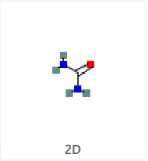
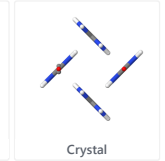
PubChem

COMPOUND SUMMARY

Urea

PubChem CID:	1176
Structure:	 2D  3D  Crystal Find Similar Structures
Chemical Safety:	Laboratory Chemical Safety Summary (LCSS) Datasheet
Molecular Formula:	CH_4N_2O or NH_2CONH_2
Chemical Names:	urea carbamide 57-13-6 Carbonyldiamide Isourea More...
Molecular Weight:	60.056 g/mol
Dates:	Modify: 2019-08-10 Create: 2004-09-16

Urea is a nitrogenous compound containing a carbonyl group attached to two amine groups with osmotic diuretic activity. In vivo, urea is formed in the liver via the urea cycle from ammonia and is the final end product of protein metabolism. Administration of urea elevates blood plasma osmolality, resulting in enhanced flow of water from tissues, including the brain, cerebrospinal fluid and eye, into interstitial fluid and plasma, thereby decreasing pressure in those tissues and increasing urine outflow.

▸ from NCIt

Urea is a carbonyl group with two C-bound amine groups. It has a role as a flour treatment agent, a human metabolite, a Daphnia magna metabolite, a Saccharomyces cerevisiae metabolite, an Escherichia coli metabolite, a mouse metabolite and a fertilizer. It is a monocarboxylic acid amide and a one-carbon compound. It derives from a carbonic acid. It is a tautomer of a carbamimidic acid.

▸ from ChEBI

A compound formed in the liver from ammonia produced by the deamination of amino acids. It is the principal end product of protein catabolism and constitutes about one half of the total urinary solids.

▸ from DrugBank

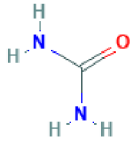
Cite Download

CONTENTS

1 Structures

1.1 2D Structure

Find Similar Structures Get Image Download

Chemical Structure Depiction	

from PubChem

1.2 3D Conformer

from PubChem

1.3 Crystal Structures

Showing 1 of 3 View More

CCDC Number	131762
Crystal Structure Data	DOI:10.5517/cc4f3d1
Crystal Structure Depiction	

Associated Article	DOI:10.1107/S0108768198005746

from The Cambridge Structural Database

2 Names and Identifiers

2.1 Computed Descriptors

2.1.1 IUPAC Name

urea

from PubChem

2.1.2 InChI

InChI=1S/CH4N2O/c2-1(3)4/h(H4,2,3,4)

from PubChem

2.1.3 InChI Key

XSQUKJJFZCRTK-UHFFFAOYSA-N

from PubChem

2.1.4 Canonical SMILES

C(=O)(N)N

from PubChem

2.2 Molecular Formula

CH_4N_2O

from EU Food Improvement Agents; PubChem

NH_2CONH_2

CH_4N_2O

from ILO International Chemical Safety Cards (ICSC)

NH_2CONH_2

from Wikipedia

2.3 Other Identifiers

2.3.1 CAS

57-13-6

from ChemIDplus; DrugBank; DTP/NCI; EPA Chemicals under the TSCA; EPA DSSTox; European Chemicals Agency (ECHA); Human Metabolome Database (HMDB); ILO International Chemical Safety Cards (ICSC); The National Institute for Occupational Safety and Health (NIOSH)

Other CAS

30535-50-3

860639-56-1

118548-06-4

1202865-46-0

1228376-38-2

1637232-71-3

2060607-07-8

923953-70-2

from ChemIDplus

4744-36-9

from ChemIDplus

Other CAS

173994-65-5

174693-33-5

173144-80-4

175276-38-7

from ChemIDplus

37955-36-5

from ChemIDplus

2.3.2 European Community (EC) Number

EC Number

200-315-5

from EU Food Improvement Agents; European Chemicals Agency (ECHA)

2.3.3 ICSC Number

0595

from ILO International Chemical Safety Cards (ICSC)

2.3.4 NSC Number

757375

from DTP/NCI

34375

from DTP/NCI

2.3.5 RTECS Number

YR6250000

from The National Institute for Occupational Safety and Health (NIOSH)

2.3.6 UNII

8W8T17847W

from FDA/SPL Indexing Data

2.3.7 Wikipedia

Urea

from Wikipedia

2.3.8 Standard Transportation Number

49 601 31; Hazardous substance, liquid (or) solid, not otherwise specified

from HSDB

2.4 Synonyms

2.4.1 MeSH Entry Terms

Basodexan
Carbamide
Carmol
Urea

from MeSH

2.4.2 Depositor-Supplied Synonyms

urea	Calmurid	carmol	Hyanit	Keratinamin Kowa	E927b	37955-36-5	Cer
carbamide	Carbaderm	Harnstoff	Caswell No. 902	MFCD00008022	(NH2)2CO	URE	Kar
57-13-6	Keratinamin	Mocovina	Carbonyl Diamine	NSC 34375	Helicosol	Urea, 99.5%, for analysis	Ure
Carbonyldiamide	Carbonyl diamide	Nutraplus	Mocovina [Czech]	Benural 70	CHEBI:16199	Urea, 99+%, for biochemistry	Urc

Isourea	Pastaron	Urea solution	Harnstoff [German]	Urea ammonium nitrate solution	XSQUKJJFZCRTK-UHFFFAOYSA-N	Urea, 98%, extra pure, pearls	am
Ureophil	Urepearl	Supercel 3000	NCI-C02119	EPA Pesticide Chemical Code 085702	8W8T17847W	Antisepsis bolus	am
Carbonyldiamine	Carbamide resin	Aqua Care HP	CCRIS 989	UNII-8W8T17847W	4744-36-9	CAS-57-13-6	Ure
Carbamimidic acid	Ultra Mide	Ureacin-20	Aquacare	UR	NCGC00090892-01	Urea [JAN]	Pas
Pseudourea	Varioform ii	Ureacin-10 lotion	HSDB 163	AI3-01202	UREA, ULTRA PURE	Urea [USP:JAN]	Ure
Ureaphil	Aqua Care	Ureacin-40 Creme	Ureum	UREA, ACS	DSSTox_CID_1426	aminoketone	E-C
Urevert	Prespersion, 75 urea	Onychomal	Carbamimic acid	EINECS 200-315-5	DSSTox_RID_76155	diaminomethanae	Aqu
Alphadrate	B-I-K	Panafil	Bubber shet	Carbamide: Carbonyl diamide	DSSTox_GSID_21426	uree	Ure
Aquadrate	basodexan	Polyurea	Elaqua xx	diaminomethanone	Urea, 99%, ACS reagent	Isoharnstoff	Ure

from PubChem

3 Chemical and Physical Properties

3.1 Computed Properties

Property Name	Property Value
Molecular Weight	60.056 g/mol
XLogP3-AA	-1.4
Hydrogen Bond Donor Count	2
Hydrogen Bond Acceptor Count	1
Rotatable Bond Count	0
Exact Mass	60.032363 g/mol
Monoisotopic Mass	60.032363 g/mol
Topological Polar Surface Area	69.1 A^2
Heavy Atom Count	4
Formal Charge	0
Complexity	29
Isotope Atom Count	0
Defined Atom Stereocenter Count	0
Undefined Atom Stereocenter Count	0
Defined Bond Stereocenter Count	0
Undefined Bond Stereocenter Count	0
Covalently-Bonded Unit Count	1
Compound Is Canonicalized	Yes

from PubChem

3.2 Experimental Properties

3.2.1 Physical Description

DryPowder; DryPowder, Liquid; Liquid; OtherSolid; OtherSolid, Liquid; PelletsLargeCrystals; PelletsLargeCrystals, Liquid; PelletsLargeCrystals, OtherSolid, Liquid; WetSolid

from EPA Chemicals under the TSCA

Colourless to white, prismatic, crystalline powder or small, white pellets

from EU Food Improvement Agents

Solid

- from Human Metabolome Database (HMDB)

WHITE CRYSTALS WITH CHARACTERISTIC ODOUR.

- from ILO International Chemical Safety Cards (ICSC)

3.2.2 Color/Form

White crystals or powder

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1157

- from HSDB

Tetragonal prisms

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

- from HSDB

3.2.3 Odor

MAY GRADUALLY DEVELOP SLIGHT ODOR OF AMMONIA, ESP IN PRESENCE OF MOISTURE

Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975., p. 864

- from HSDB

Almost odorless

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1157

- from HSDB

3.2.4 Taste

Cooling, saline taste

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

- from HSDB

3.2.5 Boiling Point

Decomposes (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

- from CAMEO Chemicals

Decomposes

Verschueren, K. Handbook of Environmental Data on Organic Chemicals. 3rd ed. New York, NY: Van Nostrand Reinhold Co., 1996., p. 1876

- from HSDB

3.2.6 Melting Point

275 ° F (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

▸ from CAMEO Chemicals

132.7 °C

PhysProp

▸ from DrugBank

132.7°C

▸ from EPA DSSTox

132 °C to 135 °C

▸ from EU Food Improvement Agents

132.70 deg C

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1157

▸ from HSDB

132°C

▸ from Human Metabolome Database (HMDB)

132.7-135 °C

▸ from ILO International Chemical Safety Cards (ICSC)

3.2.7 Solubility

Soluble (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

▸ from CAMEO Chemicals

545000 mg/L (at 25 °C)

YALKOWSKY,SH (1989)

▸ from DrugBank

Water Solubility

9.07 M

YALKOWSKY,SH (1989)

▸ from EPA DSSTox

Very soluble in water; Soluble in ethanol

▸ from EU Food Improvement Agents

10 ml 95% alc, 6 ml methanol, 1 ml boiling 95% alc, 20 ml abs alc, 2 ml glycerol; almost insol in chloroform, ether; sol in concn HCl

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

▸ from HSDB

INSOL IN BENZENE; SOL IN ACETIC ACID

Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979., p. C-536

▸ from HSDB

Sol in pyrimidine

Lide, D.R. (ed). CRC Handbook of Chemistry and Physics. 72nd ed. Boca Raton, FL: CRC Press, 1991-1992., p. 3-509

▸ from HSDB

In water, 5.45X10+5 mg/l @ 25 deg C

Yalkowsky SH; Arizona Database of Aqueous Solubilities. Univ of AZ, College of Pharmacy (1989)

▸ from HSDB

545.0 mg/mL

▸ from Human Metabolome Database (HMDB)

Solubility in water: miscible

▸ from ILO International Chemical Safety Cards (ICSC)

>9 [ug/mL]

▸ from Sanford-Burnham Center for Chemical Genomics

3.2.8 Density

1.34 at 68 ° F (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▸ from CAMEO Chemicals

1.3230 @ 20 deg C/4 deg C

Lide, DR (ed.). CRC Handbook of Chemistry and Physics. 81st Edition. CRC Press LLC, Boca Raton: FL 2000, p. 3-328

▸ from HSDB

g/cm^3

▸ from ILO International Chemical Safety Cards (ICSC)

3.2.9 Vapor Pressure

1.20e-05 mmHg

▸ from EPA DSSTox

1.2X10-5 mm Hg @ 25 deg C

Jones AH; J Chem Eng Data 5: 196-200 (1960)

▸ from HSDB

3.2.10 Octanol/Water Partition Coefficient

-2.11

HANSCH,C ET AL. (1995)

▸ from DrugBank

-2.11 (LogP)

HANSCH,C ET AL. (1995)

▸ from EPA DSSTox

log Kow = -2.11

Hansch, C., Leo, A., D. Hoekman. Exploring QSAR - Hydrophobic, Electronic, and Steric Constants. Washington, DC: American Chemical Society., 1995., p. 3

▸ from HSDB

-2.11

HANSCH,C ET AL. (1995)

▸ from Human Metabolome Database (HMDB)

LogP

-3.00/-1.54

▸ from ILO International Chemical Safety Cards (ICSC)

3.2.11 LogS

0.96

ADME Research, USCD

▸ from DrugBank

3.2.12 Autoignition Temperature

Auto-Ignition

Not flammable (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

▸ from CAMEO Chemicals

3.2.13 Decomposition

When heated to decomposition it emits toxic fumes of nitrogen oxides.

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

▸ from HSDB

3.2.14 Viscosity

1.78 mPa-s (46% solution @ 20 deg C); 1.81 mP-s @ 137 deg C; 1.90 mPa-s (saturated solution @ 20 deg C)

Environment Canada; Tech Info from Problem Spills: Urea p. 4 (1985)

▸ from HSDB

3.2.15 pH

7.2 (10% solution)

Environment Canada; Tech Info for Problem Spills: Urea p.4 (1985)

▸ from HSDB

3.2.16 Caco2 Permeability

-5.34

ADME Research, USCD

▸ from DrugBank

3.2.17 pKa

0.1 (at 21 °C)

PERRIN,DD (1965)

▸ from DrugBank

3.2.18 Dissociation Constants

pKa = 0.10 at 21 deg C (conjugate acid)

Perrin DD; Dissociation Constants of Organic Bases in Aqueous Solution. IUPAC Chem Data Ser. London, England: Buttersworth p. 450 (1965)

▸ from HSDB

3.2.19 Other Experimental Properties

On further heating it decomp to **biuret**, NH3, **cyanuric acid**; pH of 10% **water** soln: 7.2; density of **water** soln (wt/wt): 1.027 @ 10%; 1.054 @ 20%; 1.145 @ 50%

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

▸ from HSDB

Ionization potential = 9 eV; Latent heat of fusion = 15.4 kJ/mol (at melting point); Latent heat of sublimation = 87.9 kJ/mol @ 25 deg C; Heat of formation = -333.7 kJ/mol @ 25 deg C; Decomposition temp = 135 deg C

Environment Canada; Tech Info from Problem Spills: Urea p. 4 (1985)

▸ from HSDB

4 Spectral Information

4.1 1D NMR Spectra

Showing 2 of 3 View More

1D NMR Spectra	1H NMR: SAD 16982 (Sadtler Research Laboratories Spectral Collection)

from HSDB

1D NMR Spectra	1D NMR Spectrum 1227 - HMDB HMDB0000294 1D NMR Spectrum 1317 - HMDB HMDB0000294 1D NMR Spectrum 2485 - HMDB HMDB0000294

from Human Metabolome Database (HMDB)

4.1.1 1H NMR Spectra

Instrument Name	Varian A-60D
Copyright	Copyright © 2009-2018 Bio-Rad Laboratories, Inc. All Rights Reserved.
Thumbnail	

from SpectraBase

4.1.2 13C NMR Spectra

Showing 2 of 3 View More

Source of Sample	Chem Service, Inc., West Chester, Pennsylvania
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Thumbnail	

from SpectraBase

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Thumbnail	

from SpectraBase

4.1.3 15N NMR Spectra

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from SpectraBase

4.1.4 17O NMR Spectra

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from SpectraBase

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Thumbnail	

from SpectraBase

4.2 Mass Spectrometry

Showing 2 of 6 View More

Mass Spectrometry	MS: NIST 19004 (NIST/EPA MSDC Mass Spectral Database 1990 version)

from HSDB

MoNA ID	FiehnHILIC000834
MS Category	Experimental
MS Type	Chromatography identified as LC-MS
MS Level	MS2
Precursor Type	[M+H]+
precursor m/z	61.04037
Instrument	Thermo Q Exactive HF
Instrument Type	LC-ESI-QFT
Ionization Mode	positive
Collision Energy	HCD (NCE 20-30-40%)
Splash	splash10-03di-9000000000-c56d1c2b81477db87ffa
Thumbnail	
Submitter	Megan Showalter, University of California, Davis

from MassBank of North America (MoNA)

