL STATE; APPEARANCE:
COLOURLESS HYGROSCOPIC LIQUID , WITH CHARACTERISTIC ODOUR.

PHYSICAL DANGERS:

CHEMICAL DANGERS:
On combustion, forms toxic gases (nitrogen oxides). Reacts violently with oxidants, acids, acid chlorides, and isocyanates. Attacks light metals and copper.

OCCUPATIONAL EXPOSURE LIMITS (OELs):
TLV (as TWA): 10 ppm; 48 mg/m^3 (skin) (ACGIH 1992-1993).
MAK: 10 ppm; 50 mg/m^3; H (1992).
OSHA PEL: TWA 10 ppm (50 mg/m^3) skin
NIOSH REL: TWA 10 ppm (50 mg/m^3) skin
NIOSH IDLH: 100 ppm

ROUTES OF EXPOSURE:
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

INHALATION RISK:
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

EFFECTS OF SHORT-TERM EXPOSURE:
The substance irritates the eyes, the skin and the respiratory tract. Inhalation of vapour and/or fumes may cause lung oedema (see Notes). The substance may cause effects on the nervous system.

EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:

PHYSICAL PROPERTIES

Boiling point: 163°C
Melting point: -70°C
Relative density (water = 1): 0.883
Solubility in water: miscible
Vapour pressure, kPa at 20°C: 0.19
Relative vapour density (air = 1): 4.03
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.01
Flash point: 52°C (c.c.)
Auto-ignition temperature: 250°C
Explosive limits, vol% in air: 6.7-11.7
Octanol/water partition coefficient as log Pow: 0.46

ENVIRONMENTAL DATA

NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Immediate administration of an appropriate spray, by a doctor or a person authorized by him/her, should be considered. The odour warning when the exposure limit value is exceeded is insufficient.

NFPA Code: H 3; F 2; R 0;

ADDITIONAL INFORMATION

ICSC: 0257 **1,2-DIETHYLAMINOETHANOL**

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Arbete och Hälsa 1994:25

NEG and NIOSH Basis for an Occupational Health Standard

2-Diethylaminoethanol

Kjell Torén

May 1996

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DHHS (NIOSH) Publication No. 96–104

CONTENTS

12 RESEARCH NEEDS

DEAE probably has many uses in different industrial processes and as a corrosion inhibitor in water-based systems. There is a remarkable lack of exposure data. Hence, studies investigating exposure in different occupational groups should be performed. Exposure assessments regarding nitrosamines are also needed.

DEAE is excreted in urine, and studies should be performed to investigate whether this could be used for biomonitoring.

On the basis of theoretical calculations, DEAE seems to be absorbed through the skin. This property should be evaluated in experimental studies.

There is a great need for basic toxicological testing regarding sensitization and reproductive and developmental effects. Testing for mutagenicity and genotoxicity is also needed. Cancer studies should be conducted.

There is also a great need for inhalation studies in the lower-dose interval (<100 mg/m^3), both in man and in animals. These studies should investigate inflammatory changes in the upper and lower airways.

13 DISCUSSION AND CONCLUSIONS

In animals, the critical effects of DEAE seems to be irritation of the mucous membranes in both lower and upper airways. The very limited information for humans indicates that the critical effect of DEAE is irritation of the mucous membranes and skin. DEAE also affects the nervous system and the heart, but this is not important in occupational settings.

Like other alkanolamines, DEAE is a potent irritant of the mucous membranes in the airways (probably owing to its alkalinity). In rats, there is some support for a dose-response relationship regarding irritation in the upper airways. In rats, effects on the upper airways seem to develop at exposure concentrations of 120 mg/m^3.

The exposure time is important. Rats exposed to 48 mg/m^3 for 9 days showed no signs of respiratory impairment. Rats exposed to 53 mg/m^3 developed rales after 2 weeks of exposure. These exposure concentrations (53 mg/m^3 and 48 mg/m^3) are the lowest to which animals have been exposed. Hence, it is not possible on the basis of the literature to determine a no-effect concentration for DEAE.

14 SUMMARY

Torén K. 2-Diethylaminoethanol. NEG and NIOSH Basis for an Occupational Health Standard. Arbete och Hälsa 1994;25:1–17.

The literature on 2-diethylaminoethanol has been reviewed and health effects of DEAE have been evaluated. There is very limited information on health effects in humans. Based on these limited data, the critical effect seems to be irritation of the mucous membranes and skin. In animals, the critical effect seems to be irritation of the mucous membranes of both lower and upper airways.

Key words: 2-diethylaminoethanol, occupational exposure, occupational exposure limits

15 SUMMARY IN SWEDISH

Torén K. 2-Dietylaminoetanol. NEG och NIOSH underlag för hygienskt gränsvärde. Arbete och Hälsa 1994;25:1–17.

