

# Diallyldimethylammonium Chloride (DADMAC)

 $C_8H_{16}ClN$ 
(liquid) 
 Precursor Chemical


 **Inputs to Manufacturing Process:**  
Dimethylamine      Allyl Chloride

 **% of Total Domestic Consumption  
Attributed to Water Sector:**  
Less than 10%

 **Product Family:**  
Petroleum Byproducts

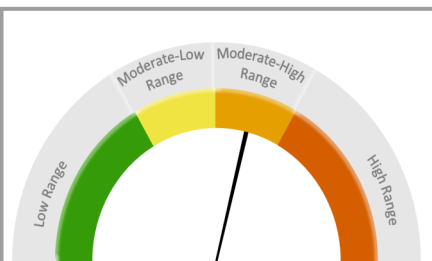
CAS No.: 7398-69-8

 **Derivative Water Treatment Chemicals:**  
polyDADMAC

 [Understanding Chemical Supply Chains](#)
 **Shelf Life:**  
6 Months

## RISK OF SUPPLY DISRUPTION (Assessed in 2022)

RISK RATING: Moderate-High



### RISK DRIVERS

Numerous supply chain challenges include a limited number of domestic manufacturers, a supply chain dependent on production of other, higher value petroleum byproducts, concentration of input manufacturing in an area prone to extreme weather, dependence on imports to meet domestic demand, and previous significant price increases and force majeure in supply to the water sector.

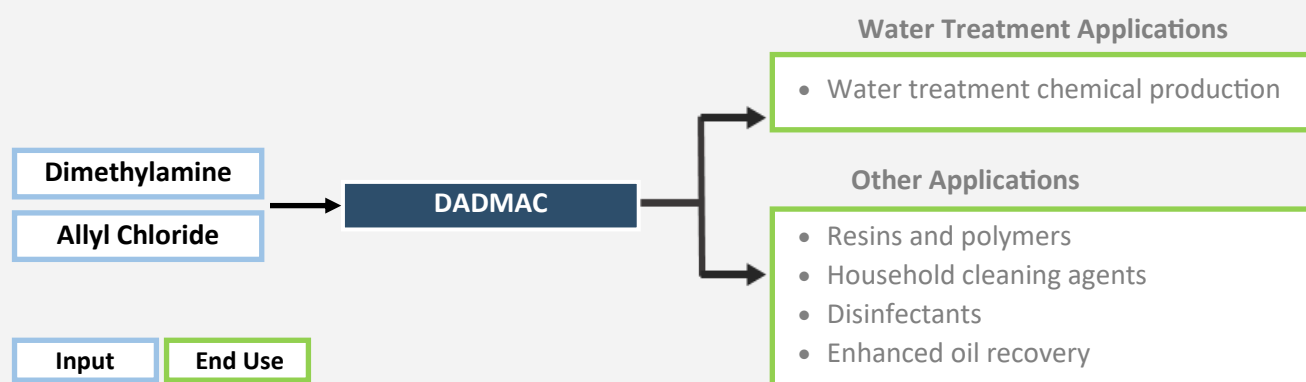
### RISK PARAMETERS

**Criticality:** High. Essential precursor for production of polyDADMAC, used in coagulation and sludge dewatering.

**Likelihood:** Moderate-Low. Previous price increases and force majeure have impacted availability and pricing.

**Vulnerability:** Moderate-High. Manufacturing is limited, high tariff on the most significant source of imports.

## MANUFACTURING PROCESS



## DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

### Domestic Manufacturing Locations (2019):

 3, in Arkansas, Louisiana, Mississippi

### International Trade (2019)

**Primary Trading Partner (Imports):** China

**Primary Trading Partner (Exports):** France

### Domestic Production and Consumption

Total domestic manufacturing of DADMAC reported under the TSCA CDR was approximately 48 M kg in 2019. Significantly, a leading manufacturer did not report production. Due to this data gap and differences in reporting between production and trade data, U.S. consumption of DADMAC could not be estimated.

### Product Description

Diallyldimethylammonium chloride (DADMAC) ( $C_8H_{16}ClN$ ), an organic quaternary ammonium salt, is a widely used intermediate in production of resins and polymers. It is the precursor to a class of polymers (polyDADMAC) used in water treatment. Domestic production is concentrated along the Gulf Coast near the source of inputs, which are reliant on petroleum product processing.

