

# Product Stewardship Summary

## *N-vinyl caprolactam*

### General Statement

N-vinyl caprolactam is a pale yellow crystalline solid stabilized with N,N'-di-sec-butyl p-phenylenediamine. N-vinyl caprolactam is a versatile reactive diluent for free radical radiation curable coatings, inks, and adhesives which are used on a wide variety of substrates such as flooring, paper, plastics and more. N-vinyl caprolactam is a moderate hazard material and risk of adverse health effects associated with both occupational and consumer use of this chemical is anticipated to be low.

### Chemical Identity

Name: N-vinyl caprolactam

Brand Names: V-Cap™ INHIBITOR

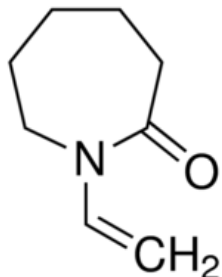
Chemical name (IUPAC): 1-Ethenylhexahydro-2H-azepin-2-one

CAS number(s): 2235-00-9

EC number: 218-787-6

Molecular formula: C<sub>8</sub>H<sub>13</sub>NO

Structure:



### Uses and Applications

N-Vinyl caprolactam serves as a diluent when coating plastics, as it softens the surface thereby aiding adhesion of the cured film. The monomer N-Vinyl caprolactam provides fast curing and low viscosity and is relatively safe in radiation curable ink. Commercial uses of this chemical have also been reported to include use as a kinetic inhibitor for natural gas hydrates when integrated as a polymer.



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## Physical/Chemical Properties

### Phys/Chem Safety Assessment

Property	Value
Form	Crystalline
Physical state	Liquid
Color	Light Yellow
Odor	Characteristic
Density	1.2184 g/cm <sup>3</sup> @ 20°C
Melting / boiling point	30°C / 250.4°C
Flammability	Does not sustain combustion
Explosive properties	Not explosive
Self-ignition temperature	No data available
Vapor pressure	~0.001165 kPa @ 25°C
Mol weight	139 g/mol
Water solubility	49.3 g/L @ 20°C, readily soluble
Flash point	112.5°C
Octanol-water partition coefficient (LogK <sub>ow</sub> )	1.24 @ 25°C

## Exposure, Hazard and Safety Assessment

The following section describes possible exposures scenarios and hazards associated with N-vinyl caprolactam. The exposure assessment describes both the amount of and the frequency with which a chemical substance reaches a person, a population of people, or the environment. Hazard refers to the inherent properties of a substance that make it capable of causing harm to human health or the environment. The safety assessment reports the possibility of a harmful event arising from exposure to a chemical or physical agent under specific conditions. Just because a substance may possess potentially harmful properties does not mean that it automatically poses a risk. It is not possible to make that determination without understanding the exposure.

### Human Health Effects

#### Human Exposure Assessment

**Consumer:** N-vinyl caprolactam is used as a reactive diluent for UV-coatings, -inks and -adhesives as well as a building block for synthesis of paper coatings. Therefore, consumer exposure is most likely limited to the extremely low levels of residual monomer present within consumer polymer products. Consumer exposure could occur through the use of products that contain significant levels of liquid monomer (not manufactured by Ashland).

**Worker:** In industrial settings, N-vinyl caprolactam is manufactured and handled in closed processes as much as possible, which ensures that worker exposure to n-vinyl caprolactam is minimized. When there is potential for exposure, during loading, unloading, sampling or during maintenance operations, exposure to n-vinyl caprolactam can be further minimized by the proper use of personal protective equipment. N-vinyl caprolactam was introduced as a safer alternative for printing methods, particularly in view of its very low volatility. Therefore, it is highly unlikely that the occupational exposure limits will be exceeded under reasonably foreseeable manufacturing operations

#### Human Hazard Assessment

N-vinyl caprolactam is harmful if swallowed, and causes liver and respiratory damage following repeated exposures. In addition, n-vinyl caprolactam can cause serious eye irritation and may cause allergic skin reactions.

Effect Assessment	Result
Acute Toxicity Oral / inhalation / dermal	Harmful if swallowed
Irritation / corrosion Skin / eye / respiratory test	May cause an allergic skin reaction, Category 1 skin sensitization Causes serious eye irritation
Toxicity after repeated exposure Oral / inhalation / dermal	Causes damage to organs (liver, upper respiratory tract) through prolonged or repeated exposure.
Genotoxicity / Mutagenicity	Neither mutagenic or genotoxic
Carcinogenicity	No carcinogenic effects expected
Toxicity for reproduction	No adverse effect on fertility and development

### Human Health Safety Assessment

**Consumer:** N-vinyl caprolactam is used as a reactive diluent for UV-coatings, -inks and -adhesives as well as a building block for synthesis of paper coatings and will be almost exclusively incorporated into the polymer matrix within consumer products. Therefore, due to the extremely low levels of residual monomer present in consumer products, exposure and subsequent risk is unlikely.

**Worker:** In industrial settings, N-vinyl caprolactam is manufactured and handled primarily in closed processes which limit exposure. Based on good manufacturing processes and industrial hygiene the occupational health risk associated with N-vinyl caprolactam is low.

### Environmental Effects

#### Environmental Exposures

N-vinyl caprolactam is inherently biodegradable and has low potential for bioaccumulation. It is soluble in water and has low potential for volatilization. Based on its physical and chemical properties, if n-vinyl caprolactam was released into the environment, it is expected to partition between water and soil. Volatilization from water surfaces is not expected.

