

# Potassium Permanganate



(solid)



**D**irect Use Chemical

**Inputs to Manufacturing Process:**  
Potassium Hydroxide  
Manganese Dioxide

**% of Total Domestic Consumption Attributed to Water Sector:**  
Greater than 50%

**Product Family:**  
Potassium Manganese

**Derivative Water Treatment Chemicals:**  
None

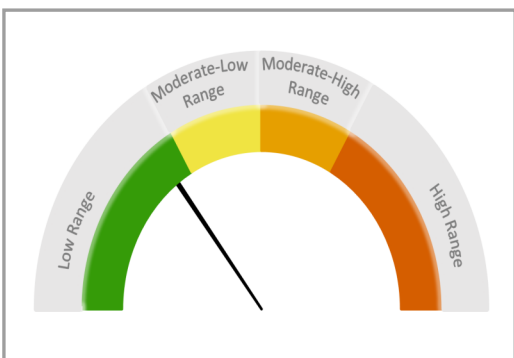
[Understanding Chemical Supply Chains](#)  
[Map of Suppliers & Manufacturers](#)

**CAS No.:** 7722-64-7

**Shelf Life:**  
60+ Months

## RISK OF SUPPLY DISRUPTION (Assessed in 2022)

**RISK RATING:** Low



### RISK DRIVERS

Concerns are primarily due to reductions in access to the raw material, manganese dioxide, and potassium chloride used to produce potassium hydroxide. Both are primarily imported from a limited number of countries and have application in industries which are primary consumers.

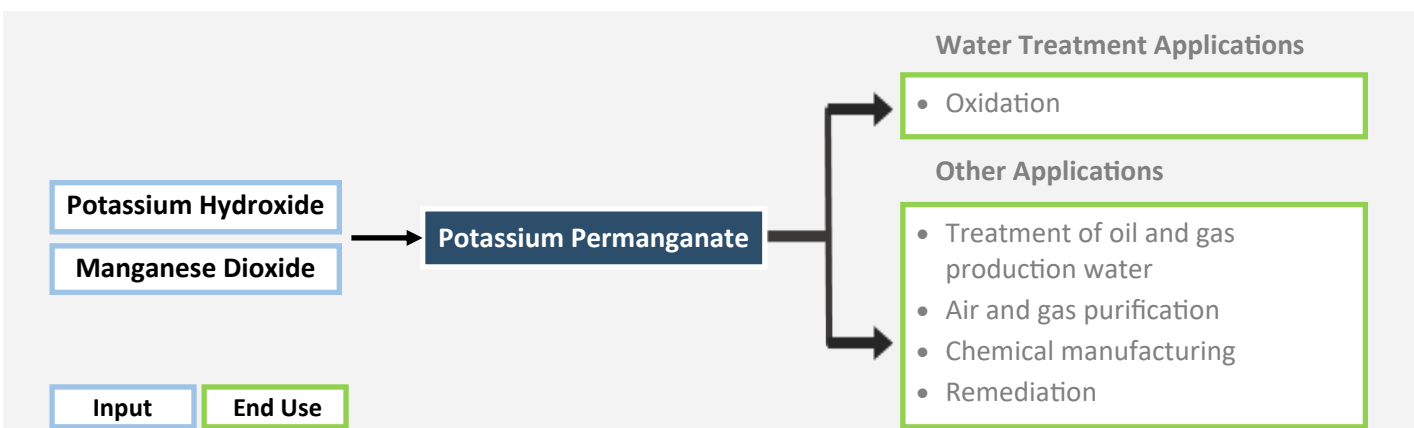
### RISK SCORE PARAMETERS

**Criticality:** High. Application as an oxidizing agent.

**Likelihood:** Low. No history of supply chain disruptions between 2000 and 2022.

**Vulnerability:** Moderate-High. Supply of manganese dioxide is entirely import-dependent, and supply of the raw material for potassium hydroxide is primarily imported and used in fertilizer. Domestic manufacturing is limited to one location.

## MANUFACTURING PROCESS



## DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

**Domestic Manufacturing Locations (2015):**

1, located in Illinois.

**International Trade (2019)**

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

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



**Domestic Consumption (2019):**  
9 Million kg

- Domestic Production (11 M kg)
- Imports for Consumption (1 M kg)
- Export of Domestic Production (3 M kg)

## Product Description

Potassium permanganate (KMnO<sub>4</sub>), a water soluble potassium salt, is a widely used oxidizing agent in water and wastewater treatment. Water treatment applications are the most common uses of potassium permanganate in the U.S.