4.2.1 GC-MS

Showing 2 of 5 View More

GC-MS	GC-MS Spectrum 523 - HMDB HMDB0000294

	GC-MS Spectrum 989 - HMDB HMDB0000294 GC-MS Spectrum 2923 - HMDB HMDB0000294 GC-MS Spectrum 29896 - HMDB HMDB0000294 GC-MS Spectrum 30707 - HMDB HMDB0000294 GC-MS Spectrum 31117 - HMDB HMDB0000294 GC-MS Spectrum 31908 - HMDB HMDB0000294

from Human Metabolome Database (HMDB)

NIST Number	229591
Library	Main library
Total Peaks	26
m/z Top Peak	17
m/z 2nd Highest	60
m/z 3rd Highest	44
Thumbnail	

from NIST

4.2.2 MS-MS

MS-MS	MS-MS Spectrum 498 - HMDB HMDB0000294 MS-MS Spectrum 499 - HMDB HMDB0000294 MS-MS Spectrum 500 - HMDB HMDB0000294 MS-MS Spectrum 21287 - HMDB HMDB0000294 MS-MS Spectrum 21288 - HMDB HMDB0000294 MS-MS Spectrum 21289 - HMDB HMDB0000294 MS-MS Spectrum 22838 - HMDB HMDB0000294 MS-MS Spectrum 22839 - HMDB HMDB0000294 MS-MS Spectrum 22840 - HMDB HMDB0000294 MS-MS Spectrum 447325 - HMDB HMDB0000294

from Human Metabolome Database (HMDB)

4.2.3 EI-MS

EI-MS	EI-MS Spectrum 749 - HMDB HMDB0000294

from Human Metabolome Database (HMDB)

4.3 UV Spectra

UV: OES 1-3 (Organic Electronic Spectral Data, Phillips et al, John Wiley & Sons, New York)

Lide, D.R., G.W.A. Milne (eds.). Handbook of Data on Organic Compounds. Volume I. 3rd ed. CRC Press, Inc. Boca Raton ,FL. 1994., p. V5 4184

from HSDB

4.4 IR Spectra

IR Spectra	IR: SADG 123 (Sadtler Research Laboratories IR Grating Collection)

from HSDB

4.4.1 FTIR Spectra

Showing 2 of 3 View More

Technique	KBr WAFER
Source of Sample	Merck & Company, Inc.
Copyright	Copyright © 1980, 1981-2018 Bio-Rad Laboratories, Inc. All Rights Reserved.
Thumbnail	

from SpectraBase

Technique	KBr WAFER
Source of Sample	Merck & Company, Inc.
Copyright	Copyright © 1980, 1981-2018 Bio-Rad Laboratories, Inc. All Rights Reserved.
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from SpectraBase

4.4.2 ATR-IR Spectra

Instrument Name	Bio-Rad FTS
Technique	ATR-Neat (DuraSamplIR II) ground
Source of Spectrum	Forensic Spectral Research
Source of Sample	Research & Development
Copyright	Copyright © 2009-2018 Bio-Rad Laboratories, Inc. All Rights Reserved.
Thumbnail	

from SpectraBase

5 Related Records

5.1 Related Compounds with Annotation

from PubChem

5.2 Related Compounds

Same Connectivity	19 Records
Same Parent, Connectivity	112 Records
Same Parent, Exact	94 Records
Mixtures, Components, and Neutralized Forms	1,755 Records
Similar Compounds	29 Records
Similar Conformers	217 Records

from PubChem

5.3 Substances

5.3.1 Related Substances

All	3,437 Records
Same	339 Records
Mixture	3,098 Records

from PubChem

5.3.2 Substances by Category

from PubChem

5.4 Entrez Crosslinks

PubMed	26,256 Records
Protein Structures	71 Records
Taxonomy	12 Records
Gene	39 Records

from PubChem

6 Chemical Vendors

from PubChem

7 Drug and Medication Information

7.1 Drug Indication

- 10% hydrate skin
- 15% accelerate fibrin degradation
- 20-30% are antipruritic, break down keratin, decrease the thickness of the stratum corneum and are used in scaling conditions such as ichthysosis
- 40% are proteolytic and may be used to dissolve and peel dystrophic nails

[Patient Self Care, 2010]

from DrugBank

7.2 FDA Orange Book

from FDA Orange Book

7.3 Drug Labels for Ingredients

Label Information	Total 59 labels
Drug Ingredient	UREA
NDC Code(s)	10481-3005-1, 12745-177-01, 12745-177-02, 12745-177-03, 12745-177-04, 13985-588-00, 15631-0449-0, 15631-0449-1, 15631-0449-2, 15631-0449-3 ... total 114.
Packagers	ACELLA PHARMACEUTICALS; AKRON PHARMA INC; AUSTIN PHARMACEUTICALS, LLC; Acella Pharmaceuticals; Agri Laboratories, Ltd.; American Health Packaging; Artesa Labs, LLC; Aspen Veterinary Resources; AvKARE, Inc.; Avent, Inc. ... total 45.

from DailyMed

7.4 Clinical Trials

7.4.1 ClinicalTrials.gov

from ClinicalTrials.gov

7.4.2 EU Clinical Trials Register

▸ from EU Clinical Trials Register

7.4.3 NIPH Clinical Trials Search of Japan

▸ from NIPH Clinical Trials Search of Japan

7.5 Therapeutic Uses

Dermatologic Agents; Diuretics, Osmotic

National Library of Medicine's Medical Subject Headings online file (MeSH, 1999)

▸ from HSDB

UREA IS /USED LESS COMMONLY THAN OTHER OSMOTIC AGENTS/ FOR THE SHORT-TERM REDUCTION OF INTRAOCULAR PRESSURE & VITREOUS VOL ... IN ANGLE-CLOSURE GLAUCOMA .. PRIOR TO SURGERY ... IN CHRONIC GLAUCOMA ... PRE- AND POSTOPERATIVE TREATMENT.

American Medical Association. AMA Drug Evaluations Annual 1991. Chicago, IL: American Medical Association, 1991., p. 1825

▸ from HSDB

DOSE--USUAL, IV INFUSION, 100 MG TO 1 G/KG DAILY, AS 30% SOLN IN DEXTROSE INJECTION @ RATE NOT EXCEEDING 4 ML/MIN.

GENNARO. REMINGTON'S PHARM SCI 17TH ED 1985 p 935

▸ from HSDB

USED TOPICALLY IN THE TREATMENT OF PSORIASIS, ICHTHYOSIS, ATOPIC DERMATITIS, AND OTHER DRY, SCALY CONDITIONS.

GENNARO. REMINGTON'S PHARM SCI 17TH ED 1985 p 785

from HSDB

Experimental: A study was made in which 57 symmetrically affected psoriatic patients applied to their lesions on opposite sides either 0.1% **dithranol** (**anthralin**) /urea cream (Psordrate 0.1%) or 0.1% **beta-methasone valerate** (**Betnovate**). After six weeks the **dithranol**/ urea cream proved to be more effective.

Ferguson A, Maden CJ; Br J Clin Prac 36: 60-67 (1982)

from HSDB

The efficacy of oral urea in producing a sufficiently high osmotic diuresis was studied in 7 patients with the syndrome of inappropriate secretion of antidiuretic hormone. In all patients, urea corrected the hyponatremia despite a normal fluid intake. Five patients were controlled with a dose of 30 g daily. The patients who needed 30 g drank up to 2 liters of fluid daily, while those who needed 60 g drank up to 3 liters/day. No major side effects were noted, even after treatment periods of up to 270 days. It was concluded that urea is a safe and efficacious treatment of the syndrome of inappropriate secretion of antidiuretic hormone.

Decaux G, Genette F; Br Med 283: 1081-1083 (1981)

from HSDB

Experimental: Use of urea kinetics in the estimation of protein balance of nutritionally unstable renal failure patients, and for optimal management of nutrition therapy.

Bennett N; Nutr Support Serv 4: 21-25 (1984)

from HSDB

Experimental: A number of studies evaluating an osmotic cervical dilator consisting of polyvinyl foam saturated with **magnesium sulfate** in women undergoing mid trimester abortion with intra-amniotic hyperosmolar urea plus **prostaglandin F2A** were completed. Comparisons with women receiving no pre-treatment with a laminaria tent or with one laminaria indicate that their use appears to shorten injection-abortion intervals, particularly in parous women, and reduce risk of endometritis and cervical laceration compared to women not receiving any type of device. The data suggests that two osmotic dilators may be more effective than one. Also, **magnesium** toxicity does not appear to be a substantial risk with their use.

Atienza MF et al; Contraception 30 (3): 215-223 (1984)

PMID:6595099

from HSDB

EXPTL: REPORTED HELPFUL IN TREATING SICKLE-CELL CRISIS

Hawley, G.G. The Condensed Chemical Dictionary. 9th ed. New York: Van Nostrand Reinhold Co., 1977., p. 905

from HSDB

In patients with squamous cell carcinoma of palpebral and bulbar conjunctiva, repeated applications of urea powder have been made to eradicate the malignant growth.

Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 965

from HSDB

A sterile preparation of urea (UREAPHIL) is available that may be reconstituted for intravenous use. When administered in this manner, the solution contains 30% urea and either 5 or 10% **dextrose** or invert sugar (equal parts of **dextrose** and **fructose**). Intravenous doses of 1 to 1.5 g of urea per kilogram of body weight are optimal in preparation for neurosurgical procedures or for reduction of intraocular pressure. On a molar basis urea is less effective as a diuretic than is **mannitol**, since approximately 50% of the compound is reabsorbed from the tubular fluid.

Gilman, A.G., T.W. Rall, A.S. Nies and P. Taylor (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 8th ed. New York, NY. Pergamon Press, 1990., p. 715

from HSDB

UREA HAS BEEN USED AS AN INSECT (MOSQUITO) REPELLENT.

HILL JA ET AL; MOSQ NEWS 39 (2): 307-310 (1979)

from HSDB

... Urea /is/ used to reduce cerebral edema and brain mass before and after neurosurgery.

Hardman, J.G., L.E. Limbird, P.B. Molinoff, R.W. Ruddon, A.G. Goodman (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 9th ed. New York, NY: McGraw-Hill, 1996., p. 697

from HSDB

Another use for ... urea is the treatment of dialysis disequilibrium syndrome.

Hardman, J.G., L.E. Limbird, P.B. Molinoff, R.W. Ruddon, A.G. Goodman (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 9th ed. New York, NY: McGraw-Hill, 1996., p. 696

from HSDB

7.6 Drug Warnings

UREA SHOULD NOT BE USED IN PATIENTS WITH SEVERELY IMPAIRED RENAL FUNCTION.

American Medical Association, AMA Department of Drugs, AMA Drug Evaluations. 3rd ed. Littleton, Massachusetts: PSG Publishing Co., Inc., 1977., p. 936

from HSDB

UREA IS OFTEN RECONSTITUTED WITH INVERT SUGAR SOLN. INVERT SUGAR CONTAINS **FRUCTOSE**, WHICH CAN CAUSE SEVERE REACTION (HYPOGLYCEMIA, NAUSEA, VOMITING, TREMORS, COMA, & CONVULSIONS) IN PATIENTS WITH HEREDITARY **FRUCTOSE** INTOLERANCE (ALDOLASE DEFICIENCY).

American Medical Association, AMA Department of Drugs, AMA Drug Evaluations. 3rd ed. Littleton, Massachusetts: PSG Publishing Co., Inc., 1977., p. 936

from HSDB

In general osmotic diuretics are contraindicated in patients who are anuric due to severe renal disease or who are unresponsive to test doses of the drugs. Urea may cause thrombosis or pain if extravasation occurs, and it should not be admin to patients with impaired liver function because of the risk of elevation of blood **ammonia** levels. Both **mannitol** and urea are contraindicated in patients with active cranial bleeding.

Hardman, J.G., L.E. Limbird, P.B. Molinoff, R.W. Ruddon, A.G. Goodman (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 9th ed. New York, NY: McGraw-Hill, 1996., p. 696

from HSDB

7.7 Reported Fatal Dose

In ruminants unaccustomed to urea, ingestion of 0.3-0.5 g urea/kg may be toxic ... The toxic dose of urea in (presumably unaccustomed) cattle is 0.45 g/kg (50 g total dose) but that animals can ingest more urea than this if the dose is increased gradually.

Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982., p. 1029

from HSDB

7.8 Drug Tolerance

Many factors alter the toxicity of urea. Degree of adaptation is very important. Animals that are adapted to ingesting urea can tolerate 1 g urea/kg/day, but if they go off feed for a few days and then come back on full feed at the same rate of urea intake, toxicosis can result, since urea adaptation can wear off quickly.

Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982., p. 1029

from HSDB

8 Food Additives and Ingredients

8.1 Food Additive Classes

JECFA Functional Classes

Food Additives: CHEWING_GUM_BASE_COMPOUND; TEXTURIZER; THICKENER; YEAST_FOOD

from FAO/WHO Food Additive Evaluations (JECFA)

8.2 FDA Substances Added to Food

Substance	UREA
Used for (Technical Effect)	FORMULATION AID
Document Number (21 CFR)	175.105 175.300 175.3520 176.180 176.320 177.1200 177.1900 184.1923

from FDA Center for Food Safety and Applied Nutrition (CFSAN)

8.3 FDA Indirect Additives used in Food Contact Substances

Indirect Additives	POLYUREA

from FDA Center for Food Safety and Applied Nutrition (CFSAN)

8.4 Food Additive Status

FDA Food Additive Status

Urea - GRAS, GMP, As formulation/fermentation aid in yeast -raised bakery prods, alc bevs, and gelatin prods -184.1923

from FDA Center for Food Safety and Applied Nutrition (CFSAN)

8.5 Evaluations of the Joint FAO/WHO Expert Committee on Food Additives - JECFA

Chemical Name	CARBAMIDE
ADI	NOT SPECIFIED
Evaluation Year	1993
Comments	Use at levels of up to 3% in chewing-gum not of toxicological concern
Report	TRS 837-JECFA 41/28

from FAO/WHO Food Additive Evaluations (JECFA)

9 Agrochemical Information

9.1 Agrochemical Category

Attractant, Fungicide

from EU Pesticides Database

9.2 EU Pesticides Data

Substance	urea
Status	Date of Approval: 01/09/2009 Expiration of Approval: 31/08/2020

from EU Pesticides Database

10 Pharmacology and Biochemistry

10.1 Pharmacology

As a humectant, urea draws water into the striatum corneum.

from DrugBank

Urea is a nitrogenous compound containing a carbonyl group attached to two amine groups with osmotic diuretic activity. In vivo, urea is formed in the liver via the urea cycle from ammonia and is the final end product of protein metabolism. Administration of urea elevates blood plasma osmolality, resulting in enhanced flow of water from tissues, including the brain, cerebrospinal fluid and eye, into interstitial fluid and plasma, thereby decreasing pressure in those tissues and increasing urine outflow.

from NCIt

10.2 ATC Code

B - Blood and blood forming organs

B05 - Blood substitutes and perfusion solutions

B05B - I.v. solutions

B05BC - Solutions producing osmotic diuresis

B05BC02 - Carbamide

from WHO ATC

D - Dermatologicals

D02 - Emollients and protectives

D02A - Emollients and protectives

D02AE - Carbamide products

D02AE01 - Carbamide

from WHO ATC

10.3 Absorption, Distribution and Excretion

SOME SMALL, WATER SOL, BUT NONIONIZABLE COMPD SUCH AS UREA READILY TRAVERSE MAMMALIAN MEMBRANES, PROBABLY ALONG WITH WATER, BY WAY OF THE PORES. THIS FILTRATION PROCESS IS PARTICULARLY RAPID BETWEEN CAPILLARIES & EXTRACELLULAR FLUID.

