Monosodium Phosphate

NaH_2PO_4

D Direct Use Chemical P Precursor Chemical

(liquid or solid)

Source of Raw Material:
Sodium Carbonate Sodium Hydroxide
Phosphoric Acid

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

Product Family:
Phosphate

CAS No.: 7558-80-7

Derivative Water Treatment Chemicals:
Sodium Polyphosphates

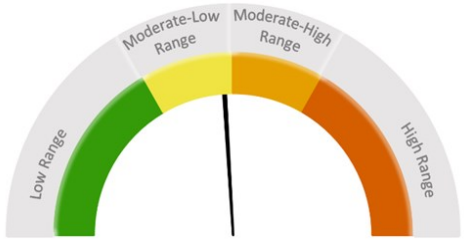
Understanding Chemical Supply Chains

Map of Suppliers & Manufacturers

Shelf Life:
24 Months

RISK OF SUPPLY DISRUPTION (Assessed in 2022)

RISK RATING: Moderate-Low



RISK DRIVERS

Strong reliance on the international market for manufacturing inputs, primarily phosphoric acid. Increased competition and reliance on imports have challenged phosphate manufacturers. Regional phosphoric acid supply disruptions have occurred between 2000 and 2022.

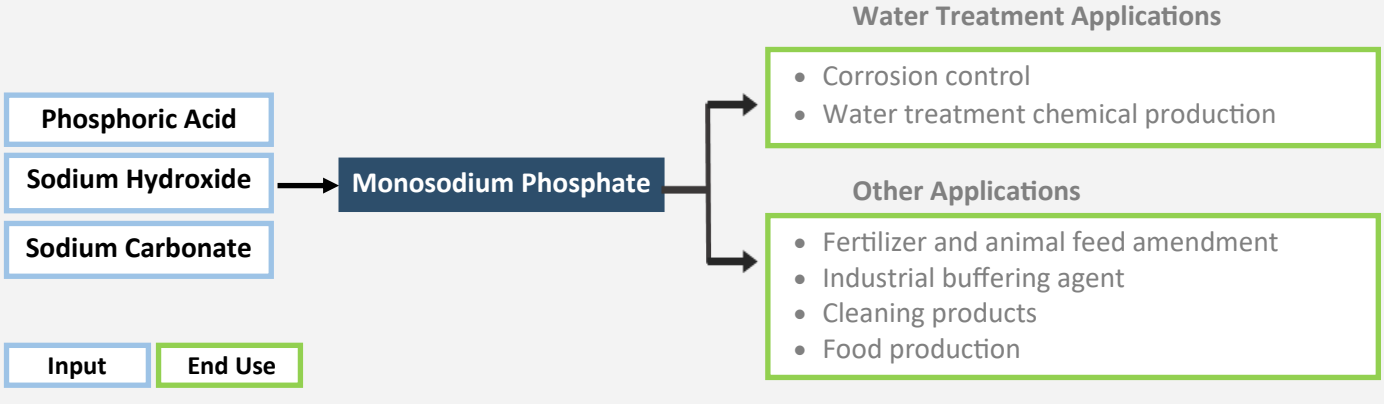
RISK PARAMETERS

Criticality: High. Essential for corrosion control and production of water treatment chemicals.

Likelihood: Moderate-Low. The water sector experienced regional supply disruptions between 2000 and 2022.

Vulnerability: Moderate-High. Manufacturing and supply is distributed, but supply is import-dependent with a high tariff on the most significant source of imports.

PRODUCTION PROCESS



DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

Domestic Production Locations (2015):
21, distributed throughout the U.S.

International Trade (2019)
Primary Trading Partner (Imports): China
Primary Trading Partner (Exports): Mexico

Mono- and Disodium Phosphate Domestic Consumption (2019): 19 Million kg

- Domestic Production (12 M kg)
- Imports for Consumption (10 M kg)
- Export of Domestic Production (3 M kg)

EPA

Product Description

Monosodium phosphate (NaH_2PO_4), is a widely used derivative product of phosphoric acid. Monosodium phosphate is used directly in water treatment on its own for corrosion control or blended with polyphosphates for corrosion control and scale inhibition, and also as an input in the manufacturing of sodium polyphosphates. The most common domestic use of monosodium phosphate is in animal feed and fertilizer manufacturing.

Use in Water Treatment

Monosodium phosphate is used directly in corrosion control and blended with polyphosphates for corrosion control and scale inhibition.

Use as a Precursor to Other Water Treatment Chemicals

Monosodium phosphate is used to manufacture sodium polyphosphates.