### Use in Water Treatment

Potassium permanganate is utilized directly as an oxidizing agent in drinking water and wastewater treatment (AWWA, 2016).

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

Potassium permanganate is not used to manufacture other water treatment chemicals.

### Other Applications

Potassium permanganate has a wide range of applications, including water treatment, oil and gas well production water treatment, air and gas purification, chemical manufacturing, and remediation (USITC, 2021a).

### Primary Industrial Consumers

The primary use of potassium permanganate is water and wastewater treatment. Past estimates have approximated the consumption of potassium permanganate for industrial and municipal water treatment at 36.1% of total domestic consumption, and industrial and municipal wastewater treatment at 22.8%. Other common uses include treatment of oil and gas well production water (17.0%), air and gas purification (11.0%), chemical manufacturing (3.6%), remediation (1.7%), metal processing (0.3%), and other uses (7.5%) (USITC, 2021a).

## Manufacturing, Transport, & Storage

### Manufacturing Process

Potassium permanganate is primarily produced through a two-step reaction of manganese dioxide and potassium hydroxide. The equations for the most common potassium permanganate manufacturing process are shown in Figure 1. The process begins with ground manganese dioxide, which is oxidized at high temperature with potassium hydroxide to produce potassium manganate. The resulting solution of potassium manganate is subject to electrolysis, which results in crystallization of potassium permanganate out of the solution. Some additional purification steps may be used to produce different grades of potassium permanganate (NCBI, 2021; USITC, 2021a).

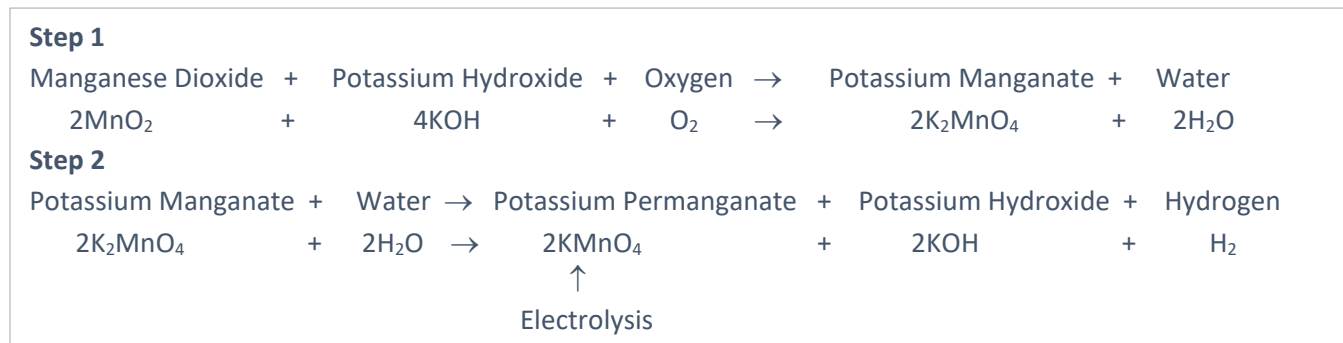


Figure 1. Chemical Equation for the Reaction to Manufacture Potassium Permanganate

## Product Transport

Potassium permanganate is primarily supplied for water treatment as free-flowing grade crystals, and is widely transported in container and bulk by truck, rail, barge, and tanker (Carus, 2012).

## Storage and Shelf Life

Potassium permanganate, should be stored in a tightly closed container and kept in cool, dry conditions. When stored properly, potassium permanganate can have a shelf life of in excess of 60 months (Carus, 2012).

## Domestic Production & Consumption

### Domestic Production

Production data was collected from the EPA Toxic Substances Control Act (TSCA) Chemical Data Reporting (CDR) while trade data was collected from the U.S. International Trade Commission (USITC) Dataweb, as characterized in Table 1. Both production and trade data are specific to potassium permanganate.