### Use in Water Treatment

None.

### Use as a Precursor to Other Water Treatment Chemicals

DADMAC is the foundational chemical for the family of cationic polymers, PolyDADMACs, which are used in water treatment as coagulants and dewatering agents. Water treatment is a primary use of PolyDADMACs, but not DADMACs.

### Other Applications

DADMAC is an intermediate in the production of resins and polymers. It is used directly in many household chemicals to modify performance as a surfactant. DADMAC is also used in disinfectant formulations as one of several quaternary ammonium compounds recognized for its ability to precipitate or denature microbial proteins. DADMAC is also commonly used in shampoos and laundry products. DADMAC may also be used directly in enhanced oil recovery for clay stabilization, flow control, and other applications (NCBI, 2022a).

### Primary Industrial Consumers

DADMAC is primarily used in resin production. While the percentage of consumption accounted for by water treatment is unknown, it is believed to be less than 10% based on estimates of other uses.

## Manufacturing, Transport, & Storage

### Manufacturing Process

The primary commercial method of DADMAC production relies on the alkylation of dimethylamine with allyl chloride, followed by neutralization with an alkali metal hydroxide. High purity DADMAC is required for production of polyDADMAC acceptable for water treatment. Obtaining high quality allyl chloride is an important step in this process (NCBI, 2022a; Olin, 2016).

Allyl chloride is produced through the chlorination of propylene. Allyl chloride is one of many organic chemical intermediates produced by reacting propylene with other chemicals. It is used widely in preparation of resins and plastics, pesticides, adhesives, dyes, flavorings, pharmaceuticals, and oil production.

Dimethylamine is produced through the methylation of ammonia with methanol (Olin, 2016). Dimethylamine is a chemical intermediate used widely in solvents, pharmaceuticals, surfactants, and rubber. Dimethylamine is also used in the production of antivirals (NCBI, 2022b).

### Product Transport

DADMAC, primarily supplied as a solution, is commonly transported by truck, rail, barge, and ship.

## Storage and Shelf Life

DADMAC is stable under recommended storage conditions, but may polymerize slowly at room temperature. When stored properly, DADMAC can have a shelf life of approximately six months, though stability may depend upon many factors (Derypol, 2021).

## Domestic Production & Consumption

### Domestic Production

Production data was collected from the 2020 Toxic Substances Control Act (TSCA) Chemical Data Reporting (CDR) for the year 2019, while trade data was collected from the U.S. International Trade Commission (USITC) Dataweb, as shown in Table 1. While production data is specific to DADMAC, trade of DADMAC may be characterized by multiple trade categories. The primary category used for trade of DADMAC includes DADMAC as part of a broader trade category of quaternary ammonium salts and hydroxides, ‘not elsewhere specified’ (NES).

**Table 1. DADMAC Production and Trade Data Sources**

Production and Trade Data			
Category	Data Source and Date	Identifier	Description
Domestic Production	2020 TSCA Chemical Data Reporting	CAS No.: 7398-69-8	DADMAC
Imports and Exports	U.S. International Trade Commission	HS Code: 2923.90	Quaternary ammonium salts and hydroxides, NES

Domestic manufacturing of DADMAC reported under the CDR occurred at three facilities located in Arkansas, Louisiana, and Mississippi. Two of three listed domestic manufacturers indicated production volume of DADMAC, approximately 48 M kg in 2019, while the third claimed confidential business information (EPA, 2020). *SNF Holding* reported 85% of the total DADMAC production reported. The majority of domestically produced DADMAC is believed to be used in captive consumption (EPA, 2020).

### Domestic Consumption

Due to differences in reporting for production and trade data, as well as production data not reported under the CDR, U.S. consumption of DADMAC could not be estimated. Reported domestic production of DADMAC represents a small quantity when compared to the import and export volume for the category of quaternary ammonium salts and hydroxides, NES including DADMAC.