Other Applications

Monosodium phosphate is widely used in fertilizer and animal feed as a granulated phosphate component. Other significant uses include use as a buffering agent in industrial processes, food additive, emulsifier, pH stabilizer, curing agent; in formulations of cleaning products; and in water treatment (NCBI, 2021).

Primary Industrial Consumers

Significant uses of monosodium phosphate include use in formulations for animal feed and fertilizer, pH buffering for industrial processes such as textile processing, formulation of cleaning products, and corrosion control and anti-scaling applications (EPA, 2020).

Manufacturing, Transport, & Storage

Manufacturing Process

The majority of monosodium phosphate produced in the U.S. starts with phosphoric acid and either sodium hydroxide or sodium carbonate. Wet process phosphoric acid, which has been further concentrated and processed to produce a high purity product, or thermal phosphoric acid are used. No information was available regarding the preferential use of sodium hydroxide or sodium carbonate, and they may be interchangeable in the manufacture of monosodium phosphate.

The most common monosodium phosphate manufacturing process proceeds in several steps, the overall equation for this process is outlined in Figure 1, noting methods for use of sodium hydroxide and sodium carbonate. In both methods, phosphoric acid is neutralized with either sodium hydroxide or sodium carbonate. Phosphate crystals form and are separated from the solution. Based on the molar ratio of phosphoric acid and sodium carbonate or sodium hydroxide, a slurry of monosodium phosphate, disodium phosphate, or a mixture of monosodium and disodium phosphates is produced. The hydrated crystals may be dehydrated in a rotary kiln to obtain anhydrous monosodium phosphate (AWWA, 2018; NCBI, 2021).

Method 1

Phosphoric Acid + Sodium Hydroxide → Monosodium Phosphate + Water

H_3PO_4 + NaOH → NaH_2PO_4 + H_2O

Method 2

Phosphoric Acid + Sodium Carbonate → Monosodium Phosphate + Carbon Dioxide + Water

$2H_3PO_4$ + Na_2CO_3 → $2NaH_2PO_4$ + CO_2 + H_2O

Figure 1. Chemical Equation for the Reaction to Manufacture Monosodium Phosphate

Product Transport

Monosodium phosphate, primarily supplied as a solution but also available as a solid or powder, is widely transported in container and bulk by truck, rail, barge, and ship.

Storage and Shelf Life

Monosodium phosphate is stable and generally non-reactive. When stored properly, monosodium phosphate can have a shelf life of approximately 24 months (ICL Performance Products, 2015; Univar 2015).

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 monosodium phosphate, trade data are for the category of monosodium and disodium phosphates.

Table 1. Monosodium Phosphate Production and Trade Data Sources

Production and Trade Data			
Category	**Data Source**	**Identifier**	**Description**
Domestic Production	2020 TSCA Chemical Data Reporting	CAS No.: 7558-80-7	Monosodium Phosphate
Imports and Exports	U.S. International Trade Commission	HS Code: 2835.22	Monosodium and Disodium Phosphate

Total reported U.S. domestic production of monosodium phosphate for commercial sale was approximately 11.5 million kilograms (M kg) in 2019 (EPA, 2020). The largest reporting domestic producers of monosodium phosphate in 2019 were *Hawkins Chemical Company, Mosaic Company*, and the *Carus Corporation*. Several significant domestic manufacturers, including *ICL Group* and *Innophos* claimed confidential business information and did not report domestic production volume in 2019. The number of domestic manufacturing locations shown in Figure 2 represents operating facilities as of 2015 (EPA, 2016). Supply of NSF/ANSI Standard 60 certified monosodium phosphate for use in drinking water treatment is distributed throughout the U.S. (NSF International, 2021). For a more current listing of manufacturing locations and supplier locations, visit the U.S. Environmental Protection Agency's (EPA's) Chemical Locator Tool (EPA, 2022a).