Genomgång av litteraturen om 2-dietylaminoetanol samt utvärdering av hälsoeffekter. Informationen om hälsoeffekter hos människa är mycket begränsad. På grundval av dessa data tycks den kritiska effekten vara irritation av slemhinnor och hud. Hos djur tycks den kritiska effekten vara irritation av slemhinnor i övre och nedre luftvägar.

Nycdkelord: 2-diethylaminoetanol, hygieniskt gränsvärde, yrkesmässig exponering

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APPENDIX I.

Permitted or recommended maximum levels of 2-diethylaminoethanol in air

Country	ppm	mg/m^3	Comments	Year	Reference
Denmark	10	50	H	1988	1
Finland	10	15	15 min, H	1993	2
Iceland	—	—	—	1989	3
Netherlands	10	50	H	1994	4
Norway	10	50	H	1989	5
Sweden	—	—	—	1993	6
USA (ACGIH)	10	48	Skin	1991–92	7
(NIOSH)	10	50	Skin	1990–91	8

H = dermal absorption

Skin = the cutaneous route, including mucous membranes and eyes (vapour or contact) contributes significantly to the overall exposure.

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McGeary Grain INCORPORATED
P.O. BOX 299
LANCASTER, PA 17608
800-624-3279

PETITION
USDA NATIONAL ORGANIC PROGRAM
NATIONAL LIST OF MATERIALS

McGeary Grain, Inc., under provisions of the Organic Food Production Act of 1990 (OFPA), petitions the NOSB to evaluate the following substance for inclusion (X) on or removal ( ) from the National List.

- Material Category: Processing and Handling Material
- Common Name: 5615 Steamline Treatment
- Manufacturer: Iowa Water Management Corporation
  P.O.Box E
  Carlisle, IA 50047-0704
  515-989-4354
- List of Use: Classified as a neutralizing amine, this treatment, containing Diethylaminoethanol; is designed to evaporate with steam and return to the boiler with condensate, maintaining the proper pH in steam and returnlines, reducing corrosion and increasing operational life of the boiler system.

  The specific application of the steam generator is as an aid to producing pelletized animal feed. Steam is required to condition the bulk feed as it enters the pelletizer, and to provide lubricant and as an aid to binding as the feed is expressed through the pelletizing die. Any neutralizing amine evaporates quickly, within seconds to minutes, leaving no residual amine in pelletized feed. Steamline treatment concentration is less than 10 parts per million (PPM), and is monitored by checking steam condensate pH(7.5 to 8.5 required).
- Manufacturing Procedures: Diethylaminoethanol is blended with sodium zeolite softened water to form 5615 Steamline Treatment. Reference MSDS Section 2 for product Composition/Information.
- Review, state/private: Note USDA Food Service approval letter (Figure 1). No other approval letters have been uncovered.
- Regulatory status: 5615 Steamline Treatment approved by FDA Food

12 Dec 00

Safety and Inspection Service, for use in processing food for human consumption. See attached letter of approval (Figure 1).

- Chemical Abstract Number: 100378
- Physical Properties: See Section 9 of Material Safety Data Sheet (MSDS) attached (Figure 2).
- Safety Information: See Material Safety Data Sheet (MSDS) attached (Figure2).
- Research Information: No research information other than MSDS exists.
- Justification Statement: Steamline Treatment is required to maintain proper pH levels in the steam and condensate return lines preventing corrosion of the boiler system and associated plumbing lines. Eliminating piping corrosion will extend boiler system useful life.

  Pelletized feed is required for some animals in order to maintain a uniform distribution of granular components, essential vitamins, and minerals in the total feed ration. Pelletized feed means that the animal will pick up and ingest the entire pellet and not selectively choose those feed particles it wants.

- Commercial Confidential Information Statement: None

12/26/00

United States Department of Agriculture

Food Safety and Inspection Service

Regulatory Programs
Building 306, BARC-East
Beltsville, MD 20705

December 08, 1994

Dr. Michael J. Van Hamme
Iowa Water Management, Corp.
Post Office Box E
Carlisle, IA 50047

Dear Dr. Van Hamme:

This is in reply to your request for compound authorization received on October 31, 1994 for your product 5615.

This product is acceptable for treating boilers or steam lines where the steam produced may contact edible products and/or cooling systems where the treated water may not contact edible products in official establishments operating under the Federal meat, poultry, shell egg grading, and egg products inspection programs.

Acceptance of compounds by this Department is in no way to be construed as an endorsement of the compounds or of any claims made for them.

If any change is made in the labeling information or formulation, the authorization for use in official plants becomes void immediately.

