HUNTSMAN

Enriching lives through innovation

PRODUCT SAFETY SUMMARY: ETHYLENEAMINES

This Product Safety Summary is intended to provide a general description of certain Huntsman chemical substances and products containing the chemical substance(s). The information in this Summary is not intended to replace the information included on the Safety Data Sheet (SDS), Product Safety Label, and other safe use and handling literature for the chemical substance(s).

Chemical Identity

Ethyleneamines are a class of amine compounds containing ethylene ($-CH_2CH_2-$) linkages between amine groups. They include the following compounds:

CAS #	Chemical Name	Note
107-15-3	Ethylenediamine (EDA)	Some ethyleneamine products may have more than one CAS number assigned due to the composition of the product or for regulatory purposes.
111-40-0	Diethylenetriamine (DETA)	
112-24-3	Triethylenetetramine (TETA)	
112-57-2	Tetraethylenepentamine (TEPA)	
68131-73-7	Ethyleneamine E-100 (E-100)	
140-31-8	Aminoethylpiperazine (AEP)	
111-41-1	Aminoethylethanolamine (AEEA)	

Of the ethyleneamines that Huntsman manufactures, ethylenediamine is the lowest molecular weight, while diethylenetriamine is the next higher molecular weight. Triethylenetetramine (TETA) and tetraethylenepentamine (TEPA) are a mixture of four TETA or four TEPA ethyleneamines, respectively, with close boiling points including one linear, one branched, and two cyclic molecules. Ethyleneamine E-100 is a mixture of polyethylenepolyamines consisting of tetraethylenepentamine (TEPA), pentaethylenehexamine (PEHA), hexaethyleneheptamine (HEHA), and higher molecular weight products. Aminoethylpiperazine is a cyclic ethyleneamine that contains one primary, one secondary, and one tertiary amine. Aminoethylethanolamine is a single component product, with minimal ethylenediamine impurity.

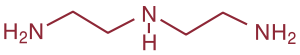
General Product Overview

Ethyleneamines are organic compounds with a wide range of commercial and industrial applications. Ethyleneamines are used primarily as reactive intermediates (i.e., building blocks) to produce other useful chemical products due to their unique combination of reactivity and basicity. Examples of ethyleneamines are as follows:

Ethylenediamine

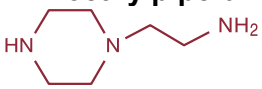
EDA

Diethylenetriamine



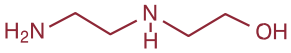
DETA

Aminoethylpiperazine



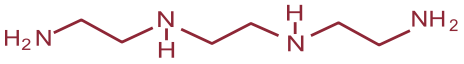
AEP

Aminoethylethanolamine

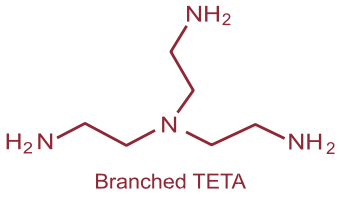


AEEA

Triethylenetetramine –
a mixture of four TETA ethyleneamines



Linear TETA

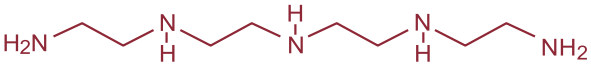


Branched TETA

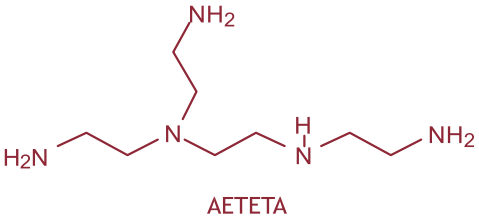
Bis AEP

PEEDA

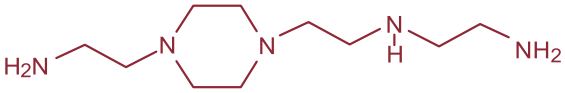
Tetraethylenepentamine –
a mixture of four TEPA ethyleneamines



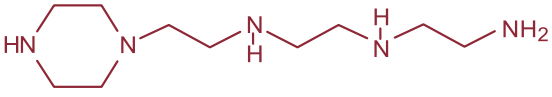
Linear TEPA



AETETA



AEPEEDA



PEDETA

Manufacturing

Huntsman manufactures ethyleneamines by the ethylene dichloride/ammonia process. This process consists of the reaction of ethylene dichloride with ammonia, followed by neutralization with sodium hydroxide to produce a mixture of ethyleneamines and sodium chloride. The salt is removed from the amine mixture, and the individual amines are separated by fractional distillation. While most individual distillation fractions are sold as products, others are formulated to obtain desired physical or chemical properties or reacted further to obtain the final product. Reliability, quality, and consistency are important in the production of ethyleneamines.

Applications and Uses

Ethyleneamines have a variety of applications and uses, including asphalt additives, fungicides, pharmaceuticals, and polymer resins.