**Table 1. Potassium Permanganate Production and Trade Data Sources**

| Production and Trade Data |                                     |                                      |  |
|---------------------------|-------------------------------------|--------------------------------------|--|
| Category                  | Data Source                         | Identifier                           | Description  |
| Domestic Production       | 2020 TSCA Chemical Data Reporting   | CAS No.: 7722-64-7                   | Potassium Permanganate   |
| Imports and Exports       | U.S. International Trade Commission | HS Code: 2841.61<br>HS Code: 2841.60 | Potassium Permanganate<br>Salts of Manganites, Manganates, and Permanganates |

Total U.S. domestic manufacturing of potassium permanganate was approximately 11 million kilograms (M kg) in 2019 (EPA, 2020). The sole reported domestic commercial manufacture of potassium permanganate takes place at the *Carus Corporation (Carus)* facility in Illinois. *Carus* has been the only known operating domestic manufacturer of potassium permanganate since at least 1998. In 2021, *Carus* has indicated that a portion of the potassium permanganate they produce is used in captive consumption to manufacture sodium permanganate (USITC, 2021a). The number of domestic manufacturing locations shown in Figure 2 represents operating facilities as of 2015. Supply of NSF/ANSI Standard 60 certified potassium permanganate for use in drinking water treatment is primarily concentrated in the eastern half of the U.S. (NSF International, 2021). Some of these permanganate suppliers obtain product from *Carus*, but other import product from India or China. 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).

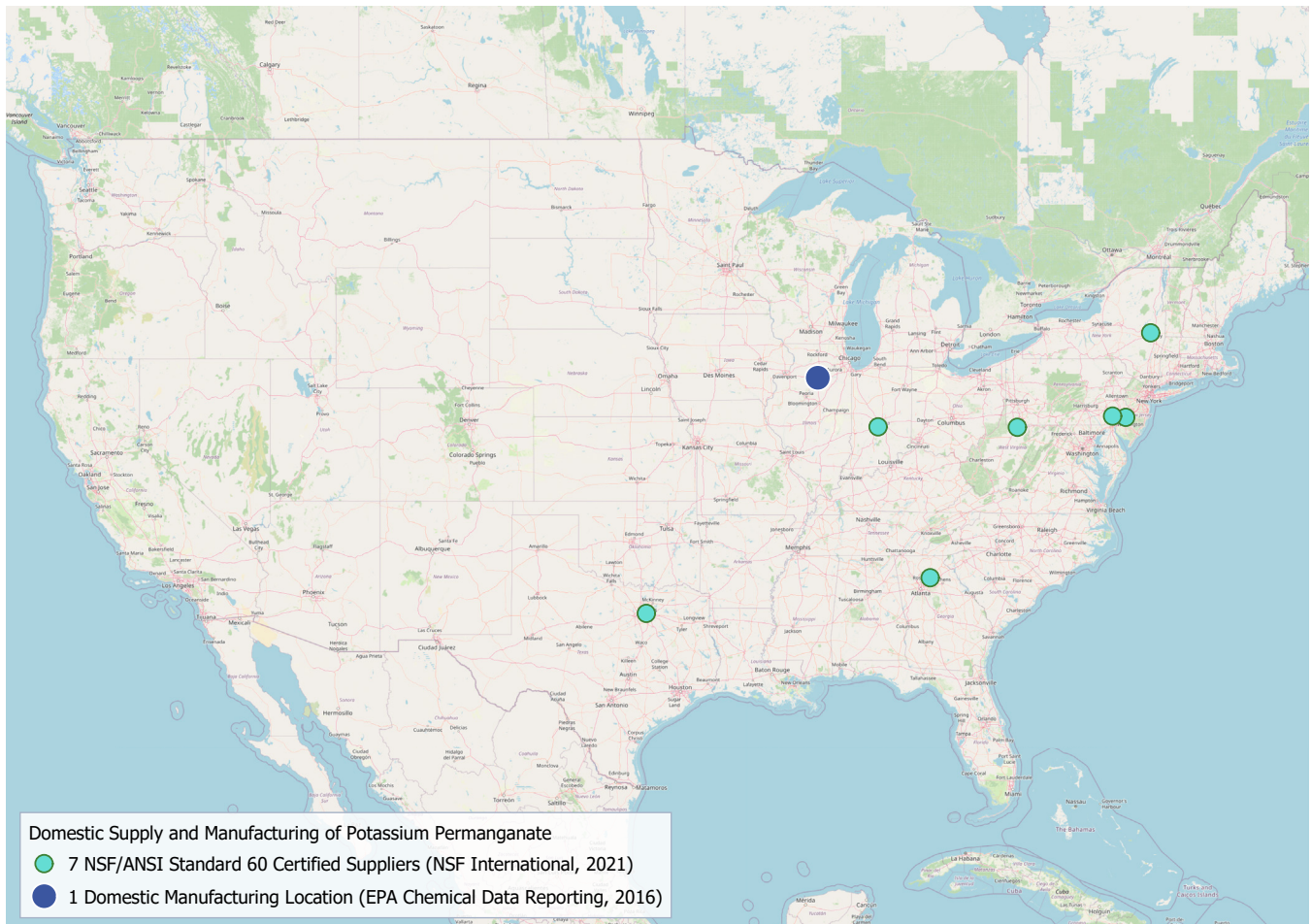


Figure 2. Domestic Supply and Manufacturing of Potassium Permanganate

### Domestic Consumption

U.S. consumption of potassium permanganate in 2019 is estimated at 9 M kg. This includes production of 11 M kg, import of 1 M kg, minus export of 3 M kg (EPA, 2020; USITC, 2021b), as shown in Figure 3.