Hayes, W.J., Jr., E.R. Laws Jr., (eds.). Handbook of Pesticide Toxicology Volume 1. General Principles. New York, NY: Academic Press, Inc., 1991., p. 127

from HSDB

... UREA ... PENETRATES OTHER CELLS RAPIDLY, ENTERS THE BRAIN ONLY VERY SLOWLY ...

LaDu, B.N., H.G. Mandel, and E.L. Way. Fundamentals of Drug Metabolism and Disposition. Baltimore: Williams and Wilkins, 1971., p. 51

from HSDB

... DISTRIBUTED APPROX IN TOTAL BODY WATER ... HAVE BEEN USED FOR MEASUREMENT OF TOTAL BODY WATER.

LaDu, B.N., H.G. Mandel, and E.L. Way. Fundamentals of Drug Metabolism and Disposition. Baltimore: Williams and Wilkins, 1971., p. 53

from HSDB

EXCRETION OF UREA DURING SWEATING IN MAN: 1.84 SWEAT/PLASMA RATIO WITH PKA @ 13.8. /FROM TABLE/

LaDu, B.N., H.G. Mandel, and E.L. Way. Fundamentals of Drug Metabolism and Disposition. Baltimore: Williams and Wilkins, 1971., p. 143

from HSDB

Regional variations in the absorption of **benzoic acid**, **cortisone**, urea, and **water** in sections obtained from the back and abdominal skin of male and female Osborne-Mendel rats were determined using in vitro diffusion cell techniques. Skin permeability constants and lag times were determined for the substances. **Benzoic acid** was absorbed from a petrolatum vehicle, and the other compounds were applied to the skin samples in an aqueous solution. Differences in absorption were compared with skin thickness measurements. The mechanism of sex related permeability differences was studied in castrated rats with subsequent permeability and histological examination of the skin. Results showed a sex related difference in variation of absorption in the back and abdominal skin of both sexes. In general, female back skin was approximately twice as permeable as male back skin. Abdominal skin, particularly in the male rat, was more permeable than back skin. The male rat back stratum corneum was approximately twice as thick as that of the female, correlating with the observed permeability differences. Similar stratum corneum thicknesses were observed in the abdominal skin from both sexes. The back skin of castrated males was similar in permeability and thickness to that of the females.

Bronaugh RL et al; J Soc Cosmet Chem 34: 127-35 (1983)

from HSDB

The maternal and newborn renal function in 84 normal pregnant women delivering at term was investigated. There was no difference between maternal and newborn plasma concentrations of urea (3.9 + or - 1.0 vs. 3.9 + or - 1.2 mmol/l) and **creatinine** (65.8 + or - 13.3 vs. 65.3 + or - 11.6 mumols/l). Newborn urea with maternal urea concentrations (p = 0.0001), and newborn **creatinine** with maternal **creatinine** concentrations (p = 0.0001).

Lao TT et al; Gynecol Obstet Invest 28 (2): 70-2 (1989)

PMID:2792916

from HSDB

10.4 Mechanism of Action

... The primary mechanism of **ammonia** toxicosis appears to be inhibition of the **citric acid** cycle. There is an increase in anaerobic glycolysis, blood **glucose**, and blood **lactate** ... . Acidosis is manifested. The exact means by which **ammonia** blocks the **citric acid** cycle is not known. It is postulated that **ammonia** saturation of the **glutamine**-synthesizing system causes a backing-up in the **citrate** cycle, a decrease in its intermediates, and a decrease in energy production and cellular respiration, which leads to convulsions ... . The decrease of **citrate** cycle intermediates is postulated to result from reamination of pyruvic, ketoglutaric, and oxaloacetic acids.

Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982., p. 1031

from HSDB

10.5 Human Metabolite Information

10.5.1 Metabolite Description

Description

Urea is a highly soluble organic compound formed in the liver from **ammonia** produced by the deamination of amino acids. It is the principal end product of protein catabolism and constitutes about one half of the total urinary solids. Urea is formed in a cyclic pathway known simply as the urea cycle. In this cycle, **amino** groups donated by **ammonia** and **L-aspartate** are converted to urea. Urea is essentially a waste product; it has no physiological function. It is dissolved in blood (in humans in a concentration of 2. 5 - 7. 5 mmol/liter) and excreted by the kidney in the urine. In addition, a small amount of urea is excreted (along with **sodium chloride** and **water**) in human sweat. Urea is found to be associated with primary hypomagnesemia, which is an inborn error of metabolism.

from Human Metabolome Database (HMDB)

10.5.2 Tissue Locations

Kidney

Liver
Prostate
Skin

from Human Metabolome Database (HMDB)

10.5.3 Cellular Locations

Extracellular
Mitochondria

from Human Metabolome Database (HMDB)

10.5.4 Metabolite Pathways

Amiloride Action Pathway
Arginine and Proline Metabolism
Arginine: Glycine Amidinotransferase Deficiency (AGAT Deficiency)
Argininemia
Argininosuccinic Aciduria
Bendroflumethiazide Action Pathway
Blue diaper syndrome
Bumetanide Action Pathway
Carbamoyl Phosphate Synthetase Deficiency
Chlorothiazide Action Pathway
Total 47 pathways, visit the HMDB page for details

from Human Metabolome Database (HMDB)

10.5.5 Associated Disorders and Diseases

Diseases	References
Cirrhosis	PubMed: 12231118, 2142586, 12297216, 3101533, 7752905, 10901139, 3426740, 2583565, 8558093, 9141546, 8231659, 7429293, 3137238, 2621422, 3997054, 9453424, 17919531, 22882828, 21458633, 23384618
Colorectal cancer	PubMed: 7482520, 19006102, 23940645, 24424155, 20156336, 19678709, 22148915, 25105552, 21773981, 25037050, 27015276, 27107423, 27275383, 28587349 Silke Matysik, Caroline Ivanne Le Roy, Gerhard Liebisch, Sandrine Paule Claus. Metabolomics of fecal samples: A practical consideration. Trends in Food Science & Technology. Vol. 57, Part B, Nov. 2016, p.244-255: http://www.sciencedirect.com/science/article/pii/S0924224416301984
Primary hypomagnesemia	PubMed: 10337938, 5419995, 9579153, 12720080
Bartter Syndrome, Type 2, Antenatal	PubMed: 26069767
Cholesteryl ester storage disease	PubMed: 11380065, 18478331, 14008104, 23485521 MetaGene: Metabolic & Genetic Information Center (MIC: http://www.metagene.de)
Bartter Syndrome, Type 4B, Neonatal, With Sensorineural Deafness	PubMed: 18310267
Dimethylglycine Dehydrogenase Deficiency	PubMed: 10102904
Tuberculous meningitis	PubMed: 12581805, 9542731, 15627241, 2885596, 12964115
Meningitis	PubMed: 12581805, 15627241, 7729054, 9542731, 15061359, 11805243, 6326460, 16150112, 6198481, 2835791, 8899053
Eosinophilic esophagitis	Mordechai, Hien, and David S. Wishart
Hepatocellular carcinoma	PubMed: 7482520, 9222688, 22882828, 19616694, 21458633

Diseases	References
Perillyl alcohol administration for cancer treatment	PubMed: 17668437, 15607313, 14569192, 10379660, 17403619, 22284503, 20300169, 22061338, 19783829, 19010317

from Human Metabolome Database (HMDB)

10.6 Biochemical Reactions

from Rhea - annotated reactions database

11 Use and Manufacturing

11.1 Use Classification

EPA Safer Chemical Functional Use Classes	Uncategorized
Safer Chemical Classes	Green circle - The chemical has been verified to be of low concern

from EPA Safer Choice

Agrochemical Category	Attractant, Fungicide

from EU Pesticides Database

JECFA Functional Classes	Food Additives: CHEWING_GUM_BASE_COMPOUND; TEXTURIZER; THICKENER; YEAST_FOOD

from FAO/WHO Food Additive Evaluations (JECFA)

Household Products Categories	Commercial / Institutional; Home maintenance; Inside the Home; Landscape/Yard; Personal care; Pesticides; Pet Care

from NLM Household Products Database

11.2 Household Products

NLM Household Products and Categories

Bonide Garden Rich Flower & Vegetable Food 5-10-5-01/03/2013 [Landscape/Yard]

Garnier Nutrisse Level 3 Permanent Creme Haircolor, Nourishing Multi-Lights, Beige Blonde H1, Pralin [Personal care]

Henry 351 FastPro Fast Grab, Pro Grade Carpet Adhesive, Professional Use-09/21/2016 [Commercial / Institutional]

... see the complete list of household products

from NLM Household Products Database

11.3 Uses

EPA CPDat Chemical and Product Categories

The Chemical and Products Database, a resource for exposure-relevant data on chemicals in consumer products, Scientific Data, volume 5, Article number: 180125 (2018), DOI:10.1038/sdata.2018.125

from EPA Chemical and Products Database (CPDat)

Use Classification

Food additives

from EU Food Improvement Agents

For Urea (USEPA/OPP Pesticide Code: 085702) ACTIVE products with label matches. /SRP: Registered for use in the U.S. but approved pesticide uses may change periodically and so federal, state and local authorities must be consulted for currently approved uses./

U.S. Environmental Protection Agency/Office of Pesticide Program's Chemical Ingredients Database on Urea (57-13-6). Available from, as of February 5, 2001: http://npirspublic.ceris.purdue.edu/ppis/

from HSDB

The active ingredient is no longer contained in any registered pesticide products ... "cancelled."

United States Environmental Protection Agency/ Prevention, Pesticides and Toxic Substances; Status of Pesticides in Registration, Reregistration, and Special Review. (1998) EPA 738-R-98-002, p. 343

from HSDB

Condensed with malonic ester to form barbituric acid; cellulose softener.

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

from HSDB

LIQUID & OTHER FERTILIZER APPLICATIONS; LIVESTOCK NUTRIENT; MONOMER FOR UREA-FORMALDEHYDE RESINS; CHEMICAL INTERMEDIATE FOR MELAMINE

SRI

▸ from HSDB

UREA HAS BEEN USED AS AN INSECT (MOSQUITO) REPELLENT.

HILL JA ET AL; MOSQ NEWS 39 (2): 307-310 (1979)

▸ from HSDB

Urea is a decomposition inhibitor for **ammonium perchlorate**

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V5 650 (1979)

▸ from HSDB

Urea is reacted with alcohols to form alkylcarbamates

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V4 475 (1978)

▸ from HSDB

Urea is reacted with fatty acids from coconut oil to produce amides in 90% yields

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V2 253 (1978)

▸ from HSDB

Urea is used with **zinc formaldehyde sulfoxylate** to remove permanent hair dye

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V12 109 (1980)

▸ from HSDB

Urea is reacted with alpha-diketones or dialdehydes to form hydantoins

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V12 702 (1980)

▸ from HSDB

Urea is used to partially reverse the methylolamine chain reaction in glue gellation processes

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V11 913 (1980)

▸ from HSDB

Concentrated urea solutions are used to promote the rate of reaction between reactive dyes and wools

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V8 387 (1979)

▸ from HSDB

Ammonolysis of urea and **ammonium thiocyanate** produces **guanidine**

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. S 519 (1984)

▸ from HSDB

Urea is used as a deicing compound on airport runways

Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. V21 219 (1983)

▸ from HSDB

Formulation and fermentation aid in yeast-raised bakery products, alcoholic beverages, and gelatin products.

21 CFR 184.1923 (4/1/91)

from HSDB

MEDICATION

from HSDB

Animal feed; plastics; chemical intermediate; stabilizer in explosives; medicine (diuretic); adhesives; separation of hydrocarbons (as urea adducts); pharmaceuticals; cosmetics; dentifrices; **sulfamic acid** production; flameproofing agents; viscosity modifier for **starch** or casein-based paper coatings; preparation of **biuret**.

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1`57

from HSDB

Widely used in solid and liquid complex fertilizers and for direct application. It is used in foliar sprays with or without the addition of pesticides and micronutrients.

Farm Chemicals Handbook 2000. Willoughby, Ohio: Meister 2000., p. B 40

from HSDB

Partially polymerized resins of urea are used by the textile industry to impart permanent-press properties to fabrics.

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (98) 620

from HSDB

As urea-formaldehyde resins, urea-clathrates in petroleum-refining industry for production jet aviation fuels, and for dewaxing aviation fuels.

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (98) 620

from HSDB

Urea is dehydrated and condensed to produce **melamine**

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V7 (93) 749

from HSDB

Urea is a building block for **amino** resins.

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V2 (92) 607

from HSDB

11.3.1 Industry Uses

Adhesives and sealant chemicals	Plastic and resin manufacturing. Final use not specifically known to Agrium.
Agricultural chemicals (non-pesticidal)	Plasticizers
Cleaning Products	Pollution control.
Distributed to wholesale suppliers. Final use not known to Agrium.	Processing aids, not otherwise listed
Dyes	Processing aids, specific to petroleum production
Finishing agents	Repackaging/chemical distribution
Fuels and fuel additives	Solids separation agents
Functional fluids (closed systems)	spent Urea is used for NOx emission control(Air Pollution Control Equipment - Chemical)
Functional fluids (open systems)	
Intermediates	
Lubricants and lubricant additives	
Odor agents	
Oxidizing/reducing agents	

https://www.epa.gov/chemical-data-reporting

from EPA Chemicals under the TSCA

11.3.2 Consumer Uses

Adhesives and sealants	Non-TSCA use
Agricultural products (non-pesticidal)	Paints and coatings
Agrium product sold to commercial and industrial customers. Final product use varied and unknown to Agrium.	Paper products
Automotive care products	Personal care products
Building/construction materials - wood and engineered wood products	Plastic and rubber products not covered elsewhere
Building/construction materials not covered elsewhere	Pollution control.
Cleaning and furnishing care products	Repackaging/chemical distribution
Fabric, textile, and leather products not covered elsewhere	Urea being used to make diesel emissions fluid (DEF)
Fuels and related products	Water treatment products
Ink, toner, and colorant products	diesel exhaust fluid
Laundry and dishwashing products	
Lawn and garden care products	
Lubricants and greases	

https://www.epa.gov/chemical-data-reporting

from EPA Chemicals under the TSCA

11.4 Methods of Manufacturing

... from **ammonia**, **carbon monoxide** and **sulfur** in **methanol**.