Applications	EDA	DETA	TETA	TEPA	E-100	AEP	AEEA	Blends & Derivatives
Asphalt Additives		●	●	●	●	●		●
Bleach Activators	●							
Chelating Agents	●	●					●	
Corrosion Inhibitors	●	●	●	●	●	●		
Drainage Aids		●						
Elastomeric Fibers	●							
Epoxy Curing Agents		●	●	●	●	●		●
Fabric Softeners		●					●	
Fungicides	●							
Hydrocarbon Purification			●	●				
Lube Oil & Fuel Additives	●	●	●	●	●		●	●
Mineral Processing Aids	●	●	●	●	●	●		
Pharmaceuticals	●							
Plastic Lubricants	●							
Polyamide Resins	●	●	●	●		●		
Rubber Processing Additives	●							
Surfactants		●	●	●			●	
Textile Additives	●	●	●	●			●	
Urethane Chemicals	●	●				●	●	
Wet-Strength Resins		●	●	●				●

Physical and Chemical Properties

These compounds are generally colorless, low-viscosity liquids with a fishy amine odor.

Certain physical properties for ethyleneamines are summarized below:

Applications	EDA	DETA	TETA	TEPA	E-100	AEP	AEEA
Molecular weight, Linear component	60.1	103.17	146.24	189.3	NA	129.21	104.15
Molecular weight, Typical product	60.1	103.1	151	200	271	128.8	104.2
Boiling point, 760 mm Hg, °C	115	207	260	332	>250	222	243
Freezing point, °C	11	102	-35	-30	-21	-17	-38
Vapor pressure, mmHg, 20°C	10	0.37	< 0.1	< 0.01	<1	< 0.1	< 0.01
Density, g/ml, 20°C	0.9	0.952	0.981	0.991	1.009	0.98	1.03
Water solubility (%)	>10	>10	>10	--	>10	--	>10

Additional physical and chemical property information is available on the product Safety Data Sheet (SDS), which can be requested at SDS@huntsman.com.

Human Health Information

The primary hazard of concern when working with ethyleneamines are those typically associated with similar organic amines; namely, corrosive action on skin and eyes. Below is the generally accepted health hazard classification based on the “Globally Harmonized System of Classification and Labelling of Chemicals” (GHS).

Health Hazard	EDA	DETA	TETA	TEPA	E-100	AEP	AEEA
Acute Toxicity - Oral	Cat 4	Cat 4	Cat 4	Cat 4	Cat 4	Cat 4	
Acute Toxicity - Dermal	Cat 3	Cat 4		Cat 4	Cat 4	Cat 3	
Acute Toxicity - Inhalation	Cat 4	Cat 2					
Skin corrosion & irritation	Cat 1B	Cat 1B	Cat 1B	Cat 1B	Cat 1A	Cat 1B	Cat 1B
Serious eye damage & eye irritation	Cat 1	Cat 1	Cat 1	Cat 1	Cat 1	Cat 1	Cat 1
Respiratory sensitization	Cat 1B						
Skin sensitization	Cat 1B	Cat 1B	Cat 1	Cat 1	Cat 1	Cat 1	Cat 1
Reproductive toxicity						Cat 2	Cat 1B
Effects on or via lactation							
Germ cell mutagenicity							
Carcinogenicity							

The potential health effects from exposure to ethyleneamines are discussed below. Different regulatory classification criteria apply in different geographic regions. These different criteria may result in different human health regulatory classifications for the same product in different geographic regions. Specific regulatory classification information is contained in the Safety Data Sheet for each product in use in specific geographic region. The acute and chronic health effects information set forth below is based on Safety Data Sheets in use in the United States.

Acute Health Effects

Almost any ocular contact with any ethyleneamine may cause irreparable damage, even blindness. Acute dermal toxicity of ethyleneamines range from low to medium. Acute accidental dermal exposure to ethyleneamines may cause severe skin burns. Exposures may also cause allergic skin reactions in some individuals.

Acute oral toxicity of ethyleneamines is low. The oral LD50 for rats is in the range of 1000 to 4500 mg/kg for the ethyleneamines. However, accidental ingestion will cause burns to the membranes of the mouth, throat, and stomach, and may cause gastrointestinal irritation or ulceration.

Acute inhalation exposure to ethyleneamine vapors can cause painful irritations to the eyes, nose, throat, and lungs. Exposure may also cause respiratory sensitization in susceptible individuals.

Chronic Health Effects

In general, ethyleneamines are considered not to produce reproductive, mutagenic or carcinogenic effects. However, it has been shown that aminoethylpiperazine (AEP) and aminoethylethanolamine (AEEA) produce reproductive effects after repeated or prolonged exposure in animal studies.

More information can be obtained in the specific product Safety Data Sheet.

Environmental Information

Ethyleneamines are an industrial raw material used in closed systems. During normal operating conditions, ethyleneamines are not expected to be released to the air, soil or water. Procedural and/or control technologies are used to minimize emissions and potential exposure during cleaning and maintenance activities. Below is the generally accepted environmental hazard classification based on the “Globally Harmonized System of Classification and Labelling of Chemicals” (GHS).