Sincerely,

John M. Damaré, Chief
Compounds and Packaging Branch
Product Assessment Division

Figure 1

Material Safety Data Sheet

Product: 5615 Steamline Treatment
Date of Preparation: 12/98

Section 1 - Chemical Product and Company Identification

56
Product/Chemical Name: 5615 Steamline Treatment
Chemical Formula: A Blend of Water Treatment Application Materials
Emergency Response No. INFOTRAC (800) 535-5053
Manufacturer: Iowa Water Management, Corp.
P.O. Box E
Carlisle, IA 50047-0704

Section 2 - Composition/Information on Ingredients

Ingredient Name	CAS Number	% wt or % vol	OSHA PEL TWA STEL	ACGIH TLV TWA STEL	Other
Diethylaminoethanol	100378	15-25	10 ppm	10 ppm	
NON HAZARDOUS INGREDIENTS		75-85			
Total					

Section 3 - Hazards Identification

+ + + + Emergency Overview + + + +

HMIS	
H	3
F	0
R	1
PPE	J
+Sec.8	

Potential Health Effects

Primary Entry Routes: Eye Contact, Skin Contact, Inhalation
Acute Effects: Irritation and Corrosive to eyes and skin and mucous membranes.
Inhalation: High mist concentrations can cause burns to eyes, nose, throat and lungs.
Eye: Severe irritation with corneal injury and may result in permanent impairment of vision and even blindness.
Skin: Prolonged or repeated contact can cause skin irritation and potential burns
Ingestion: Material is corrosive to mucous membranes if swallowed. Single dose toxicity is low. Ingestion may cause gastrointestinal irritation or ulceration and burns of mouth and throat.
Carcinogenity: IARC, NTP, and OSHA do not list this product or it=s components as a carcinogen.
Medical Conditions Aggravated by Long-Term Exposure: No specific information provided on compounds at date of issue.
Chronic Effects: See Section II- Toxicological Information

Section 4 - First Aid Measures

Inhalation: Remove to fresh air and treat symptomatically. Provide oxygen if breathing is difficult. Give artificial respiration if the victim is not breathing. Seek prompt medical attention.
Eye Contact: Flush eyes with a large amount of water for 15 minutes. Seek medical attention immediately if any irritation persists. After first aid, get appropriate in-plant, paramedic or community medical support.
Skin Contact: Wash affected areas thoroughly with soap and water for at least 15 minutes. Seek medical attention if any irritation persists.
Ingestion: If swallowed, give 2 glasses of water to drink. DO NOT induce vomiting. After first aid, IMMEDIATELY seek appropriate in-plant, paramedic, or community medical support. Never give anything by mouth to an unconscious person.

Figure 2

Product: 5615 Steamline Treatment

Section 5 - Fire-Fighting Measures

Flash Point: Non-flammable
Flash Point Method: NIA
Burning Rate:
Autoignition Temperature: Does not burn.
LEL: NIA
UEL: NIA
Flammability Classification: Non Flammable
Extinguishing Media: Water fog, Alcohol foam, Carbon Dioxide, Dry Chemical
Unusual Fire or Explosion Hazards: None known other than material can splatter above 100°C/212F. Containers exposed to intense heat from fires should be cooled with water to prevent vapor pressure buildup which could result in container rupture. Containers that are exposed to direct flame should be cooled with water to eliminate structural weakening of the containers wall and possible rupture.
Hazardous Combustion Products: Emits toxic gases when heated to decomposition.
Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways.
Fire-Fighting Equipment: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full face piece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: See ERG code 154 for more detailed information.
Small Spills: Absorb spill with paper towel or similar absorbent; or flush to sewer or ground with large amounts of water.
Large Spills: Evacuate the hazard area of unprotected personnel. Wear appropriate respirator and protective clothing. Shut off source of leak if safe to do so. Dike and contain. If vapor cloud forms, water fog may be used to suppress. Remove with vacuum trucks or pump to storage/salvage vessels. Soak up residue with an absorbent such as clay, sand or other suitable material. Place in non leaking containers for proper disposal. Flush area with water to remove trace deposits.
Containment: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways. Absorb spill with vermiculite, oil dry or similar non-reactant absorbent.
Cleanup: Accumulate the absorbed materials and dispose of according to federal, state and local regulations.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120)

Section 7 - Handling and Storage

Handling Precautions: Use the recommended safety controls and personal protective equipment as outlined. Fully review all data before handling of the material itself. Avoid contact with skin or eyes. Avoid breathing dust or mist. Keep from contact with clothing and other combustible materials. Observe good personal hygiene and housekeeping practices.
Storage Requirements: Do not store this material near any strong acids, bases, oxidizers, flammables or any other type of reactive material. Do not expose the material to temperature extremes.
Regulatory Requirements: Store materials according to all local, state and federal guidelines which are established for corrosive liquid NOS

Section 8 - Exposure Controls/Personal Protection

Engineering Controls:
Ventilation: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.
Administrative Controls:
Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessel, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective eyeglasses or chemical safety goggles, per OSHA eye-and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating,drinking, smoking, using the toilet, or applying cosmetics.