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

from HSDB

Liquid **ammonia** and liquid **carbon dioxide** at 1750-3000 psi and 160-200 deg C react to form **ammonium carbamate**, NH4CO2NH2, which decomposes at lower pressure (about 80 psi) to urea and **water**. Method of purification: crystallization.

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1157

from HSDB

11.5 Impurities

Cyanates are present as an impurity /American Research Products Co/

CHEMCYCLOPEDIA 1986 p.207

from HSDB

0.3-2.0 wt% of **biuret** is typically present in solid urea

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (98) 620

from HSDB

11.6 Formulations/Preparations

DOSAGE FORMS--STERILE USP: 40 & 90 G.

Osol, A. and J.E. Hoover, et al. (eds.). Remington's Pharmaceutical Sciences. 15th ed. Easton, Pennsylvania: Mack Publishing Co., 1975., p. 864

from HSDB

Ultrahigh purity grades; solutions at 5M /American Research Products Co/

CHEMCYCLOPEDIA 1986 p.207

from HSDB

UAL-37 contains 35% urea

FARM CHEM HDBK 1986 p.B65

from HSDB

N-Dure contains 26% urea

FARM CHEM HDBK 1986 p.B66

from HSDB

UF Concentrate-85 contains 26% urea

FARM CHEM HDBK 1986 p.B66

from HSDB

Urea is pelletized or prilled to avoid caking and to make it easy to handle.

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (98) 613

from HSDB

Ureacin-20 Creme contains urea at 20%; Ureacin-40 Creme contains urea at 40%; Ureacin-10 lotion contains urea at 10%.

Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. V-691

from HSDB

Technical; CP; US; fertilizer (45-46% **nitrogen**); feed grade (about 42% **nitrogen**)

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1157

from HSDB

Formulations (solid form): urea-ammonia phosphate (UAP); urea-**ammonia sulfate** (UAS); urea-**phosphate**. Formulations (solution): urea-ammonia nitrate (UAN)

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (98) 620

from HSDB

Grade: reagent-grade; solid urea

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (98) 620

from HSDB

11.7 Consumption Patterns

37% AS A LIQUID FERTILIZER; 24% FOR OTHER FERTILIZER USES; 22% AS A LIVESTOCK NUTRIENT; 17% FOR RESINS AND OTHER INDUSTRIAL USES (1973)

SRI

from HSDB

Fertilizer, solid, 39%; Fertilizer solutions, 32%; Exports, 19%; Urea-formaldehyde resins and adhesives, 6%; Others, including animal feeds and **melamine**, 4% (1985)

CHEMICAL PROFILE: Urea, 1985

from HSDB

CHEMICAL PROFILE: Urea. Fertilizer, solid, 42%; fertilizer solutions, 31%; exports, 13%; urea-formaldehyde resins and adhesives, 5%; other, including animal feeds and **melamine**, 9%.

Kavaler AR; Chemical Marketing Reporter 234 (13): 54 (1988)

▸ from HSDB

CHEMICAL PROFILE: Urea. Demand: July 1987-June 1988: 7.46 million tons; 1988-1989: 8.17 million tons; 1992-1993 /projected/: 8.5 million tons per year. (Includes exports, but not imports, which totaled 2.1 million tons in 1987-1988.)

Kavaler AR; Chemical Marketing Reporter 234 (13): 54 (1988)

▸ from HSDB

Fertilizers, including solid and **nitrogen** solutions (86%); livestock feed (7%); urea-formaldehyde resins (5%); miscellaneous, including **cyanuric acid** for chlorinated isocyanurates, crystalline adducts, deicing agents, pharmaceutical intermediates, and **sulfamic acid** and its ammonium salt (1%).

ChemExpo; Chemical Profile Database on Urea (57-13-6). Dec 13, 1999.

▸ from HSDB

Demand in United States (which equals production plus imports, less exports): in 1997, 8.81 million tons; in 1998, 9.49 million tons; in 2002 (est), 10 million tons.

ChemExpo; Chemical Profile Database on Urea (57-13-6). Dec 13, 1999.

▸ from HSDB

11.8 U.S. Production

Aggregated Product Volume (EPA CDR 2016)

20,000,000,000 - 30,000,000,000 lb

https://www.epa.gov/chemical-data-reporting

▸ from EPA Chemicals under the TSCA

(1972) 3.2X10+12 G

SRI

▸ from HSDB

(1975) 3.8X10+9 G (EST)

SRI

▸ from HSDB

(1985) 5.95X10+12 g

Chem Eng News 64(23): 35 (1986)

▸ from HSDB

(1990) 16.24 billion lb

Chem Eng News 70 (15): 17 (4/13/92)

▸ from HSDB

(1991) 16.27 billion lb

Chem Eng News 71 (15): 11 (4/12/93)

▸ from HSDB

(1991) 6.972X10+6 metric tons

SRI. 1992 Directory of Chemical Producers-United States of America. Menlo Park, CA: SRI International, 1992., p. 1046

from HSDB

(1992) 17.96 billion lb

Chem & Engineering News 72 (15): 13 (4/11/94)

from HSDB

(1993) 15.66 billion lb

Chem & Engineering News 72 (15): 13 (4/11/94)

from HSDB

Millions of tons:(1996) 7.6; (1980) 7.1; (1970) 2.9 (capacity)

Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. SUPP (1998) 619

from HSDB

11.9 U.S. Imports

(1972) 5.1X10+11 G

SRI

from HSDB

(1975) 6.6X10+8 G

SRI

from HSDB

(1984) 2.0X10+10 G

BUREAU OF THE CENSUS. U.S. IMPORTS FOR CONSUMPTION AND GENERAL IMPORTS 1984 p.1-387

from HSDB

11.10 U.S. Exports

(1972) 4.5X10+11 G

SRI

from HSDB

(1975) 6.5X10+8 G

SRI

from HSDB

(1984) 1.11X10+13 G

BUREAU OF THE CENSUS. U.S. EXPORTS, SCHEDULE E, 1984 p.2-117

from HSDB

11.11 Manufacturers

Agrium US Inc., 4582 S. Ulster St., Suite 1400, Denver, CO 80237, (303) 804-4400; Production site: Borger, TX 79008

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Bordon Chemicals and Plastics, Operating Limited Partnership, Highway 73, Geismer, LA 70734, (225) 673-6121; Production site: Geismer, LA 70734

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

CF Industries Inc., 1 Salem Lake Drive, Long Grove, IL 60047-8402, (847) 438-9500; Production site: Donaldsonvile, LA 70346-0468

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Coastal Chem Inc., P.O. Box 1287, Cheyenne, WY 82003, (307) 637-2700; Production site: Cheyenne, WY 82003

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Coastal Refining and Marketing Inc., 9 Greenway Plaza, Houston, TX 77046, (713) 877-6559; Production site: St. Helens, OR 97051

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Cytec Industries Inc., Building Block Chemicals, 5 Garret Mountain Plaza, W. Patterson, NJ 07424, (973) 357-3100; Production site: Waggaman, LA 70094

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Farmland Industries Inc., 3315 N. Oak Trafficway, P.O. Box 7305, Kansas City, MO 64116; Production sites: Beatrice, NE 68310; Coffeyville, KS 67337; Dodge City, KS 67801; Enid, OK 73702; Fort Dodge, IA 50501; Lawrence, KS 66044

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

IMC-Agrico Co., IMC-Agrico Phosphates, 2100 Sanders Rd., Northbrook, IL 60062-6146, (847) 272-9200; Production site: Faustina, LA 70346

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

LaRoche Industries Inc., 1100 Johnson Ferry Rd. NE, Atlanta, GA 30342-1708, (404) 851-0300; Production site: Cherokee, AL 35616

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

MissChem Nitrogen LLC, P.O. Box 1348, Yazoo City, MS 39194-1348, (662) 746-5787; Production site: Yazoo City, MS 39194

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

PCS Nitrogen Fertilizer L.P., 6750 Poplar Ave., Suite 600, Memphis, TN 38138- 7419, (901) 758-7419; Production sites: Augusta, GA 30903; Geismer, LA 70734; Memphis, TN 38127

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

PCS Nitrogen Ohio L.P., P.O. Box 628, Lima, OH 45802, (419) 226-1404; Production site: Lima, OH 45802

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Royster-Clark Inc., 999 Waterside Dr., Suite 800, Norfolk VA 23510, (757) 222-9500; Production site: E. Dubuque, IL 61025-0229

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

J.R. Simplot Co., 999 Main St., Suite 1300, Boise, ID 83605, (208) 336-2110. Minerals and Chemicals Div.; Production site: Pocatello, ID 83204

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Terra Industries Inc., Terra Centre, 600 4th St., Sioux City, IA 51101, (712) 277-1340; Production sites: Sergeant Bluff, IA 51054; Woodward, OK 73801

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Terra Nitrogen L.P., 600 4th St., Sioux City, IA 51101, (712) 277-1340; Production sites: Blytheville, AR 72315; Verdigris, OK 74017

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Triad Nitrogen L.L.C., P.O. Box 1851, Yazoo City, MS 39194, (662) 746-6302; Production site: Donaldsonville, LA 70346

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Unocal Corp., 2141 E. Rosecrans Ave., Suite 400, El Segundo, CA 90245, (310) 726-7600; Production site: Kenai, AK 99611

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

Willard Grain and Feed Inc., 104 Ash St., Celina, TX 75009, (800) 322-2367. Wil-Gro Fertilizer Inc. Division; Production site: Pryor, OK 74362

SRI International. 2000 Directory of Chemical Producers -- United States. SRI Consulting, Menlo Park: CA 2000, p. 958

from HSDB

11.12 General Manufacturing Information

Industry Processing Sectors

Adhesive manufacturing	Plastic material and resin manufacturing
Agriculture, forestry, fishing and hunting	Plastics product manufacturing
All other basic inorganic chemical manufacturing	Repackaging/chemical distribution
All other basic organic chemical manufacturing	Repackaging/chemical distribution
All other chemical product and preparation manufacturing	Services
Fabricated metal product manufacturing	Soap, cleaning compound, and toilet preparation ma
Food, beverage, and tobacco product manufacturing	Textiles, apparel, and leather manufacturing
Mining (except oil and gas) and support activities	Transportation equipment manufacturing
Nonmetallic mineral product manufacturing (includes clay, glass, cement, concrete, lime, gypsum, and other nonmetallic mineral product manufacturing.	Utilities
Oil and gas drilling, extraction, and support activities	Wholesale and retail trade

Paper manufacturing
Pesticide, fertilizer, and other agricultural chemical manufacturing
Pharmaceutical and medicine manufacturing
Wood product manufacturing

from EPA Chemicals under the TSCA

EPA TSCA Commercial Activity Status

Urea: ACTIVE

https://www.epa.gov/tsca-inventory

from EPA Chemicals under the TSCA

Occurs in urine and other body fluids. First org cmpd to be synthesized ...

Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 1157

from HSDB

Pure urea should not give the **biuret** reaction unless heated above melting point. In practice all reagent grade urea gives positive **biuret** reaction.

Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 1683

from HSDB

ALTHOUGH UREA ... HAS BEEN EMPLOYED IN THE PAST AS ORAL DIURETICS FOR TREATMENT OF CHRONIC EDEMA ... IT HAS BEEN REPLACED BY SUPERIOR AGENTS.

Goodman, L.S., and A. Gilman. (eds.) The Pharmacological Basis of Therapeutics. 5th ed. New York: Macmillan Publishing Co., Inc., 1975., p. 821

from HSDB

UREA, THE **DIAMIDE** OF **CARBONIC ACID**, IS MOST IMPORTANT DEGRADATION OF PROTEIN CATABOLISM IN MAN, IN OTHER MAMMALS & IN CERTAIN OTHER ANIMAL SPECIES. UREA IS FORMED IN LIVER & FORMS THE MAJOR PART OF ORGANICS IN URINE.

Bergmeyer, H.W. (ed.). Methods of Enzymatic Analysis. 2nd English ed. New York City: Academic Press, 1974., p. 1791

from HSDB

12 Identification

12.1 Analytic Laboratory Methods

THIN-LAYER CHROMATOGRAPHIC IDENTIFICATION FEASIBILITY OR SEMIQUANTITATIVE DETERMINATION OF UREA IN AQ MODEL SOLN.

THIELEMANN H; ACTA HYDROCHIM HYDROBIOL 7 (1): 125-6 (1979)

from HSDB

A technique for hydrolyzing urea using 78% w/w **sulfuric acid** (20 minute refluxing). ... This assay can be used to determine urea in creams.

Dreyer-van der Glas SM, Dingjan HA; Pharm Weekbl 118: 575-6 (1983)

from HSDB

AOAC Method 959.03. Urea in fertilizers. Urease method.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. V1 21

from HSDB

AOAC Method 983.01. Urea and methyleneureas (**water** soluble) in fertilizers. Liquid chromatographic method.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. V1 21-22

from HSDB

AOAC Method 941.04. Urea and ammoniacal **nitrogen** in animal feed. Urease method.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. V1 76

from HSDB

AOAC Method 967.07. Urea in animal feed. Colorimetric method.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. V1 76

from HSDB

AOAC Method 951.06. Urea in deodorants. Titrimetric method.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. V1 365

from HSDB

AOAC Method 945.88. Urine stains on foods and containers. Ultraviolet light examination.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. V1 407

from HSDB

AOAC Method 942.24. Urine stains on foods and containers. Urease test for urea.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. 407.

from HSDB

AOAC Method 959.14. Urine stains on foods and containers. **Xanthydrol** test for urea.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. 409

from HSDB

AOAC Method 963.28. Urine on grain. Magnesium uranyl acetate test.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. 410

from HSDB

AOAC Method 972.41 Urine on grain. Urease-**bromothymol blue**-agar test.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. 410

from HSDB

AOAC Method 980.28. Urine stains on foods and containers. Thin layer chromatographic Method 1.

Association of Official Analytical Chemists. Official Methods of Analysis. 15th ed. and Supplements. Washington, DC: Association of Analytical Chemists, 1990, p. 411

from HSDB

Determination and stability studies of urea in urea creams by high-performance liquid chromatography using a UV-spectrometer at 200 nm.