## Trade & Tariffs

### Worldwide Trade

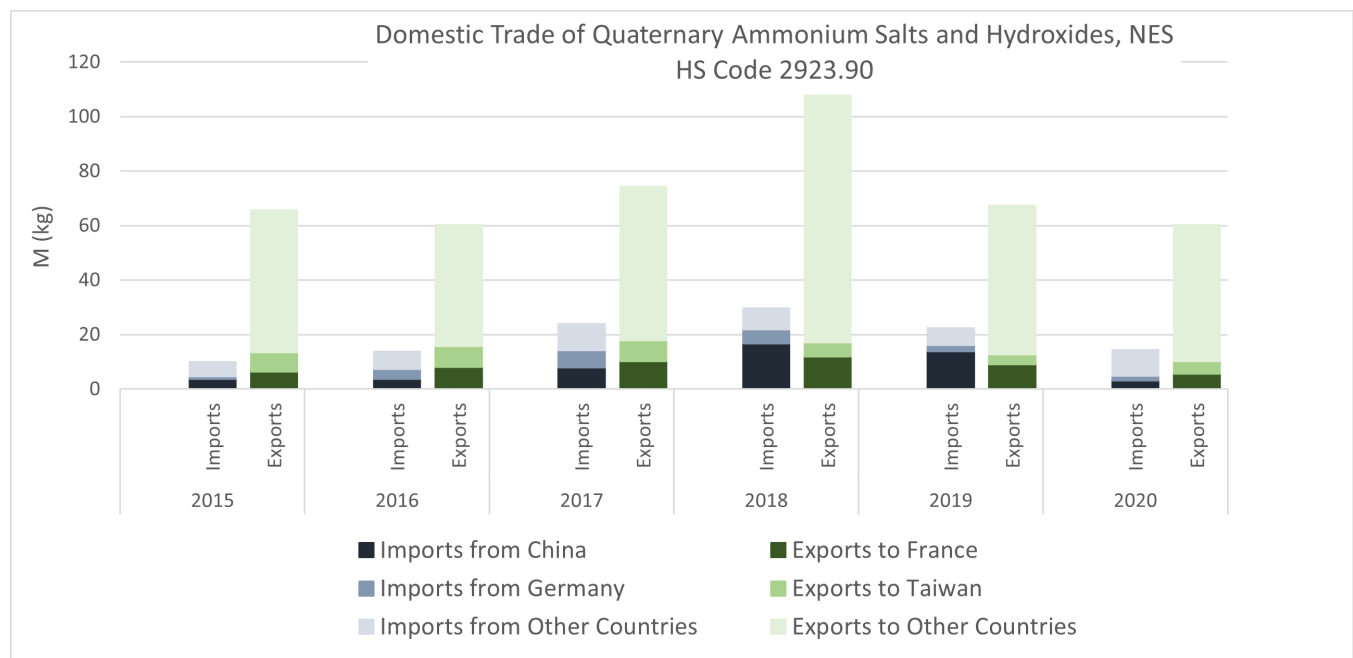
Worldwide import and export data for DADMAC are reported through the World Bank’s World Integrated Trade Solutions (WITS), as a category representing a class of quaternary ammonium salts and hydroxides, NES. In 2021, the U.S. ranked second worldwide in total exports and fourth in quaternary ammonium salts and hydroxides, NES. In 2021, China ranked first worldwide in total exports and Japan ranked first in total imports (WITS, 2022), as shown in Table 2. Import and export data specific to DADMAC is unavailable from the referenced sources.

**Table 2. WITS Worldwide Export and Import of Quaternary Ammonium Salts and Hydroxides, NES, including DADMAC, in 2021**

2021 Worldwide Trade Quaternary Ammonium Salts and Hydroxides, NES (HS Code 2923.90)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
China	108 M kg	Japan	27 M kg
<b>United States</b>	<b>68 M kg</b>	China	25 M kg
Netherlands	35 M kg	Netherlands	21 M kg
Japan	25 M kg	<b>United States</b>	<b>21 M kg</b>
Italy	23 M kg	United Kingdom	16 M kg

### Domestic Imports and Exports

Domestic imports and export data are reported by USITC in a category representing a class of quaternary ammonium salts and hydroxides, NES. Figure 1 summarizes imports for consumption<sup>1</sup> and domestic exports<sup>2</sup> between 2015 and 2020. During this period, the overall quantities of exports and imports varied with a five-year high in 2018. The quantity of domestic exports consistently exceeded imports for consumption. Over this five-year period, France was the primary recipient of domestic exports while China was the primary source of imports (USITC, 2022a).