Product: 5615 Steamline Treatment

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance and Odor: Clear Liquid/Amine Odor
Vapor Pressure: Same as Water
Vapor Density (Air=1): Same as Water
Specific Gravity (H_2O=1, at 4°C): 0.98
pH: 12+

Water Solubility: Complete
Other Solubilities: Not tested for this blend
Boiling Point: 212 F
Freezing/Melting Point: NIA
Volatile: 100 %
Evaporation Rate: 1.00

Section 10 - Stability and Reactivity

Stability: This product is stable at room temperature in closed containers under normal storage and handling conditions. However, avoid temperature extremes.
Polymerization: Hazardous polymerization will not occur
Chemical Incompatibilities: Strong Acids, Strong Alkalies, Oxidizers or any other type of reactive material.
Conditions to Avoid: Contact with Zinc, Lead, Copper and their alloys.
Hazardous Decomposition Products: Oxides and compounds of Nitrogen, Carbon Dioxide, Carbon Monoxide and unidentified organic compounds may be formed during combustion.

Section 11 - Toxicological Information

Eye Effects: Corrosive to Eyes. Potentially permanent damage.

Skin Effects: Irritation to skin and potentially corrosive over longer term exposure.

Chronic Effects: Not tested for the blend but formula components can cause Skin, Eyes, Lungs and Liver injuries

Acute Inhalation Effects: Corrosive to mucous membranes.

Acute Oral Effects: Corrosive to mucous membranes

Carcinogenicity: Non Carcinogenic

Mutagenicity: Non Mutagenetic
Teratogenicity: N.I.A.

**See NIOSH, RTECS, for additional toxicity data.

Section 12 - Ecological Information

Ecotoxicity: No specific data is available on this product. However, for the chemical components which make up this product, there may be specific data available and in the public domain. Consult the data available for each individual raw material component.
Environmental Fate: The components of this blend are volatile
Environmental Degradation: N.I.A.
Soil Absorption/Mobility: No studies have been performed for this blend

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable federal, state and local regulations.
Disposal Regulatory Requirements:
Container Cleaning and Disposal: Triple rinse the empty containers with water before disposal to reconditioner or land fill or garbage.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

Shipping Name: Corrosive Liquid NOS
Contains: Diethylaminoethanol
Shipping Symbols:
Hazard Class: 8
ID No.: UN 1760
Packing Group: III
Label Code: C
Emergency Response Guide No: 154

Packaging Authorizations

a) Exceptions:
b) Non-bulk Packaging:
C) Bulk Packaging

Quantity Limitations

a) Passenger, Aircraft or Railcar:
b) Cargo Aircraft Only:

Vessel Stowage Requirements
a) Vessel Stowage:
b) Other:

Product: 5615 Steamline Treatment

Section 15 - Regulatory Information

EPA Regulations:
RCRA Hazardous Waste Number (40 CFR 261.33): D001 for the ingredients of the blend
RCRA Hazardous Waste Classification (40 CFR 261.):
CERCLA Hazardous Substance (40 CFR 302.4) listed/unlisted specific per RCRA, Sec. 3001; CWA, Sec. 311 (b)(4); CWA, Sec. 307 (a), CAA, Sec. 112
CERCLA Reportable Quantity (RQ): Not listed.
SARA 313Codes:
SARA Toxic Chemical: Not listed.
SARA 302/304 EHS (Extremely Hazardous Substance): Not listed,
Threshold Planning Quantity (TPQ) Not Listed
OSHA Regulations:
Air Contaminant (20 CFR 1910.1000, Table Z-1, Z-1-A). See Section 2
OSHA Specifically Regulated Substance (29 CFR 1910.): See Section 2
State Regulations: Check with your local authorities

Section 16 - Other Information

Prepared By: D. Mesa
Revision Notes:

Additional Hazard Rating Systems:
Disclaimer:

USER=S RESPONSIBILITY

The information and recommendations contained herein cannot cover all possible situations which the user may experience during processing. Each aspect of your operation should be examined to determine if, or where, additional precautions may be necessary. All health and safety information contained in this bulletin should be provided to your employees or customers. It is your responsibility to use this information to develop appropriate work practice guidelines and employee instructional programs for your operation.

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