Yasuda T et al; Yakugaku Zasshi 112 (2): 141-5 (1992)

PMID:1517978

from HSDB

12.2 Clinical Laboratory Methods

Three analytical techniques for determining urea serum levels were evaluated. A colorimetric method was found to give identical results to an enzymatic method. The Merckognost urea test gave results acceptable in a clinical laboratory practice.

Ivanovic I et al; Arch Farm 31 (3): 101-6 (1981)

from HSDB

Urea detn milk by enzymic hydrolysis and photometry

Andersson G et al; Zentralbl Veterinaermed Reihe A 33 (1): 53-8 (1986)

from HSDB

13 Safety and Hazards

13.1 Hazards Identification

13.1.1 GHS Classification

GHS Hazard Statements	Not Classified Reported as not meeting GHS hazard criteria by 2912 of 3059 companies (only ~ 4.8% companies provided GHS information). For more detailed information, please visit ECHA C&L website

from European Chemicals Agency (ECHA)

13.1.2 EPA Safer Chemical

Chemical: Urea

Green circle - The chemical has been verified to be of low concern based on experimental and modeled data.

from EPA Safer Choice

13.1.3 Health Hazard

May irritate eyes. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

from CAMEO Chemicals

13.1.4 Fire Hazard

Behavior in Fire: Melts and decomposes, generating ammonia. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

from CAMEO Chemicals

Not combustible. Gives off irritating or toxic fumes (or gases) in a fire.

from ILO International Chemical Safety Cards (ICSC)

13.1.5 Fire Potential

NONCOMBUSTIBLE

Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987., p. 1209

▸ from HSDB

13.1.6 Skin, Eye, and Respiratory Irritations

Urea causes redness and irritation of skin and eyes.

Environment Canada; Tech Info for Problem Spills: Urea p.2 (1985)

▸ from HSDB

13.2 Safety and Hazard Properties

13.2.1 Explosive Limits and Potential

Reacts with **sodium hypochlorite** or **calcium hypochlorite** to form the explosive **nitrogen trichloride**.

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

▸ from HSDB

13.3 First Aid Measures

13.3.1 First Aid

EYES: 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. SKIN: IMMEDIATELY flood affected skin with **water** while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and **water**. If symptoms such as redness or irritation develop, IMMEDIATELY call a physician and be prepared to transport the victim to a hospital for treatment. 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 Protective Clothing. INGESTION: DO NOT INDUCE VOMITING. 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. Be prepared to transport the victim to a hospital if advised by a physician. 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. IMMEDIATELY transport the victim to a hospital. (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

▸ from CAMEO Chemicals

13.3.2 Inhalation First Aid

Fresh air, rest.

▸ from ILO International Chemical Safety Cards (ICSC)

13.3.3 Skin First Aid

Rinse and then wash skin with **water** and soap.

▸ from ILO International Chemical Safety Cards (ICSC)

13.3.4 Eye First Aid

First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.

- from ILO International Chemical Safety Cards (ICSC)

13.3.5 Ingestion First Aid

Give one or two glasses of water to drink. Rest.

- from ILO International Chemical Safety Cards (ICSC)

13.4 Fire Fighting

Fire Extinguishing Agents: Water (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

- from CAMEO Chemicals

In case of fire in the surroundings, use appropriate extinguishing media.

- from ILO International Chemical Safety Cards (ICSC)

13.5 Accidental Release Measures

13.5.1 Spillage Disposal

Sweep spilled substance into covered containers. If appropriate, moisten first to prevent dusting. Wash away remainder with plenty of water.

- from ILO International Chemical Safety Cards (ICSC)

13.5.2 Cleanup Methods

Water Spill: Contain by damming, water diversion or natural barriers. Remove and treat contaminated liquids. Absorb small amounts of liquid spill with natural or synthetic sorbents, shovel into containers and cover.

Environment Canada; Tech Info for Problem Spills: Urea p.2 (1985)

- from HSDB

If urea is spilled in solid form, shovel material into containers and cover. Construct barriers to contain solutions or divert to impermeable holding area. Remove material by manual or mechanical means.

Environment Canada; Tech Info for Problem Spills: Urea p.1 (1985)

- from HSDB

13.5.3 Disposal Methods

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices.

- from HSDB

Urea is a waste chemical stream constituent which may be subjected to ultimate disposal by controlled incineration. Incinerator is equipped with a scrubber or thermal unit to reduce nitrogen oxide emissions.

USEPA; Engineering Handbook for Hazardous Waste Incineration p.2-10 (1981) EPA 68-03-3025

from HSDB

The following wastewater treatment technology has been investigated for urea: Concentration process: Biological treatment.

USEPA; Management of Hazardous Waste Leachate, EPA Contract No.68-03-2766 p.E-36 (1982)

from HSDB

13.5.4 Preventive Measures

SRP: The scientific literature for the use of contact lenses in industry is conflicting. The benefit or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses. However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place.

from HSDB

13.6 Handling and Storage

13.6.1 Nonfire Spill Response

SMALL SPILLS AND LEAKAGE: If you spill this chemical, you should dampen the solid spill material with **water**, then transfer the dampened material to a suitable container. Use absorbent paper dampened with **water** to pick up any remaining material. Seal your contaminated clothing and the absorbent paper in a vapor-tight plastic bag for eventual disposal. Wash all contaminated surfaces with a 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. STORAGE PRECAUTIONS: You should store this chemical under refrigerated temperatures, and protect it from moisture. (NTP, 1992)

National Toxicology Program, Institute of Environmental Health Sciences, National Institutes of Health (NTP). 1992. National Toxicology Program Chemical Repository Database. Research Triangle Park, North Carolina.

from CAMEO Chemicals

13.6.2 Safe Storage

Separated from incompatible materials. See Chemical Dangers.

from ILO International Chemical Safety Cards (ICSC)

13.7 Exposure Control and Personal Protection

13.7.1 Other Standards Regulations and Guidelines

Workplace Environmental Exposure Level (WEEL): 8-hr Time-weighted Average (TWA) 10 mg/cu m.

American Industrial Hygiene Association. The AIHA 1999 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook. American Industrial Hygiene Association. Fairfax, VA 1999., p. 41

from HSDB

13.7.2 Inhalation Risk

Evaporation at 20 °C is negligible; a nuisance-causing concentration of airborne particles can, however, be reached quickly , especially if powdered.

from ILO International Chemical Safety Cards (ICSC)

13.7.3 Effects of Short Term Exposure

The substance is irritating to the eyes, skin and respiratory tract.

from ILO International Chemical Safety Cards (ICSC)

13.7.4 Effects of Long Term Exposure

Repeated or prolonged contact with skin may cause dermatitis.

from ILO International Chemical Safety Cards (ICSC)

13.7.5 Allowable Tolerances

Residues of urea are exempted from the requirement of a tolerance when used as a stabilizer, inhibitor in accordance with good agricultural practices as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest.

40 CFR 180.1001(c) (7/1/2000)

from HSDB

Urea is exempted from the requirement of a tolerance when used as a adjuvant/intensifier for herbicides in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only.

40 CFR 180.1001(d) (7/1/2000)

from HSDB

Urea is exempted from the requirement of a tolerance when used as a stabilizer, inhibitor in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to animals.

40 CFR 180.1001(e) (7/1/2000)

from HSDB

An exemption from the requirement of a tolerance is established for residues of the frost protectant urea in or on the following raw agricultural commodities when used before harvest in the production of. alfalfa, almonds, apples, apricots, artichokes, asparagus, avocados, beans, bell peppers, blackberries, blueberries, broccoli, brussels sprouts, boysenberries, caneberries, canola, cantaloupes, carrots, cauliflower, casaba, celery, cherries, chili peppers, chinese cabbage (bok choy, napa), cooking peppers, corn, cotton, crenshaw, cucumbers, figs, grapefruit, grapes, honeydew melon, hops, kiwifruit, kohlrabi, lemons, lentils, lettuce, limes, macadamia nuts, musk melon, nectarines, olives, onions, oranges, peaches, pears, peanuts, peas, persian melon, pistachios, plums, potatoes, pumpkin, prunes, radish, raspberries, rice, safflower, sorghum, spinach, spinach (New Zealand), squash (winter and summer), strawberries, sugar beets, sunflower, sweet pepper, table beets, tangerines, tomatoes, walnuts, watermelon, and zucchini.

40 CFR 180.1117 (7/1/2000)

from HSDB

13.7.6 Exposure Prevention

PREVENT DISPERSION OF DUST!

from ILO International Chemical Safety Cards (ICSC)

13.7.7 Inhalation Prevention

Use local exhaust.

from ILO International Chemical Safety Cards (ICSC)

13.7.8 Skin Prevention

Protective gloves.

- from ILO International Chemical Safety Cards (ICSC)

13.7.9 Eye Prevention

Wear safety spectacles.

- from ILO International Chemical Safety Cards (ICSC)

13.7.10 Ingestion Prevention

Do not eat, drink, or smoke during work.

- from ILO International Chemical Safety Cards (ICSC)

13.7.11 Protective Equipment and Clothing

Goggles or face shield; dust mask. (USCG, 1999)

U.S. Coast Guard. 1999. Chemical Hazard Response Information System (CHRIS) - Hazardous Chemical Data. Commandant Instruction 16465.12C. Washington, D.C.: U.S. Government Printing Office.

- from CAMEO Chemicals

13.8 Stability and Reactivity

13.8.1 Air and Water Reactions

Water soluble.

- from CAMEO Chemicals

13.8.2 Reactive Group

Amides and Imides

- from CAMEO Chemicals

13.8.3 Reactivity Profile

UREA is a weak base. Reacts with hypochlorites to form **nitrogen trichloride** which explodes spontaneously in air [J. Am. Chem. Soc. 63:3530-32]. Same is true for **phosphorus pentachloride**. It reacts with azo and diazo compounds to generate toxic gases. Reacts with strong reducing agents to form flammable gases (hydrogen). The heating of improper stoichiometric amounts of urea and sodium nitrite lead to an explosion. Heated mixtures of **oxalic acid** and urea yielded rapid evolution of gases, **carbon dioxide**, **carbon monoxide** and **ammonia** (if hot, can be explosive). Titanium tetrachloride and urea slowly formed a complex during 6 weeks at 80° C, decomposed violently at 90 C, [Chem. Abs., 1966, 64, 9219b]. Urea ignites spontaneously on stirring with **nitrosyl perchlorate** due to the formation of the diazonium **perchlorate**. **Oxalic acid** and urea react at high temperatures to form toxic and flammable **ammonia** and **carbon monoxide** gases, and inert CO2 gas [Von Bentzinger, R. et al., Praxis Naturwiss. Chem., 1987, 36(8), 41-42].

- from CAMEO Chemicals

13.9 Regulatory Information

13.9.1 Atmospheric Standards

This action promulgates standards of performance for equipment leaks of Volatile Organic Compounds (VOC) in the Synthetic Organic Chemical Manufacturing Industry (SOCMI). The intended effect of these standards is to require all newly constructed, modified, and reconstructed SOCMI process units to use the best demonstrated system of continuous emission reduction for equipment leaks of VOC, considering costs, non air quality health and environmental impact and energy requirements. Urea is produced, as an intermediate or a final product, by process units covered under this subpart.

40 CFR 60.489 (7/1/2000)

from HSDB

13.9.2 FIFRA Requirements

As the federal pesticide law FIFRA directs, EPA is conducting a comprehensive review of older pesticides to consider their health and environmental effects and make decisions about their future use. Under this pesticide reregistration program, EPA examines health and safety data for pesticide active ingredients initially registered before November 1, 1984, and determines whether they are eligible for reregistration. In addition, all pesticides must meet the new safety standard of the Food Quality Protection Act of 1996. Pesticides for which EPA had not issued Registration Standards prior to the effective date of FIFRA, as amended in 1988, were divided into three lists based upon their potential for human exposure and other factors, with List B containing pesticides of greater concern and List D pesticides of less concern. Urea is found on List D. Case No: 4096; Pesticide type: antimicrobial; Case Status: No products containing the pesticide are actively registered ... The case /is characterized/ as "cancelled." Under FIFRA, pesticide producers may voluntarily cancel their registered products. EPA also may cancel pesticide registrations if registrants fail to pay required fees or make/meet certain reregistration commitments, or if EPA reaches findings of unreasonable adverse effects.; Active ingredient (AI): Urea; AI Status: The active ingredient is no longer contained in any registered pesticide products ... "cancelled."

USEPA/OPP; Status of Pesticides in Registration, Reregistration and Special Review p.343 (Spring, 1998) EPA 738-R-98-002

from HSDB

Residues of urea are exempted from the requirement of a tolerance when used as a stabilizer, inhibitor in accordance with good agricultural practices as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest.

40 CFR 180.1001(c) (7/1/2000)

from HSDB

Urea is exempted from the requirement of a tolerance when used as a adjuvant/intensifier for herbicides in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to growing crops only.

40 CFR 180.1001(d) (7/1/2000)

from HSDB

Urea is exempted from the requirement of a tolerance when used as a stabilizer, inhibitor in accordance with good agricultural practice as inert (or occasionally active) ingredients in pesticide formulations applied to animals.

40 CFR 180.1001(e) (7/1/2000)

from HSDB

An exemption from the requirement of a tolerance is established for residues of the frost protectant urea in or on the following raw agricultural commodities when used before harvest in the production of. alfalfa, almonds, apples, apricots, artichokes, asparagus, avocados, beans, bell peppers, blackberries, blueberries, broccoli, brussels sprouts, boysenberries, caneberries, canola, cantaloupes, carrots, cauliflower, casaba, celery, cherries, chili peppers, chinese cabbage (bok choy, napa), cooking peppers, corn, cotton, crenshaw, cucumbers, figs, grapefruit, grapes, honeydew melon, hops, kiwifruit, kohlrabi, lemons, lentils, lettuce, limes, macadamia nuts, musk melon, nectarines, olives, onions, oranges, peaches, pears, peanuts, peas, persian melon, pistachios, plums, potatoes, pumpkin, prunes, radish, raspberries, rice, safflower, sorghum, spinach, spinach (New Zealand), squash (winter and summer), strawberries, sugar beets, sunflower, sweet pepper, table beets, tangerines, tomatoes, walnuts, watermelon, and zucchini.

40 CFR 180.1117 (7/1/2000)

from HSDB

13.9.3 FDA Requirements

Substance added directly to human food affirmed as generally recognized as safe (GRAS).

21 CFR 184.1923 (4/1/2000)

from HSDB

13.10 Other Safety Information

13.10.1 Other Hazardous Reactions

Preparation of the N-labeled urea is hazardous.

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

from HSDB

13.10.2 Special Reports

Environment Canada; Tech Info for Problem Spills: Urea (1985)

from HSDB

Haliburton JC, Morgan SE; Nonprotein Nitrogen-induced Ammonia Toxicosis and Ammoniated Feed Toxicity Syndrome; Vet Clin North Am Food Anim Pract 5 (2): 237-49 (1989)

from HSDB

WHO/IPCS; Toxicological Evaluation of Certain Food Additives and Contaminants WHO Food Additives Series 32 (1993)

from HSDB

14 Toxicity

14.1 Toxicological Information

14.1.1 NIOSH Toxicity Data

from The National Institute for Occupational Safety and Health (NIOSH)

14.1.2 Exposure Routes

The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

▸ from ILO International Chemical Safety Cards (ICSC)

14.1.3 Inhalation Symptoms

Cough. Shortness of breath. Sore throat.