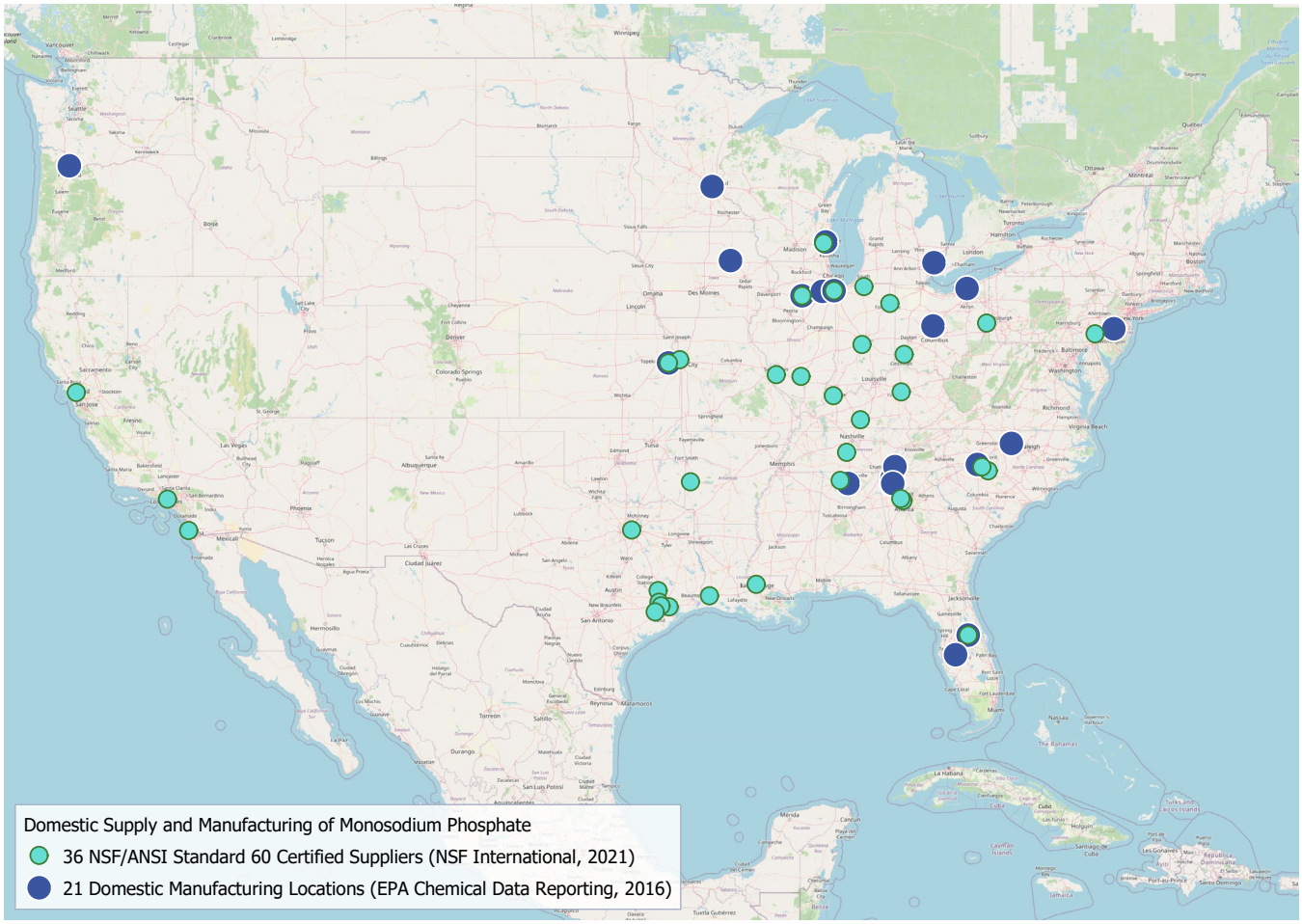


Figure 2. Domestic Supply and Manufacturing of Monosodium Phosphate

Domestic Consumption

U.S. consumption of monosodium and disodium phosphate in 2019 is estimated at 19 M kg. This estimate includes combined production of 12 M kg, import of 10 M kg, minus export of 3 M kg, as shown in Figure 3. Of this, domestic production of monosodium phosphate (11.5 M kg) represented 96% of all production (EPA, 2020; USITC 2021).

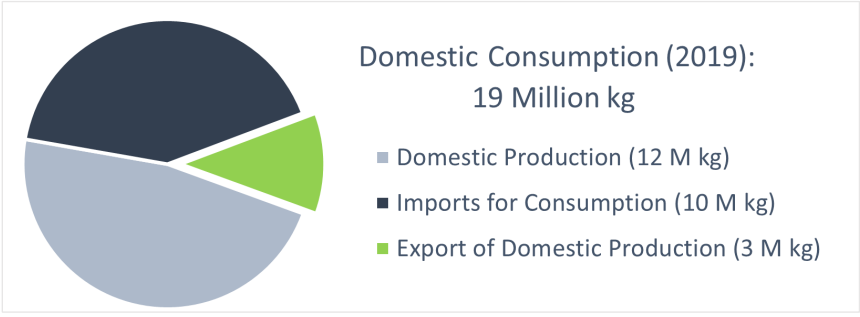


Figure 3. Domestic Production and Consumption of Monosodium and Disodium Phosphate in 2019

Trade &Tariffs

Worldwide Trade

Worldwide import and export data for monosodium phosphate are reported through the World Bank's World Integrated Trade Solutions (WITS) software, as a category for both monosodium and disodium phosphate. In 2021, the U.S. ranked fifth worldwide in total exports and first in total imports of monosodium and disodium phosphate. In 2021, China ranked first worldwide in total exports (WITS, 2022) as shown in Table 2.