#### Environmental Hazard Assessment

Effect Assessment	Result
Aquatic Toxicity	Not harmful to aquatic organisms

Fate and behavior	Result
Biodegradation	Inherently biodegradable
Bioaccumulation potential	Not potentially bioaccumulative (log Kow = 1.23)
PBT / vPvB conclusion	Not considered to be either PBT or vPvB

#### Environmental Safety Assessment

Based on the available data, n-vinyl caprolactam is not considered harmful to aquatic organisms. It is inherently biodegradable and is not anticipated to bioaccumulate

## Risk Management Recommendations

Exposure to n-vinyl caprolactam in the workplace can be controlled by sufficient ventilation, proper handling and storage techniques, and the use of appropriate personal protective equipment as recommended in the SDS. Consumer products that contain significant levels of the liquid monomer should include necessary safety labeling and provide appropriate handling and disposal methods.

No occupational exposure limit values specific to n-vinyl caprolactam have been developed.

## Regulatory Agency Review

N-vinyl caprolactam is on the following lists:

Australian Inventory of Chemical Substances (AICS)  
China - Chemical Inventory of Existing Chemical Substances (IECSC) - CAS Numbers  
Danish Environmental Protection Agency (DK-EPA) - Advisory List for Self-classification of Dangerous Substances  
ECHA - List of Pre-registered Substances  
Environment Canada - Domestic Substances List (DSL)  
EPA - Chemical Update System (CUS) - 2002  
EPA - TSCA - Inventory  
EU - European Inventory of Existing Commercial Substances (EINECS)  
New Zealand - Inventory of Chemicals (NZIoC)  
OECD - High Production Volume (HPV) Chemicals - 2004  
OECD - High Production Volume (HPV) Chemicals - 2007  
Philippine Inventory of Chemicals and Chemical Substances (PICCS)

## Regulatory Information / Classification and Labeling

Under the Globally Harmonized System for classification and labeling (GHS), substances are classified according to their physical, health, and environmental hazards. The hazards are communicated via specific labels and the (Extended) SDS. GHS attempts to standardize hazard communication so that the intended audience (workers, consumers, transport workers, and emergency responders) can better understand the hazards of the chemicals in use.

### GHS Classification:

Combustible Dust  
Acute toxicity (oral): Category 4  
Acute toxicity (dermal): Category 4  
Skin irritation: Category 2  
Eye Irritation: Category 2A  
Skin sensitization: Category 1  
Specific target organ systemic toxicity – repeated exposure (Inhalation):  
Category 1 (Respiratory Tract, Liver)  
Specific target organ systemic toxicity – repeated exposure (Oral):  
Category 2 (Liver)

### Hazard Statements:

H301: Toxic if swallowed.  
H302: Harmful if swallowed.  
H312: Harmful in contact with skin.  
H314: Causes severe skin burns and eye damage.  
H315: Causes skin irritation.  
H317: May cause an allergic skin reaction.  
H318: Causes serious eye damage.  
H319: Causes serious eye irritation.  
H335: May cause respiratory irritation.

H372: Causes damage to organs through prolonged or repeated exposure if inhaled.  
H373: May cause damage to organs through prolonged or repeated exposure if swallowed.

**Signal Word: Danger**

**Precautionary Statements:**

P260: Do not breathe dust/ fume/ gas/ mist/ vapors/ spray.  
P264: Wash skin thoroughly after handling.  
P270: Do not eat, drink or smoke when using this product.  
P272: Contaminated work clothing must not be allowed out of the workplace.  
P280: Wear eye protection/ face protection.  
P280: Wear protective gloves/ protective clothing.  
P301: IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.  
P302: IF ON SKIN: Wash with plenty of soap and water. Call a POISON CENTER or doctor/ physician if you feel unwell.  
P305: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.  
P314: Get medical advice/ attention if you feel unwell.  
P333: If skin irritation or rash occurs: Get medical advice/ attention.  
P337: If eye irritation persists: Get medical advice/ attention.  
P362: Take off contaminated clothing and wash before reuse.  
P501: Dispose of contents/ container to an approved waste disposal plant.

**Hazard Pictograms:**



**Conclusion**

N-vinyl caprolactam is used as a reactive diluent for UV-coatings, -inks and -adhesives as well as a building block for synthesis of paper coatings. Reactive diluent for UV curing applications, such as printing inks (especially silk screening), vinyl flooring, and wood coating. N-vinyl caprolactam is used as a reactive diluent to accelerate the UV curing rate; its caprolactam ring imparts adhesiveness, hydrophobicity, strength and complexing capability. Its active double bond facilitates its use in free radical homopolymerization, copolymerization and grafting reactions. When handled responsibly, the potential for acute or repeated dose toxicity, skin and eye irritation, and skin sensitization can be minimized, allowing consumers and workers to use materials containing n-vinyl caprolactam safely.

**Contact Information with Company**

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**Date of Issue:** October 17, 2016

**Revision:** 1

## **Additional Information**

For more information on GHS, visit <http://www.osha.gov/dsg/hazcom/ghsguideoct05.pdf> or [http://live.unece.org/trans/danger/publi/ghs/ghs\\_welcome\\_e.html](http://live.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html).

Ashland product stewardship summaries are located at <http://www.ashland.com/sustainability/product/product-stewardship>

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*Inclusion on the New Zealand Inventory of Chemicals applies only to the pure substance listed. The importer of record must determine whether or not their substances are in compliance.*