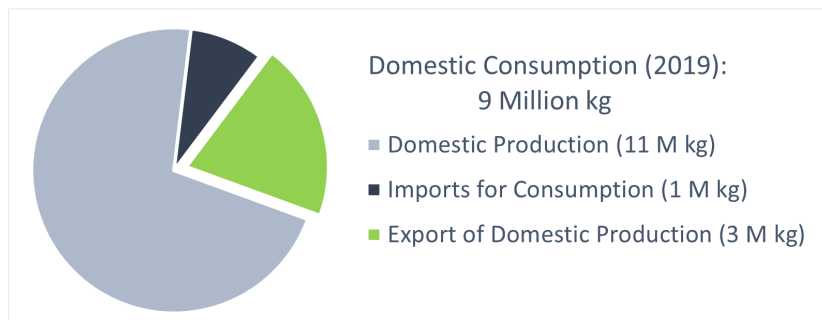


Figure 3. Domestic Production and Consumption of Potassium Permanganate in 2019

### Trade & Tariffs

#### Worldwide Trade

Worldwide import and export data for potassium permanganate is reported through the World Bank’s World Integrated Trade Solutions (WITS) software, as a category specific to salts of manganites, manganates, and permanganates, including but not exclusive to potassium permanganate. In 2021, the U.S. ranked fourth

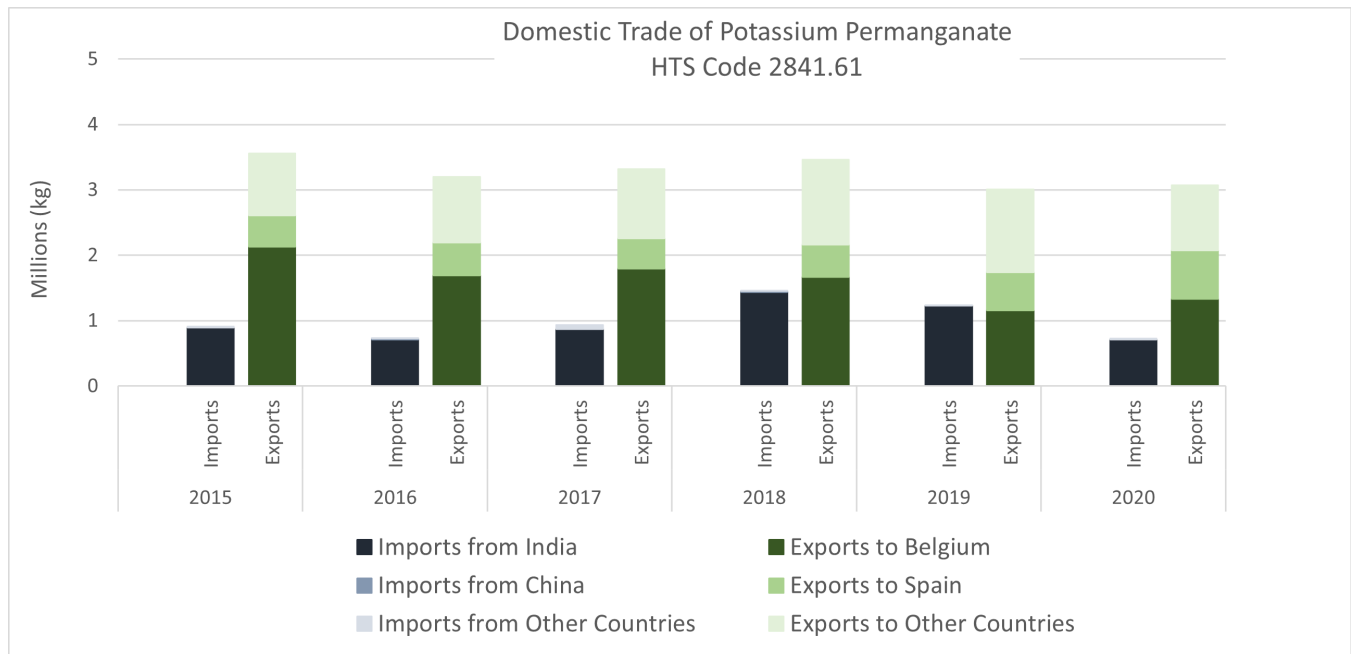
worldwide in total exports and third in total imports. In 2021, Laos ranked first worldwide in total exports while Thailand ranked first in total imports (WITS, 2022), as shown in Table 2.