Environmental Hazard	**EDA**	**DETA**	**TETA**	**TEPA**	**E-100**	**AEP**	**AEEA**
Aquatic Hazard (short-term)			Cat 3	Cat 2	Cat 1	Cat 3	Cat 3
Aquatic Hazard (long-term)	Cat 3	Cat 3	Cat 3	Cat 2	Cat 1	Cat 3	Cat 3
Biodegradability	Yes	Yes	No	No	No	No	Yes
Bioaccumulation	No	No	No	No	No	No	No

Aquatic Toxicity

The aquatic toxicity for ethyleneamine range from highly toxic (e.g., Ethyleneamine E-100) to low toxicity (e.g., ethylenediamine and diethylenetriamine).

Environmental Fate

Ethyleneamine is readily biodegradable and photodegradable for some compounds (e.g., ethylenediamine and diethylenetriamine), while other compounds are not (e.g., Ethyleneamine E-100). Ethyleneamines in general do not bioaccumulate.

Potential Occupational Exposure

Ethyleneamines are used at Huntsman in closed systems. During normal operating conditions, occupational exposure to ethyleneamines is not expected during the manufacturing process. Procedural and/or control technologies are used to minimize exposure during sampling, cleaning, maintenance, or upset conditions.

Potential Consumer Exposure

Huntsman does not market ethyleneamines directly for consumer use. Because ethyleneamines are fully reacted during the manufacture of various products, it is not expected to present an exposure risk to downstream users or consumers.

Safe Use Recommendations/Workplace Exposure Controls

Due to the corrosive properties of ethyleneamines, precautions should be taken to prevent contact by use of protective clothing and chemical goggles. If contact occurs, immediately flush the exposed area with plenty of water for at least 15 minutes. Eye exposures should be immediately flushed with plenty of water for at least 15 minutes and then be immediately examined by a physician. Contaminated clothing should be laundered before reuse. If ingestion occurs, do not induce vomiting. Have the person drink a large amount of water (or milk, if it is readily available) and transport the person to a medical facility immediately.

Huntsman follows workplace exposure guidelines through a variety of industrial hygiene and ventilation measures. Workplace exposure guidelines include national/regional workplace limit values, including:

- The ACGIH Threshold Limit Value-Time Weighted Average (TLV-TWA, concentration for a conventional 8-hour workday and a 40-hour workweek for a working lifetime without adverse effect)

- The OSHA PEL (Occupational Safety and Health Administration's permissible exposure limit expressed as a timeweighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek)

- The NIOSH REL (recommended exposure limit (REL) recommended by the United States National Institute for Occupational Safety and Health to OSHA for adoption as a PEL)

Workplace exposure guidelines	EDA	DETA	TETA	TEPA	E-100	AEP	AEEA
ACGIH TLV-TWA	10 ppm (25 mg/m^3)	1 ppm (4.2 mg/m^3)					
OSHA PEL	10 ppm (25 mg/m^3)						
NIOSH REL	10 ppm (25 mg/m^3)	1 ppm (4 mg/m^3)					

See the Safety Data Sheets for the specific ethyleneamine for additional information about first aid measures, accidental releases (spills and leaks), waste disposal, toxicity, transportation, regulatory requirements, and other important topics.

Additional Information

Information on registered substances is available on the European Chemicals Agency (ECHA) website at https://echa.europa.eu.

References

- Huntsman regional SDSs per compound
- Huntsman Technical Bulletins per compound
- Huntsman Brochure: ETHYLENEAMINES – A Global Profile of Products and Services
- Huntsman Brochure: Safe Handling of Ethyleneamines

Disclaimer

The information and recommendations in this publication are, to the best of our knowledge, information and belief, accurate at the date of publication. NOTHING HEREIN IS TO BE CONSTRUED AS A WARRANTY, EXPRESS OR OTHERWISE.

IN ALL CASES, IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE THE APPLICABILITY OF SUCH INFORMATION AND RECOMMENDATIONS AND THE SUITABILITY OF ANY PRODUCT FOR ITS OWN PARTICULAR PURPOSE.

THE PRODUCT MAY PRESENT HAZARDS AND SHOULD BE USED WITH CAUTION. WHILE CERTAIN HAZARDS ARE DESCRIBED IN THIS PUBLICATION, NO GUARANTEE IS MADE THAT THESE ARE THE ONLY HAZARDS THAT EXIST.

Hazards, toxicity, and behavior of the products may differ when used with other materials and are dependent upon the manufacturing circumstances or other processes. Such hazards, toxicity, and behavior should be determined by the user and made known to handlers, processors, and end users.

NO PERSON OR ORGANIZATION EXCEPT A DULY AUTHORIZED HUNTSMAN EMPLOYEE IS AUTHORIZED TO PROVIDE OR MAKE AVAILABLE DATA SHEETS FOR HUNTSMAN PRODUCTS. DATA SHEETS FROM UNAUTHORIZED SOURCES MAY CONTAIN INFORMATION THAT IS NO LONGER CURRENT OR ACCURATE.