▸ from ILO International Chemical Safety Cards (ICSC)

14.1.4 Skin Symptoms

Redness.

▸ from ILO International Chemical Safety Cards (ICSC)

14.1.5 Eye Symptoms

Redness.

▸ from ILO International Chemical Safety Cards (ICSC)

14.1.6 Ingestion Symptoms

Convulsions. Headache. Nausea. Vomiting.

▸ from ILO International Chemical Safety Cards (ICSC)

14.1.7 Acute Effects

▸ from ChemIDplus

14.1.8 Interactions

A case of sudden collapse after the intra-amniotic injection of 5 mg **dinoprostone** (**Prostaglandin E2**) and 40 g urea for pregnancy termination in a 36 yr old woman after the diagnosis of fetal Down's syndrome is reported. Within one minute of injection of a test dose of one mg of **dinoprostone**, the patient collapsed. Intravenous injections of 100 mg **hydrocortisone**

and 10 mg chlorpheniramine maleate were administered and the patient was given oxygen by a face mask. Within 10 minutes blood pressure had returned to 110/68 mm Hg, and after a further 15 minutes pulse rate was normal.

Cameron IT, Baird DT; Lancet 2: 1046-7 (1984)

from HSDB

TREATMENT OF GUINEA PIGS WITH UREA INCR THE EFFECT OF THEIR SUBSEQUENT SENSITIZATION WITH EPOXY RESIN (EGK-19) OR K2CR207. UREA TREATMENT INCR PERCENTAGE OF ANIMALS SENSITIZED BY EPOXY RESINS FROM 50-87%. UREA ALONE DID NOT SENSITIZE SKIN.

ZIGLER F, ROETER A; DERMATOL VENEROL (SOFIA) 18 (1): 25-28 (1979)

from HSDB

The hemolytic action on human red blood cells (RBC) and the aggregations of human and rat red blood cells in the presence of sodium alginate were studied. Sodium alginate had no hemolytic action on human red blood cells. Human and rat red blood cells showed a marked aggregation by sodium alginate in a neutral medium. Sodium alginates having larger molecular weights showed more pronounced activities for aggregation of red blood cells as compared with those having smaller molecular weights, and the aggregation of red blood cells increased with an increase in the concentration of sodium alginate. The aggregation was inhibited by urea, suggesting the aggregation of red blood cells is caused by hydrogen bonding. When sodium alginate was added to human or rat blood rouleaux formation of red blood cells covered with fibrin net was observed in the coagulation cruor (blood clot).

Daigo K et al; Yakugaku Zasshi 102 (6): 573-578 (1982)

PMID:7175688

from HSDB

Osmotic diuretics (mannitol, urea) decrease the effect on serum lithium level; significant increase in lithium excretion. /Lithium-drug interactions; from table/

Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988., p. 1043

from HSDB

14.1.9 Antidote and Emergency Treatment

/VET:/ This should involve the use of weak acid as a chemical antidote, demulcents and stimulants. ... Recommended 2.5-5 l of 5% acetic acid as an effective antidote to urea poisoning in cattle. ... /It was/ also shown that weak acids such as acetic and propionic acid offer some protection against the harmful effects of urea. Drenching with acetic acid those animals showing signs of intoxication does not lower their blood ammonia concentration within 120 minutes ... . However, administration of 2 mol of acetic acid per mol of urea at 15 minutes, and 1 mol per mol 180 minutes after giving 0.44 g/kg body weight of urea ... resulted in the survival of 28 of 29 pregnant cows ... . Emptying the rumen of fistulated cattle showing clinical signs of poisoning results in a rapid fall in their blood ammonia concentration and recovery within one to two hours ... .

Humphreys, D.J. Veterinary Toxicology. 3rd ed. London, England: Bailliere Tindell, 1988., p. 18

from HSDB

/VET:/ In animals that are not too ill, the cold water acetic acid treatment may work. the adult cow is given 19-38 liters cold water and 3.8 liters 5% acetic acid (or vinegar) orally. This treatment limits absorption of ammonia from the rumen by diluting the rumen contents and slowing the rate of hydrolysis of urea by decreasing rumen pH and temperature. The treatment also promotes urine flow that, if maintained by fluid therapy, may assure recovery from urea toxicosis. Gaseous or fluid bloat should be relieved before pumping water into the rumen.

Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982., p. 1033

from HSDB

/VET:/ This involves chemical examination of the suspect fertilizer, feed or rumen contents. In most cases of urea poisoning the ammonial level in the rumen contents will be greater than 80 mg/100 ml (47 mmol/l) and may be as high as 200 mg/100 ml (117 mmol/l). It should be remembered that rumen contents should be examined quickly after death or kept frozen until they can be analysed. The reason for this is that microbial decomposition can produce ammonia and thus lead to misleading results. The possible uneven distribution of the causal agent in feed and rumen contents must be borne in mind when collecting samples for chemical examination. Blood and serum ammonia nitrogen concentrations between 2 and 4 mg/100 ml (1.17 and 2.35 mmol/l) or greater which are associated with urea poisoning may also have diagnostic applications.

Humphreys, D.J. Veterinary Toxicology. 3rd ed. London, England: Bailliere Tindell, 1988., p. 18

from HSDB

/SRP:/ Basic treatment: Establish a patent airway. Suction if necessary. Watch for signs of respiratory insufficiency and assist ventilations if needed. Administer **oxygen** by nonrebreather mask at 10 to 15 L/min. Monitor for pulmonary edema and treat if necessary ... . Monitor for shock and treat if necessary ... . Anticipate seizures and treat if necessary ... . For eye contamination, flush eyes immediately with **water**. Irrigate each eye continuously with normal saline during transport ... . Do not use emetics. For ingestion, rinse mouth and administer 5 ml/kg up to 200 ml of **water** for dilution if the patient can swallow, has a strong gag reflex, and does not drool ... . Cover skin burns with dry sterile dressings after decontamination ... . /Poison A and B/

Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994., p. 139

▸ **from HSDB**

/SRP:/ Advanced treatment: Consider orotracheal or nasotracheal intubation for airway control in the patient who is unconscious, has severe pulmonary edema, or is in respiratory arrest. Positive pressure ventilation techniques with a bag valve mask device may be beneficial. Monitor cardiac rhythm and treat arrhythmias as necessary ... . Start an IV with D5W /SRP: "To keep open", minimal flow rate/. Use lactated Ringer's if signs of hypovolemia are present. Watch for signs of fluid overload. Consider drug therapy for pulmonary edema ... . For hypotension with signs of hypovolemia, administer fluid cautiously. Watch for signs of fluid overload ... . Treat seizures with **diazepam** (**Valium**) ... . Use **proparacaine hydrochloride** to assist eye irrigation ... . /Poison A and B/

Bronstein, A.C., P.L. Currance; Emergency Care for Hazardous Materials Exposure. 2nd ed. St. Louis, MO. Mosby Lifeline. 1994., p. 139

▸ **from HSDB**

14.1.10 Human Toxicity Excerpts

ADVERSE REACTIONS INCLUDE HEADACHE, NAUSEA, VOMITING, SYNCOPE, DISORIENTATION, TRANSIENT CONFUSION, & ELECTROLYTE DEPLETION (HYPONATREMIA & HYPOKALEMIA).

GENNARO. REMINGTON'S PHARM SCI 17TH ED 1985 p 935

▸ **from HSDB**

BECAUSE THE EYE IS PERMEABLE TO UREA, REBOUND ELEVATION IN INTRAOCULAR PRESSURE & VITREOUS VOL MAY OCCUR AFTER OCULAR HYPOTENSIVE EFFECT HAS TERMINATED (ABOUT 8 TO 12 HR AFTER ADMIN).

American Medical Association, AMA Department of Drugs, AMA Drug Evaluations. 3rd ed. Littleton, Massachusetts: PSG Publishing Co., Inc., 1977., p. 936

▸ **from HSDB**

THE SYSTEMIC TOXICITY OF UREA IS SIMILAR TO THAT OF **MANNITOL**. UREA IS IRRITATING TO TISSUES; IT CAUSES PAIN AT SITE OF INFUSION & NECROSIS MAY RESULT IF EXTRAVASATION OCCURS. SUPERFICIAL & DEEP THROMBOSIS MAY RESULT IF UREA IS INFUSED IN VEINS OF LOWER EXTREMITIES.

American Medical Association, AMA Department of Drugs, AMA Drug Evaluations. 3rd ed. Littleton, Massachusetts: PSG Publishing Co., Inc., 1977., p. 936

▸ **from HSDB**

Human reproductive effects by intraplacental route: fertility effects. ... Human mutation data reported. A human skin irritant.

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

▸ **from HSDB**

14.1.11 Non-Human Toxicity Excerpts

INTRAVITREAL INJECTION OF 0.2 ML OF 10 MOLAR /SOLN INTO VITREOUS HUMOR OF/ RABBITS HAS CAUSED INFLAMMATION, CHORIORETINITIS, & DEGENERATION OF RETINA.

Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 965

▸ **from HSDB**

UREA MIXED WITH SOYA MEAL IS PARTICULARLY DANGEROUS, AS UREASE IN LATTER LEADS TO FORMATION OF **AMMONIA** ... POISONING OF CATTLE MAY ALSO BE CAUSED BY UREA AS FERTILIZER & SPREAD UNEVENLY ON PASTURE

Clarke, E.G., and M. L. Clarke. Veterinary Toxicology. Baltimore, Maryland: The Williams and Wilkins Company, 1975., p. 30

from HSDB

LAMBS GIVEN 2 G/KG OF UREA DIED IN 90-200 MIN. ADULT SHEEP GIVEN SAME DOSE EXHIBITED ALMOST CONTINUOUS CONVULSIONS AFTER 165 MIN ... SHEEP CAN CONSUME UP TO 100 G OF UREA A DAY PROVIDED THAT CONCN OF UREA IN RATION DOES NOT EXCEED 6% ... LIVER DYSFUNCTION INCR SUSCEPTIBILITY TO POISONING.

Clarke, E.G., and M. L. Clarke. Veterinary Toxicology. Baltimore, Maryland: The Williams and Wilkins Company, 1975., p. 30

from HSDB

... ORAL ADMIN OF 50 G OF UREA KILLED 4 OUT OF 5 GOATS WITHIN 30 MIN, 450 G GIVEN BY MOUTH KILLED 7 PONIES OUT OF 8 ...

Clarke, E.G., and M. L. Clarke. Veterinary Toxicology. Baltimore, Maryland: The Williams and Wilkins Company, 1975., p. 30

from HSDB

TOXIC DOSE IN CATTLE GIVEN UREA FOR FIRST TIME IS VARIOUSLY CONSIDERED TO BE 0.45 G/KG ... OR TOTAL OF 100-200 G ... SLOWLY INCR UREA CONTENT OF FEED, MATURE BULLOCKS CAN DIGEST AS MUCH AS 400 G A DAY WITHOUT ILL EFFECT. AS LITTLE AS 50 G MAY CAUSE POISONING IN CATTLE NOT ACCUSTOMED TO IT ... .

Clarke, E.G., and M. L. Clarke. Veterinary Toxicology. Baltimore, Maryland: The Williams and Wilkins Company, 1975., p. 30

from HSDB

Urea was tested for mutagenicity in the Salmonella/microsome preincubation assay using the standard protocol approved by the National Toxicology Program. Urea was tested at doses of 0.10, 0.33, 1.0, 3.3, and 10 mg/plate in as many as 5 Salmonella typhimurium strains (TA1535, TA1537, TA97, TA98, and TA100) in the presence and absence of rat or hamster liver S-9. Urea was negative in these tests and the highest ineffective dose tested in any Salmonella typhimurium strain was 10 mg/plate.

Mortelmans K et al; Environ Mutagen 8:1-119 (1986)

from HSDB

Single doses of 16 g/kg body weight and 10% of urea in the feed has been reported to have no apparent effect on ten week old piglets ... . Although the highest level made the feed unpalatable, incorporation of 0.4, 0.6 or 1.0 g of urea per kg body weight into the ration of 18 month old pigs weighing 120-140 kg also failed to produce intoxication ... .

Humphreys, D.J. Veterinary Toxicology. 3rd ed. London, England: Bailliere Tindell, 1988., p. 17

from HSDB

Administration of 450 g of urea, which caused the death of seven of eight ponies, resulted in an increase in blood urea, **ammonia**, **alphaketoglutarate**, **glucose** and **pyruvate** concentrations. The sequence and nature of the changes produced suggested that inhibition of **alphaketoglutarate** decarboxylation may be the primary site of **ammonia** intoxication.

Humphreys, D.J. Veterinary Toxicology. 3rd ed. London, England: Bailliere Tindell, 1988., p. 17

from HSDB

Urea poisoning has been reported in sheep which drank a 21% solution used as a fertilizer for cotton ... and in those consuming treated rations ... . Sheep grazing pastures low in protein are particularly susceptible to urea poisoning ... . The short term feeding of protein concentrates before giving urea supplements can increase sheep's tolerance to urea ... . Experimental administration of 0.5 g/kg of urea has been shown to cause intoxication in the heaviest, while 0.8 g/kg resulted in poisoning in all the treated sheep ... . Urea poisoning in sheep is associated with an elevated blood **ammonia** concentration, increased erythrocyte counts and packed cell volume values, and decreased leucocyte counts ... . Detailed clinical biochemical studies on experimental urea poisoned sheep have been reported ... . The blood **ammonia** concentration of the fetus in fatally poisoned sheep is lower than that of the dam at death, and the **ammonia** concentrations in their livers, kidneys, spleen and muscles are similarly different.

Humphreys, D.J. Veterinary Toxicology. 3rd ed. London, England: Bailliere Tindell, 1988., p. 17

from HSDB

On rabbit eyes saturated urea solution causes loss of epithelium from the cornea after five minutes contact, and produces moderate grayness of the stroma, with subsequent slow regeneration of the epithelium. A rabbit's cornea can return to normal in several weeks after exposure for an hour to 40% urea solution.

Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 965

from HSDB

Intravenous urea in monkeys has not damaged the ciliary epithelium, supporting a belief that reduction of intraocular pressure in glaucomatous patients is accomplished by an osmotic, rather than a toxic mechanism. However, intracarotid injection of concentrated urea in monkeys has done dramatic damage to the retina and the ciliary body. **Retinal** pigment epithelial cells are affected and blood-retina barrier broken down. The blood-aqueous barrier is broken down secondary to changes in the capillaries and selective damage to the ciliary body epithelium. Intraocular pressure is strikingly reduced and the aqueous outflow system rapidly shows swelling of the connective tissue of the inner wall of Schlemm's canal, and then edema of the trabecular meshwork. However, in several weeks there is general return to normal, except for failure of pigmented ciliary epithelium to regenerate.

Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 965

from HSDB

Accidental urea intoxication resulted in the death of 17 of 29 suckler cows within six hours after the contamination of their drinking **water** with urea fertiliser. The other cows showed no lasting ill effects and neither their three-month-old calves nor the stock bull were affected. The urea concentration in the **water** was 86 mmol/litre, and the concentrations of **ammonia nitrogen** in the rumen fluid of two of the cows which were examined after death were 1825 and 957 mg/litre.

Caldow GL, Wain EB; Vet Rec 128 (21): 489-91 (1991)

PMID:1651027

from HSDB

14.1.12 Non-Human Toxicity Values

LD100 Sheep 500 mg/l; mean survival time: 165 minutes

Edjtehad; M et al; Canadian J Comp Med 64 (1): 63-68 (1978) as cited in Environment Canada; Tech Info for Problem Spills: Urea p.46 (1985)

from HSDB

LD50 Sheep acute oral 28.5 g/100 kg

Booth, N.H., L.E. McDonald (eds.). Veterinary Pharmacology and Therapeutics. 5th ed. Ames, Iowa: Iowa State University Press, 1982., p. 1029

from HSDB

LD50 Rat oral 8471 mg/kg

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

from HSDB

LD50 Rat subcutaneous 8200 mg/kg

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

from HSDB

LD50 Rat iv 5300 mg/kg

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

from HSDB

LD50 Mouse subcutaneous 9200 mg/kg

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

from HSDB

LD50 Mouse iv 4600 mg/kg

Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van Nostrand Reinhold, 1996., p. 3352

from HSDB

14.1.13 Ecotoxicity Values

Toxicity threshold: Scenedesmus quadricauda (green algae) >10,000 mg/l, toxic effect: multiplication inhibition of cell. /Time not specified/

Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p. 1179

from HSDB

Toxicity threshold: Entosiphon sulcatum (protozoa) >29 mg/l, toxic effect: inhibition of cell multiplication. /Time not specified/

Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p. 1179

from HSDB

Toxicity threshold: Pseudomonas putida >10,000 mg/l; toxic effect: inhibition of cell multiplication. /Time not specified/

Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p. 1178

from HSDB

14.2 Ecological Information

14.2.1 Environmental Fate/Exposure Summary

Urea's production and use as a fertilizer and animal feed is expected to result in its direct release to the environment. Urea's production and use as a chemical intermediate, stabilizer in explosives, medicine, and viscosity modifier, and in plastics, adhesives, pharmaceuticals, cosmetics, dentifrices, flameproofing agents, and preparation of **biuret** may result in its release to the environment through various waste streams. Urea is a natural product of **nitrogen** and protein metabolism; and it is found in urine and animal waste. If released to air, a vapor pressure of 1.20X10-5 mm Hg at 25 deg C indicates urea will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase urea will be degraded in the atmosphere by reaction with photochemically-produced **hydroxyl** radicals; the half-life for this reaction in air is estimated to be 9.6 hrs. Particulate-phase urea will be removed from the atmosphere by wet and dry deposition. If released to soil, urea is expected to have very high mobility based upon a Koc of 8. Volatilization from moist soil surfaces is not expected to be an important fate process based upon an estimated Henry's Law constant of 1.74X10-12 atm-cu m/mole. If released into **water**, urea is not expected to adsorb to suspended solids and sediment based upon its Koc. Biodegradation is expected to be the major fate process in the aquatic ecosystem. Various screening studies have demonstrated that urea can biodegrade readily with the release of **carbon dioxide** and **ammonia**. In a river die-away testconducted at 5 deg C, 1.05-2.20% of added urea hydrolyzed after 10-days while only 0.35% hydrolyzed in sterile controls. Urea was completely biodegraded in aerobic biodegradation studies using activated sludge and a 14-day incubation period. Volatilization from **water** surfaces is not expected to be an important fate process based upon this compound's estimated Henry's Law constant. BCF values of 1 and <10 suggest bioconcentration in aquatic organisms is low. Chemical hydrolysis is catalyzed by increasing temperatures, alkalinity, and especially the presence of the biological enzyme, urease. Occupational exposure to urea may occur through inhalation and dermal contact with this compound at workplaces where urea is produced or used. Monitoring data indicate that the general population may be exposed to urea via ingestion of food and drinking water, and dermal contact with this compound and other products containing urea. (SRC)

from HSDB

14.2.2 Natural Pollution Sources

Urea is a natural product of **nitrogen** and protein metabolism(1,2); it also occurs in urine(3) and animal waste(2).

(1) Budavari S, ed; The Merck Index. 12th ed. Whitehouse Station, NJ: Merck and Co Inc p. 1863 (1996) (2) Brockett OD; Water Res 11: 317-21 (1977) (3) Verschueren K; Handbook of Environmental Data on Organic Chemicals. 3rd ed NY, NY: Van Nostrand Reinhold p. 1875 (1996)

from HSDB

14.2.3 Artificial Pollution Sources

Urea's production and wide use as a fertilizer and animal feed(1,2) is expected to result in its direct release to the environment(SRC). Urea's production and use as a chemical intermediate, stabilizer in explosives, medicine (diuretic), and viscosity modifier (for **starch** or casein-based paper coatings), and use in plastics, adhesives, pharmaceuticals, cosmetics, dentifrices, flameproofing agents, and preparation of **biuret**(3) may result in its release to the environment through various waste streams(SRC).

(1) Farm Chemicals Handbook 2000. Willoughby, OH: Meister p. B 40 (2000) (2) Cornell SE et al; Atmos Environ 32: 1903-10 (1998) (3) Lewis RJ Sr, ed; Hawley's Cond Chem Dict 13th ed. NY, NY: John Wiley and Sons Inc p. 1157 (1997)

from HSDB

14.2.4 Environmental Fate

TERRESTRIAL FATE: Based on a classification scheme(1), a Koc value of 8(2) indicates that urea is expected to have very high mobility in soil(SRC). Volatilization of urea from moist soil surfaces is not expected to be an important fate process(3) given an estimated Henry's Law constant of 1.74X10-12 atm-cu m/mole(SRC) determined from its vapor pressure, 1.20X10-5 mm Hg(4), and water solubility, 5.45x10+5 mg/l(5). Urea is not expected to volatilize from dry soil surfaces(SRC) based upon its vapor pressure(4). Various field and laboratory studies have demonstrated that urea degrades rapidly in most soils(6-8). Urea is rapidly hydrolyzed to ammonium ions through soil urease activity(6) which produces volatile gases, i.e., ammonia and carbon dioxide(9). In a variety of soils, the hydrolysis may near completion within 24 hrs(7). However, the rate of hydrolysis can be much slower depending upon the soil type, moisture content, and urea formulation(6). For example, increasing the pellet size of urea fertilizers can decrease the rate of urea decomposition from days to weeks(6). In a study examining the fate of soil-applied urea, a major part (e.g., 22-49%) of the applied urea was lost in gaseous form (e.g., ammonia or N2O)(10). Although soil adsorption studies have demonstrated that urea adsorbs very weakly to soil(11); only a minor part was leached out of soil (<1%) in this study(10). Roughly one third (eg, 26-43%), however, was incorporated into soil organic matter(10).

(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Hance RJ; Weed Res 5: 98-107 (1965) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9 (1990) (4) Jones AH; J Chem Eng Data 5: 196-200 (1960) (5) Yalkowsky SH; Arizona Database of Aqueous Solubilities. Univ of AZ, College of Pharmacy (1989) (6) Malhi SS, Nyborg M; Plant Soil 51: 177-86 (1979) (7) Sankhayan SD, Shukla UC; Geoderma 16: 171-8 (1976) (8) Scheunert I et al; Chemosphere 16: 1031-41 (1987) (9) Mavrovic I et al; Kirk-Othmer Encycl Chem Technol 4th ed. NY, NY: John Wiley and Sons Inc Supp: 597 (1998) (10) Sotiriou N, Scheunert I; Chemosphere 28: 333-340 (1994) (11) Hance RJ; Weed Res 5: 98-107 (1965)

from HSDB

AQUATIC FATE: Based on a classification scheme(1), a Koc value of 8(2), indicates that urea is not expected to adsorb to suspended solids and sediment(SRC). Volatilization from water surfaces is not expected(3) based upon an estimated Henry's Law constant of 1.74X10-12 atm-cu m/mole(SRC) determined from its vapor pressure, 1.20X10-5 mm Hg(4), and water solubility, 5.45X10+5 mg/l(5). According to a classification scheme(6), BCF values of 1(7) and <10(8) suggest the potential for bioconcentration in aquatic organisms is low(SRC). Urea is rapidly hydrolyzed to ammonia and carbon dioxide in environmental systems by the extracellular enzyme, urease, which originates from microorganisms and plant roots(9). The degradation of urea was examined in a river die-away study using various river waters and test conditions(10). At 20 deg C, degradation of urea was complete within 6-14 days of incubation, while at lower temperatures (e.g., 4-12 deg C) little or no degradation occurred in 10-14 days(10). Abiotic hydrolysis of urea occurs very slowly in relation to biotic hydrolysis(11).

(1) Swann RL et al; Res Rev 85: 17-28 (1983) (2) Hance RJ; Weed Res 5: 98-107 (1965) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 4-9, 15-1 to 15-29 (1990) (4) Jones AH; J Chem Eng Data 5: 196-200 (1960) (5) Yalkowsky SH; Arizona Database of Aqueous Solubilities. Univ of AZ, College of Pharmacy (1989) (6) Franke C et al; Chemosphere 29: 1501-14 (1994) (7) Gluth G et al; Comp Biochem Physiol 81C: 273-7 (1985) (8) Freitag D et al; Chemosphere 14: 1589-616 (1985) (9) Swensen B, Singh BR; J Environ Qual 26: 1516-23 (1997) (10) Evans WH et al; Water Res 7: 975-85 (1973) (11) Stiff MJ, Gardiner DK; Water Treat Exam 22: 259-68 (1973)

from HSDB

ATMOSPHERIC FATE: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere(1), urea, which has a vapor pressure of 1.2X10-5 mm Hg at 25 deg C(2), will exist in both the vapor and particulate phases in the ambient atmosphere(SRC). Vapor-phase urea is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals(SRC); the half-life for this reaction in air is estimated to be 9.6 days(SRC), calculated from its rate constant of 4.00X10-11 cu cm/molecule-sec at 25 deg C(3). Particulate-phase urea may be removed from the air by wet and dry deposition(SRC).

(1) Bidleman TF; Environ Sci Technol 22: 361-367 (1988) (2) Jones AH; J Chem Eng Data 5: 196-200 (1960) (3) Atkinson R; Environ Toxicol Chem 7: 435-42 (1988)

from HSDB

14.2.5 Environmental Biodegradation

AEROBIC: Urea is rapidly hydrolyzed to ammonia and carbon dioxide in environmental systems by the extracellular enzyme, urease, which originates from microorganisms and plant roots(1). The degradation of urea was examined in a river die-away study using various river waters and test conditions(2). At 20 deg C, degradation was complete within 6-14 days of incubation while at lower temperatures (e.g., 4-12 deg C), little or no degradation occurred in 10-14 days in some waters(2). Below 8 deg C (simulating winter conditions), a maximum daily degradation of 3-6% was observed during the first 7 days of incubation(2). Depending upon the source of the water, degradation under aerobic conditions varied from slightly faster to more than twice as fast as compared to anaerobic conditions(2). In a river die-away, 1.05-2.20% of added urea hydrolyzed after 10-days while only 0.35% hydrolyzed in sterile controls(3). Urea was completely biodegraded in aerobic biodegradation studies using activated sludge inoculum and a 14-day incubation period(4). In degradation studies using estuary and coastal waters from Georgia, avg urea degradation rates of 6.2 to 19.6 nmoles/l hr were observed(5); phytoplankton was responsible for urea decomposition in these waters(5). Using an activated sludge seed, 85.9% of the theoretical carbon dioxide production was measured from urea biodegradation over a 5-day incubation period(6). In another study, 66% of urea at initial concn of approx 0.1 mg/l biodegraded in a soil-water suspension at 35 deg C after 5 days(7). In 4-day carbon dioxide evolution tests using waters collected from three regions of the Pacific Ocean, gas evolution was observed to be much faster in sunlight than in dark controls (e.g., ratio of light to light+dark was 61.6-86.4%)(8); the reason for the accelerated rate in sunlight is that urea is actively decomposed by photosynthesis of phytoplankton that occurs in seawater(8).

(1) Swensen B, Singh BR; J Environ Qual 26: 1516-23 (1997) (2) Evans WH et al; Water Res 7: 975-85 (1973) (3) Atkinson R; Water Treat Exam 20: 193-203 (1971) (4) Ebisuno T et al; Seitai Kagaku 7: 27-34 (1984) (5) Remsen CC; Ecology 53: 921-6 (1972) (6) Freitag D et al; Chemosphere 14: 1589-616 (1985) (7) Scheunert I et al; Chemosphere 16: 1031-41 (1987) (8) Mitamura O, Saijo Y; Marine Biology 58: 147-152

(1980)

▸ from HSDB

ANAEROBIC: Under anaerobic conditions, 70% of the initial concn (0.1 mg/l) of urea biodegraded in a soil-water suspension at 35 deg C after 5 days; 18% of initial concn urea remained in water after this 5 days period(1).

(1) Scheunert I et al; Chemosphere 16: 1031-41 (1987)

▸ from HSDB

14.2.6 Environmental Abiotic Degradation

The rate constant for the vapor-phase reaction of urea with photochemically produced hydroxyl radicals has been estimated to be 4.00X10-11 cu cm/molecule-sec at 25 deg C(1) which corresponds to an atmospheric half-life of about 9.6 hr at an atmospheric concn of 5X10+5 hydroxyl radicals per cu cm(SRC). The rate constant for the reaction between photochemically produced hydroxyl radicals in water and urea is reported to be 7.9X10+5 l/mole-sec(2). Assuming the conc of hydroxyl radicals in brightly sunlit natural water is 1X10-17 mole/l(3), the half-life would be in excess of 3000 yrs for continuous (24 hr/day) sunlight conditions(SRC). In one photodegradation study using a silica gel adsorbent(4), only 0.2% of applied urea photomineralized after 17-hrs of irradiation with a UV lamp (>290 nm). In the absence of microorganisms, urea hydrolyzes very slowly to yield ammonium carbamate which will decompose to form ammonia and carbon dioxide(5). Hydrolysis of urea is catalyzed by increasing temperatures, alkalinity, and especially the presence of the biological enzyme, urease(6). In chemical hydrolysis studies where urease was artificially added to aqueous urea solutions, 20 to 50% of initial urea hydrolyzed in 3 hr at respective temperatures of 2 to 10 deg C(6); at 0 deg C (with added urease), hydrolysis ranged from 25 to 100% after 24 hr at respective pHs of 6.4 to 8.4(6). At 5 deg C in demineralized/distilled water, only 0.35% of added urea chemically hydrolyzed during a 10-day test period(7).