**Figure 1. USITC Domestic Import and Export of Quaternary Ammonium Salts and Hydroxides, NES, including DADMAC, between 2015 and 2020**

<sup>1</sup> Imports for consumption are a subset of general imports, representing the total amount cleared through customs and entering consumption channels, not anticipated to be reshipped to foreign points, but may include some reexports.

<sup>2</sup> Domestic exports are a subset of total exports, representing export of domestic merchandise which are produced or manufactured in the U.S. and commodities of foreign origin which have been changed in the U.S.

## Tariffs

There is a 6.2% general duty and a 25% additional duty on imports from China (USITC, 2022b), as summarized in Table 3. The additional duty enacted in 2018 may have had an impact on imports from China (see Figure 1)

**Table 3. 2021 Domestic Tariff Schedule for DADMAC**

HS Code	General Duty	Additional Duty - China (Section 301 Tariff List)	Special Duty
2923.90	6.2%	25%	Free (A, AU, BH, CL, CO, D, E, IL, JO, K, KR, MA, OM, P, PA, PE, S, SG) <sup>3</sup>

## Market History & Risk Evaluation

### History of Shortages

There were repeated shortages of a raw ingredient of allyl chloride and propylene, between 2000 and 2020 (Tullo, 2021). Propylene is a byproduct of the petroleum refining process. The majority of domestic petrochemical feedstock for production of allyl chloride and production facilities for allyl chloride are located in proximity to refineries and ports along the U.S. Gulf Coast. Geographic concentration of the feedstock and production has, over the years, resulted in supply bottlenecks. Periodic weather disturbances to manufacturing, including Winter Storm Uri in February 2021 and Hurricane Ida in August 2021, temporarily halted manufacturing at primary domestic propylene manufacturing locations along the Gulf Coast and led to declarations of force majeure. This has resulted in shortages of downstream chemicals.

### Risk Evaluation

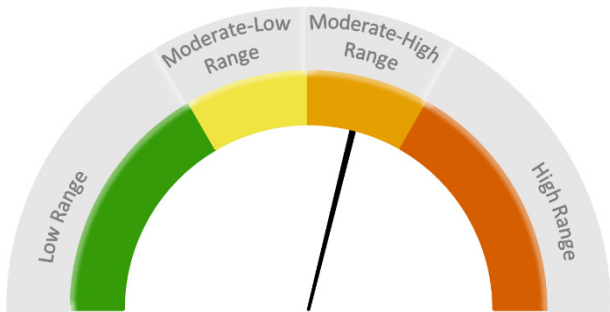
The complete risk evaluation methodology is described in *Understanding Water Treatment Chemical Supply Chains and the Risk of Disruptions* (EPA, 2022). The risk rating is calculated as the product of the following three risk parameters:

Risk = Criticality x Likelihood x Vulnerability	
<b>Criticality</b>	Measure of the importance of a chemical to the water sector
<b>Likelihood</b>	Measure of the probability that the chemical will experience a supply disruption in the future, which is estimated based on past occurrence of supply disruptions
<b>Vulnerability</b>	Measure of the market dynamics that make a chemical market more or less resilient to supply disruptions

The individual parameter rating is based on evaluation of one or more attributes of the chemical or its supply chain. The ratings and drivers for these three risk parameters are shown below in Table 4.

<sup>3</sup> Symbols used to designate the various preference programs and trade agreements. A full list of special trade agreements and associated acronyms can be found at [https://help.cbp.gov/s/article/Article-310?language=en\\_US](https://help.cbp.gov/s/article/Article-310?language=en_US) and the General Notes Section of the Harmonized Tariff Schedule <https://hts.usitc.gov/current>

Table 4. Supply Chain Risk Evaluation for DADMAC

Risk Parameter Ratings and Drivers					
<b>Criticality</b>	<b>High</b>	<b>Likelihood</b>	<b>Moderate-Low</b>	<b>Vulnerability</b>	<b>Moderate-High</b>
DADMAC is not used directly in water treatment but serves as the raw material for production of polyDADMAC, used in coagulation and sludge dewatering.		A history of price increases and force majeure due to shortages of or steep increase in the cost of a key input, allyl chloride, have impacted availability and pricing of polyDADMAC.		There is limited domestic manufacturing of DADMAC in locations concentrated along the Gulf Coast near the source of inputs. There is also a high tariff on the most significant source of imports.	
<b>Risk Rating: Moderate-High</b>					
					

## References

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