**Table 2. WITS Worldwide Export and Import of Salts of Manganites, Manganates, and Permanganates in 2021**

| 2021 Worldwide Trade<br>Salts of Manganites, Manganates, and Permanganates (HS Code 2841.60) |               |                           |               |
|--|---------------|---------------------------|---------------|
| Top 5 Worldwide Exporters  |               | Top 5 Worldwide Importers |               |
| Laos   | 76 M kg       | Thailand                  | 4 M kg        |
| China  | 19 M kg       | Japan                     | 2 M kg        |
| India  | 6 M kg        | <b>United States</b>      | <b>2 M kg</b> |
| <b>United States</b>   | <b>4 M kg</b> | South Korea               | 2 M kg        |
| Japan  | 1 M kg        | Spain                     | 1 M kg        |

### Domestic Imports and Exports

Domestic import and export data are reported by USITC in categories specific to potassium permanganate. Figure 4 summarizes imports for consumption<sup>1</sup> and domestic exports<sup>2</sup> of potassium permanganate between 2015 and 2020. During this period, the overall quantity of exports and imports remained relatively steady, with domestic exports consistently exceeding imports for consumption. Over this five-year period, Belgium was the primary recipients of domestic exports while India was consistently the source of greater than 90% of imports for consumption (USITC, 2021b).



**Figure 4. USITC Domestic Import and Export of Potassium Permanganate 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 5% general duty for import of potassium permanganate (USITC, 2022), as summarized in Table 3. Imports from China are subject to additional duties of 25% and 128.94% (Federal Register, 2021; USITC, 2022).

**Table 3. Domestic Tariff Schedule for Potassium Permanganate in 2021**

| HS Code | General Duty | Additional Duty – China (Section 301 Tariff List) | Additional Duty – China <sup>3</sup> | Special Duty  |
|---------|--------------|---|--------------------------------------|---|
| 2841.61 | 5%           | 25%   | 128.94%                              | Free (A, AU, BH, CL, CO, D, E, IL, JO, KR, MA, OM, P, PA, PE, S, SG) <sup>4</sup> |

## Market History & Risk Evaluation

### History of Shortages

No notable potassium permanganate domestic supply chain disruptions were identified between 2000 and 2022.

### 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:

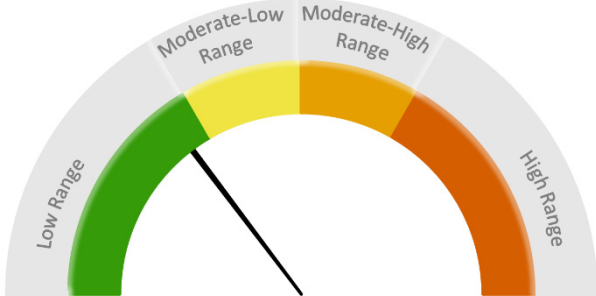
| Risk = Criticality x Likelihood x Vulnerability |   |
|---|---|
| <b>Criticality</b>                              | Measure of the importance of a chemical to the water sector   |
| <b>Likelihood</b>                               | Measure of the probability that the chemical will experience a supply 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> Continuation of Antidumping Duty Order; Potassium Permanganate from the People’s Republic of China: Final Results of the Expedited First Sunset Review of the Countervailing Duty Order, 86 Fed. Reg. 234,70113 (December 9, 2021), the Department of Commerce published noticed that potassium permanganate imported from China would continue to be subject to countervailing import duties.

<sup>4</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 Potassium Permanganate

| Risk Parameter Ratings and Drivers   |   |   |
|--|---|---|
| <b>Criticality</b> <b>High</b>   | <b>Likelihood</b> <b>Low</b>  | <b>Vulnerability</b> <b>Moderate-High</b>   |
| Potassium permanganate is widely used as an oxidizing agent in the water sector.   | The water sector has not experienced potassium permanganate supply chain disruptions between 2000 and 2022. | Domestic manufacturing is limited to one location, and inputs of manganese ore (manganese dioxide) and the raw material for potassium hydroxide production (potassium chloride) are heavily-dependent on imports. |
| <b>Risk Rating: Low</b>  |   |   |
|  |   |   |

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