(1) Atkinson R; Environ Toxicol Chem 7: 435-42 (1988) (2) Buxton GV et al; J Phys Chem Ref Data 17: 727 (1988) (3) Mill T et al; Sci 207: 886-7 (1980) (4) Freitag D et al; Chemosphere 14: 1589-616 (1985) (5) Mavrovic I et al; Kirk-Othmer Encycl Chem Technol 4th ed. NY: John Wiley and Sons Inc Supp: 597 (1998) (6) Stiff MJ, Gardiner DK; Water Treat Exam 22: 259-68 (1973) (7) Atkinson R; Water Treat Exam 20: 193-203 (1971)

▸ from HSDB

14.2.7 Environmental Bioconcentration

In a 6 to 72 hr bioaccumulation study using carp (Cyprinus carpio), the concn of urea was found to be equally distributed between tissue and water during all time periods(1); thus, the BCF would be 1 for this species(SRC). In 3-day static-system tests using golden ide fish (Leuciscus idus melanotus), the BCF of urea was <10(2). According to a classification scheme(3), these BCF values suggest the potential for bioconcentration in aquatic organisms is low(SRC).

(1) Gluth G et al; Comp Biochem Physiol 81C: 273-7 (1985) (2) Freitag D et al; Chemosphere 14: 1589-616 (1985) (3) Franke C et al; Chemosphere 29: 1501-14 (1994)

▸ from HSDB

14.2.8 Soil Adsorption/Mobility

Soil Adsorption Coefficient

1.41 L/kg

▸ from EPA DSSTox

The adsorption of urea was measured in six different British soils with organic carbon contents ranging from 1.76 to 36.5%(1). No adsorption was measurable in five of the soils(1). In a sixth soil (36.5% organic carbon), a Koc of 8 can be determined from the Freundlich isotherm(SRC). According to a classification scheme(2), this Koc value suggests that urea is expected to have high mobility in soil. However, it has been reported that urea can adsorb to humic acids by free-radical complexation(3). Complexed urea may adsorb to soil more strongly than uncomplexed urea(SRC).

(1) Hance RJ; Weed Res 5: 98-107 (1965) (2) Swann RL et al; Res Rev 85: 23 (1983) (3) Choudhry GG; Toxicol Environ Chem 6: 127-71 (1983)

▸ from HSDB

14.2.9 Volatilization from Water/Soil

The Henry's Law constant for urea is estimated as 1.74X10-12 atm-cu m/mole(SRC) based upon its vapor pressure, 1.20X10-5 mm Hg(1), and water solubility, 5.45X10+5 mg/l(2). This Henry's Law constant indicates that urea is expected to be essentially nonvolatile from moist soil and water surfaces(3). Urea is not expected to volatilize from dry soil surfaces(SRC) based upon its vapor pressure(1). However, urea is rapidly hydrolyzed by soil urease to form ammonium ions which may volatilize as ammonia(4).

(1) Jones AH; J Chem Eng Data 5: 196-200 (1960) (2) Yalkowsky SH; Arizona Database of Aqueous Solubilities. Univ of AZ, College of Pharmacy (1989) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. Washington, DC: Amer Chem Soc pp. 15-1 to 15-29 (1990) (4) Martens DA, Bremner JM; Pestic Sci 49: 344-352 (1997)

from HSDB

14.2.10 Environmental Water Concentrations

SURFACE WATER: Urea concns in surface waters off the continental shelf between Panama and Callao, Peru varied from 0.54-5.00 ug/l(1); along the continental shelf of the northeast US between Cape Cod and Cape May, urea concn varied from a low of 0.25 ug/l (in a deep water sample) to a high of 11.20 ug/l in New York Harbor(1). In monitoring conducted in Mar 1971, urea concns ranged from 36 to 535 ug/l in the Savannah-Wilmington-Ogeechee estuaries and adjacent coastal waters in Georgia(2). The following urea concns were detected in water samples collected from three regions of the Pacific Ocean(3): 0.85-1.43 ug/l (Sagami Bay, Japan), 0.19-0.51 ug/l (northwestern Pacific central waters), and 0.17-0.40 ug/l (subarctic Pacific waters).

(1) Remsen CC; Limnol Oceanogr 16: 732-40 (1971) (2) Remsen CC; Ecology 53: 921-6 (1972) (3) Mitamura O, Saijo Y; Marine Biology 58: 147-152 (1980)

from HSDB

RAIN: The mean concn of urea in rainwater samples from Papeete (Tahiti) and Norwich (England) were 3.1 (range, 1.0-7.5) and 3.7 (below detection limit-8.8) umol/l nitrogen as urea, respectively(1).

(1) Cornell SE et al; Atmos Environ 32: 1903-10 (1998)

from HSDB

14.2.11 Effluent Concentrations

Domestic sewage and sewer effluent contained 2-6 mg/l urea and 0.020 mg/l urea, respectively(1). A primary domestic sewage plant effluent contained 0.016-0.043 mg/l urea(1). Nitrogen fluxes to the atmosphere as a direct consequence of the use of urea in agriculture are estimated at 5-10X10+9 g nitrogen(2); ammonia emissions account for 10-20% loss of urea nitrogen applied to soil while nitrous oxide and NOx emissions account for 0.11% and approximately 1%, respectively, of atmospheric fluxes(2).

(1) Verschueren K; Handbook of Environmental Data on Organic Chemicals. 3rd ed. NY, NY: Van Nostrand Reinhold Co p. 1876 (1996) (2) Cornell SE et al; Atmos Environ 32: 1903-10 (1998)

from HSDB

14.2.12 Probable Routes of Human Exposure

NIOSH (NOES Survey 1981-1983) has statistically estimated that 783,504 workers (326,824 of these are female) are potentially exposed to urea in the US(1). The NOES Survey does not include farm workers(SRC). Occupational exposure to urea may occur through inhalation and dermal contact with this compound at workplaces where urea is produced or used(SRC), especially to workers applying urea fertilizers(2). Monitoring data indicate that the general population may be exposed to urea via ingestion of food and drinking water, and dermal contact with this compound and other products containing urea(SRC).

(1) NIOSH; National Occupational Exposure Survey (NOES) (1983) (2) Parmeggiani L; Encyl Occup Health Saf 3rd ed. Geneva, Switzerland: International Labour Office p. 846-8 (1983)

from HSDB

15 Literature

15.1 Depositor Provided PubMed Citations

from PubChem

15.2 NLM Curated PubMed Citations

from PubChem

15.3 Synthesis References

Ryo Yoshida, Haruhiko Katoh, Seizo Sumida, Ichiki Takemoto, Junya Takahashi, Katsuzo Kamoshita, "Urea derivatives, and their production and use." U.S. Patent US4334912, issued 0000.

from DrugBank

Leuthardt, F.; Glasson, B. Biological synthesis of urea. Verhandl. Ver. schweiz. Physiol. (1942), 21 25-7.

from Human Metabolome Database (HMDB)

15.4 Metabolite References

from Human Metabolome Database (HMDB)

15.5 Springer Nature References

from Springer Nature

15.6 Thieme References

from Thieme Chemistry

15.7 Chemical Co-Occurrences in Literature

from PubChem

15.8 Chemical-Disease Co-Occurrences in Literature

from PubChem

15.9 Chemical-Gene Co-Occurrences in Literature

from PubChem

16 Patents

16.1 Depositor-Supplied Patent Identifiers

from PubChem

17 Biomolecular Interactions and Pathways

17.1 Protein Bound 3-D Structures

from PDB

View 71 proteins in NCBI Structure

from PubChem

17.2 Biosystems and Pathways

from PubChem

17.3 DrugBank Interactions

Showing 1 of 8 View More

Target	Arginase-1
PubChem Protein Target	P05089
PubChem Gene Target	ARG1
General Function	Manganese ion binding
Interaction References	1. Overington JP, Al-Lazikani B, Hopkins AL: How many drug targets are there? Nat Rev Drug Discov. 2006 Dec;5(12):993-6. [PMID: 17139284] 2. Imming P, Sinning C, Meyer A: Drugs, their targets and the nature and number of drug targets. Nat Rev Drug Discov. 2006 Oct;5(10):821-34. [PMID: 17016423] 3. Berman HM, Westbrook J, Feng Z, Gilliland G, Bhat TN, Weissig H, Shindyalov IN, Bourne PE: The Protein Data Bank. Nucleic Acids Res. 2000 Jan 1;28(1):235-42. [PMID: 10592235]

from DrugBank

18 Biological Test Results

18.1 BioAssay Results

from PubChem

19 Classification

19.1 Ontologies

19.1.1 MeSH Tree

from MeSH

19.1.2 ChEBI Ontology

from ChEBI

19.1.3 KEGG: Drug

from KEGG

19.1.4 KEGG: ATC

from KEGG

19.1.5 KEGG: JP15

from KEGG

19.1.6 KEGG: Risk Category of Japanese OTC Drugs

from KEGG

19.1.7 KEGG: OTC drugs

from KEGG

19.1.8 KEGG: Additive

from KEGG

19.1.9 WHO ATC Classification System

from WHO ATC

19.1.10 WIPO IPC

from WIPO

19.1.11 EPA Safer Choice

from EPA Safer Choice

19.1.12 ChemIDplus

from ChemIDplus

19.1.13 CAMEO Chemicals

from CAMEO Chemicals

19.1.14 Guide to PHARMACOLOGY Target Classification

from IUPHAR/BPS Guide to PHARMACOLOGY

19.1.15 ChEMBL Target Tree

from ChEMBL

19.1.16 Household Products Database Tree

from NLM Household Products Database

19.1.17 UN GHS Classification

from UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

19.1.18 EPA CPDat Classification

from EPA Chemical and Products Database (CPDat)

20 Information Sources

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1. **CAMEO Chemicals**
   UREA
   https://cameochemicals.noaa.gov/chemical/9165
   CAMEO Chemical Reactivity Classification
   https://cameochemicals.noaa.gov/browse/react
2. **ILO International Chemical Safety Cards (ICSC)**
   UREA
   http://www.ilo.org/dyn/icsc/showcard.display?p_version=2&p_card_id=0595
3. **HSDB**
   UREA
   https://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@rn+@rel+57-13-6
4. **DrugBank**
   Urea
   http://www.drugbank.ca/drugs/DB03904
   http://www.drugbank.ca/drugs/DB03904#targets
   http://www.drugbank.ca/drugs/DB03904#transporters
5. **EPA DSSTox**
   Urea
   https://comptox.epa.gov/dashboard/DTXSID4021426
6. **EU Food Improvement Agents**
   CARBAMIDE
   http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32012R0231
7. **Human Metabolome Database (HMDB)**
   Urea
   http://www.hmdb.ca/metabolites/HMDB0000294
8. **Sanford-Burnham Center for Chemical Genomics**
   SID49640652
   https://pubchem.ncbi.nlm.nih.gov/bioassay/1996#section=Data-Table
9. **ChEBI**
   Urea
   http://www.ebi.ac.uk/chebi/searchId.do?chebiId=CHEBI:16199
   ChEBI Ontology
   http://www.ebi.ac.uk/chebi/userManualForward.do#ChEBI%20Ontology
10. **NCIt**
    Urea
    https://ncit.nci.nih.gov/ncitbrowser/ConceptReport.jsp?dictionary=NCI_Thesaurus&ns=NCI_Thesaurus&code=C29531
11. **ChemIDplus**
    Urea [USP:JAN]
    https://chem.nlm.nih.gov/chemidplus/sid/0000057136
    Isourea
    https://chem.nlm.nih.gov/chemidplus/sid/0004744369
    Polyurea
    https://chem.nlm.nih.gov/chemidplus/sid/0037955365
    ChemIDplus Chemical Information Classification
    https://chem.sis.nlm.nih.gov/chemidplus/
12. **DTP/NCI**
    urea
    https://dtp.cancer.gov/dtpstandard/servlet/dwindex?searchtype=NSC&outputformat=html&searchlist=757375

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https://echa.europa.eu/substance-information/-/substanceinfo/100.000.286

Urea
https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/10451

15. ## The National Institute for Occupational Safety and Health (NIOSH)

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https://www.cdc.gov/niosh-rtecs/YR5F5E10.html

16. ## ClinicalTrials.gov

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https://clinicaltrials.gov/

17. ## DailyMed

UREA
https://dailymed.nlm.nih.gov/dailymed/search.cfm?labeltype=all&query=UREA

18. ## EPA Chemical and Products Database (CPDat)

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> https://www.epa.gov/privacy/privacy-act-laws-policies-and-resources

urea
https://comptox.epa.gov/dashboard/DTXSID4021426#exposure

EPA CPDat Classification
https://www.epa.gov/chemical-research/chemical-and-products-database-cpdat

19. ## EPA Safer Choice

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https://www.epa.gov/saferchoice/safer-ingredients

EPA Safer Chemical Ingredients Classification
https://www.epa.gov/saferchoice

20. ## EU Pesticides Database

Urea
http://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.detail&language=EN&selectedID=2003

21. ## FAO/WHO Food Additive Evaluations (JECFA)

CARBAMIDE
http://apps.who.int/food-additives-contaminants-jecfa-database/chemical.aspx?chemID=2177

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23. EU Clinical Trials Register
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27. FDA/SPL Indexing Data
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29. MassBank of North America (MoNA)
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https://spectrabase.com/spectrum/L3x3Z0sHasU
https://spectrabase.com/spectrum/74MTLi3qKe4
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https://spectrabase.com/spectrum/KibvfyCnWEY
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https://www.ccdc.cam.ac.uk/structures/Search?Ccdcid=239749
https://www.ccdc.cam.ac.uk/structures/Search?Ccdcid=731958

37. Thieme Chemistry

38. **WHO ATC**
https://www.whocc.no/atc/
ATC Code
https://www.whocc.no/atc_ddd_index/

39. **MeSH**
Urea
https://www.ncbi.nlm.nih.gov/mesh/68014508
MeSH Tree
http://www.nlm.nih.gov/mesh/meshhome.html

40. **PubChem**
https://pubchem.ncbi.nlm.nih.gov

41. **KEGG**
Therapeutic category of drugs in Japan
http://www.genome.jp/kegg-bin/get_htext?br08301.keg
Anatomical Therapeutic Chemical (ATC) classification
http://www.genome.jp/kegg-bin/get_htext?br08303.keg
Drugs listed in the Japanese Pharmacopoeia
http://www.genome.jp/kegg-bin/get_htext?br08311.keg
Risk category of Japanese OTC drugs
http://www.genome.jp/kegg-bin/get_htext?br08312.keg
Classification of Japanese OTC drugs
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Pharmaceutical additives in Japan
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42. **WIPO**
International Patent Classification
http://www.wipo.int/classifications/ipc/

43. **UN Globally Harmonized System of Classification and Labelling of Chemicals (GHS)**
GHS Classification Tree
http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

44. **ChEMBL**
Target Tree
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