Table 2. WITS Worldwide Export and Import of Monosodium and Disodium Phosphate in 2021

2021 Worldwide Trade Monosodium and Disodium Phosphate (HS Code 2835.22)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
China	26 M kg	**United States**	**14 M kg**
Germany	13 M kg	Malaysia	11 M kg
France	5 M kg	Thailand	8 M kg
Thailand	5 M kg	Indonesia	4 M kg
United States	**4 M kg**	Kenya	4 M kg

Domestic Imports and Exports

Domestic import and export data are reported by USITC in a category which includes both monosodium and disodium phosphate. Figure 4 summarizes imports for consumption[1] and domestic exports[2] between 2015 and 2020. During this period, the overall quantity of imports remained relatively steady, with imports consistently exceeding exports, while the quantity of exports decreased. Over this five-year period, Mexico was the primary recipient of domestic exports while China was the primary source of imports (USITC, 2021).

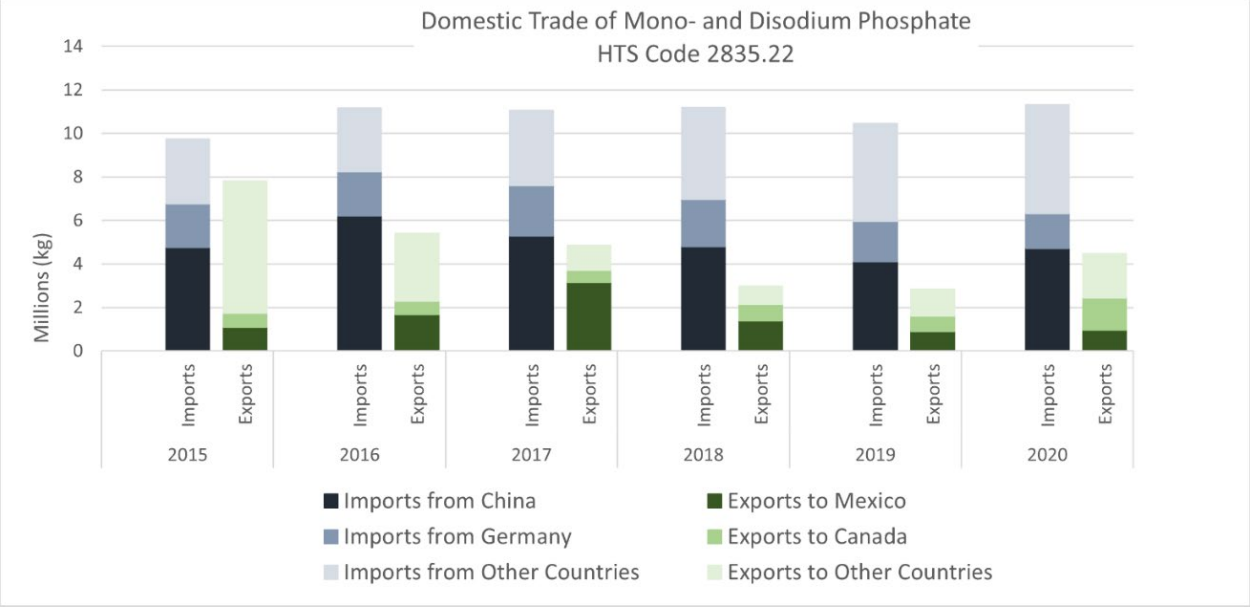


Figure 4. USITC Domestic Import and Export of Monosodium and Disodium Phosphate between 2015 and 2020

[1] 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.

[2] 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 1.4% general duty for import of monosodium phosphate and an additional 25% duty on imports from China (USITC, 2022), as summarized in Table 3. Imports of monosodium and disodium phosphate are primarily supplied from China and Germany. Though an additional 25% duty was added to imports from China in 2019, the quantity of imports of monosodium and disodium phosphate from China did not decrease between 2019 and 2021 (USITC, 2021).

Table 3. 2020 Domestic Tariff Schedule for Monosodium and Disodium Phosphate

HS Code	General Duty	Additional Duty – China (Section 301 Tariff List)	Special Duty
2835.22	1.4%	25%	Free (A, AU, BH, CL, CO, D, E, IL, JO, KR, MA, OM, P, PA, PE, S, SG)[3]

Market History & Risk Evaluation

History of Shortages

Disruptions to phosphoric acid production and the supply chain for phosphate rock can have a significant impact on availability of phosphoric acid and phosphates used in corrosion control applications. The increased demand for phosphoric acid and phosphates for use in fertilizers and animal feed has led to price increases and supply disruptions. Domestic manufacturers and suppliers of phosphate-based water treatment chemicals oftentimes rely on the international market for supply of phosphate rock and phosphoric acid and may encounter persistent challenges in obtaining these raw materials. This has led to repeated shortages of phosphate-based water treatment chemicals. In 2021, disruptions in international trade caused by the COVID-19 pandemic severely challenged these manufacturers.

Risk Evaluation

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

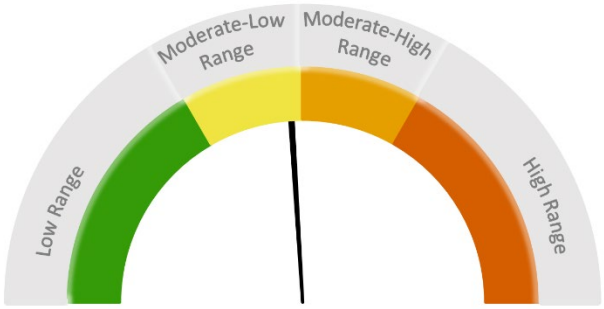
Risk = Criticality x Likelihood x Vulnerability	
Criticality	Measure of the importance of a chemical to the water sector
Likelihood	Measure of the probability that the chemical will experience a supply disruption in the future, which is estimated based on past occurrence of supply disruptions
Vulnerability	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.

[3] 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 and the General Notes Section of the Harmonized Tariff Schedule https://hts.usitc.gov/current

Table 4. Supply Chain Risk Evaluation for Monosodium Phosphate

Risk Parameter Ratings and Drivers		
Criticality: High	**Likelihood: Moderate- Low**	**Vulnerability: Moderate-High**
Monosodium phosphate is essential to the water sector and has widespread application for corrosion control. It is a precursor in the production of sodium polyphosphates.	The water sector has experienced regional monosodium phosphate supply disruptions in the past. Concerns are primarily due to increased competition and reliance on imports for raw materials and inputs (phosphate rock and phosphoric acid, respectively).	Domestic manufacturing and supply are distributed. However, there is a significant reliance on imports for both inputs and finished product. As of 2022, there was a high tariff on the most significant source of imports.
Risk Rating: Moderate-Low		



References

American Water Works Association (AWWA), 2018. *B504, Monosodium Phosphate, Anhydrous and Liquid*. Denver, CO: American Water Works Association.

EPA, 2016. 2016 TSCA Chemical Data Reporting, retrieved from https://www.epa.gov/chemical-data-reporting/access-cdr-data#2016

EPA, 2020. 2020 TSCA Chemical Data Reporting, retrieved from https://www.epa.gov/chemical-data-reporting/access-cdr-data#2020

EPA, 2022a. Chemical Suppliers and Manufacturers Locator Tool, retrieved from https://www.epa.gov/waterutilityresponse/chemical-suppliers-and-manufacturers-locator-tool

EPA, 2022b. *Understanding Water Treatment Chemical Supply Chains and the Risk of Disruptions*, retrieved from https://www.epa.gov/waterutilityresponse/risk-disruptions-supply-water-treatment-chemicals

ICL Performance Products, 2015. Shelf life and storage conditions statement, retrieved from https://ingredi.com/content/pdfs/TSPc_Shelf_life.pdf

National Center for Biotechnology Information (NCBI), 2021. PubChem Compound Summary for CID 23672064, Monosodium phosphate, retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/Monosodium-phosphate

NSF International, 2021. Search for NSF Certified Drinking Water Treatment Chemicals, retrieved from https://info.nsf.org/Certified/PwsChemicals/

Univar USA Inc., 2014. Safety Data Sheet for Monosodium Phosphate, Anhydrous, retrieved from http://portlandcleanair.org/files/merge/msds/MONOSODIUM_PHOSPHATE_ANHYDROUS.PDF

U.S. International Trade Commission (USITC), 2021. USITC DataWeb, retrieved from https://dataweb.usitc.gov/

U.S. International Trade Commission (USITC), 2022. Harmonized Tariff Schedule (HTS) Search, retrieved from https://hts.usitc.gov/current

World Integrated Trade Solutions (WITS), 2022. Trade Statistics by Product (HS 6-digit), retrieved from https://wits.worldbank.org/trade/country-byhs6product.aspx?lang=en#void