



UREA

Introduction, Applications, and Market Review

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What is Urea? Urea, also known as carbamide $\text{CO}(\text{NH}_2)_2$, is an organic compound initially derived from ammonia via amino acid breakdown. It's widely used as a nitrogen-rich chemical fertilizer, making it integral to agriculture. Urea is a colorless, crystalline, odorless, and neutral compound—neither alkaline nor acidic—with high water solubility. Apart from agricultural applications, it also plays a role in pharmaceutical manufacturing and plastic production.

Biological Role of Urea In living organisms, urea is crucial for metabolizing nitrogen. For plants, urea in soil breaks down into usable forms, enriching roots with essential nutrients. This enhances plant health, growth, and productivity across multiple dimensions.

Why Urea Fertilizer? Urea fertilizer—a white, odorless compound made from carbon dioxide and ammonia—is one of the most popular nitrogen fertilizers due to its high nitrogen content and safety. Nitrogen supports chlorophyll production, photosynthesis, and protein synthesis, giving plants their green color and vital energy for growth.

Key Applications in Agriculture:

- **Nitrogen Source:** Urea provides nitrogen, crucial for healthy crop yield.
- **Versatility:** Effective for a wide range of crops, especially those requiring higher nitrogen levels (e.g., vegetables, fruits, cereals, oilseeds).
- **Precautions:** While suitable for most plants, urea can harm nitrogen-sensitive varieties.
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Conclusion Urea is indispensable in modern agriculture, benefiting both plant health and productivity. Its solubility, safety, and cost-effectiveness ensure its continued dominance in the global fertilizer market.

Types of Urea Fertilizers Like other fertilizers, urea fertilizers come in various types, each designed to achieve specific results. One of the most prominent types is urea phosphate fertilizer. In this section, we'll explore urea phosphate and highlight several other types of urea fertilizers.

What is Urea Phosphate Fertilizer? Urea phosphate is a crystalline, colorless, and odorless chemical compound known for its high solubility and high melting point. It has acidic properties, making it compatible with other acidic compounds. As its name suggests, urea phosphate contains nitrogen and phosphorus—two essential nutrients for plants. These properties make it one of the most widely used fertilizers in agriculture.

This white chemical fertilizer features a controlled-release mechanism, delivering nutrients to the soil gradually. This ensures better plant health, improved performance and yield, and optimized nutrient absorption. Its low pH and acidic nature enhance soil properties, while the nitrogen content supports rapid and healthy plant growth.

Other Types of Urea Fertilizers

- Urea peril
- Urea ammonium nitrate
- Urea sulfur (sulfur-coated urea)
- Urea polymer
- Nitroform
- Urea formaldehyde
- Urea super granule

Why Urea Fertilizer Is Popular Urea fertilizer is one of the most commonly used chemical fertilizers in agriculture. As a rich source of nitrogen, it promotes plant growth effectively. Its excellent water solubility and easy absorption by plants help improve the quality of agricultural products. Beyond boosting plant growth, urea fertilizers enhance soil fertility and nutrient levels, making them suitable for various crops, gardens, and greenhouses.

Key Features of Urea Fertilizer



- **Composition:** Urea fertilizer is an organic compound with the chemical formula $\text{CH}_4\text{N}_2\text{O}$, consisting of carbon, hydrogen, nitrogen, and oxygen. Its high nitrogen content (about 46%) makes it one of the richest nitrogen sources in agriculture.
- **Physical Properties:** This fertilizer appears as white crystals with a neutral pH, is odorless, and has a melting point of 132.7°C . It dissolves well in water and alcohol but is insoluble in ether and chloroform.
- **Granular Form:** Urea fertilizer, made from anhydrous ammonia, is also available as granules. These granules are larger, more durable, and resistant to moisture, making them more widely used in modern farming.

Application of Urea Fertilizer As mentioned earlier, urea fertilizer is a rich source of nitrogen, and its uses include:

- Increasing chlorophyll production, resulting in faster leaf growth and enhanced greenness in plants
- Improving the quality and enrichment of nutrient-deficient soils caused by continuous cultivation
- Enhancing the quality and texture of fruit in orchards
- Supporting greenhouse cultivation to promote the growth of ornamental plants and vegetables like tomatoes and cucumbers
- Boosting the yield of crops such as wheat, rice, corn, barley, and other grains

Properties of Urea Fertilizer

1. Stimulates plant growth and greenness due to its high nitrogen content
 2. Contains 46% nitrogen, one of the most essential nutrients for plants
 3. Improves soil properties, enriching it for optimal plant growth
 4. Highly soluble in water, enabling rapid absorption by soil and plants
 5. Suitable for irrigation and foliar spraying applications
 6. Neutral pH, compatible with both acidic and alkaline soil types, ensuring effective plant growth
 7. Cost-effective due to its affordable price
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8. Easy to combine with other fertilizers for a comprehensive plant nutrition program
 9. Versatile, usable for a variety of crops, gardens, and greenhouses



Disadvantages of Urea Fertilizer

- Prolonged use may lead to soil acidity
- Highly sensitive to moisture and temperature, leading to potential wastage and reduced soil absorption
- Application without proper soil analysis can result in plant toxicity

Stages of Application

- **Before Planting:** Used to enrich the soil and ensure nitrogen availability after planting
- **Early Growth Stages:** Applied to meet the plant's high nitrogen requirements for accelerated growth
- **Before Flowering:** Enhances flower, resistance and improves the final product

How to Use

- Urea fertilizer can be applied through irrigation, foliar spraying, or direct soil application. For optimal effectiveness:
 - Apply at moderate temperatures, as extreme cold or wind can hinder proper soil mixing. Excessive heat may cause nitrogen loss to the atmosphere.
 - Dissolution time for urea granules depends on water levels and soil temperature, taking a few minutes to hours.
 - Mix urea with soil or sand before use to prevent issues with waterlogged soils. Its water solubility allows it to reach deeper soil layers when irrigated.

Urea fertilizer can also be combined with other fertilizers in either solid or water-soluble forms.

Global Urea Production and Usage China is the largest producer and consumer of urea globally, followed by India and the United States. High demand in these countries has made India and the United States the largest importers of urea. More than 70% of the world's urea is

produced in Asia. Several Asian and Latin American countries are key export destinations for Iranian urea fertilizer.

Urea Production in Iran is among the top global producers of urea, using natural gas as its primary feedstock. The country's major petrochemical complexes, including Pardis, Razi,



Shiraz, Khorasan, and Kermanshah, utilize advanced technologies and abundant natural gas resources to produce high-quality urea at competitive prices.

Iran's Urea Export Iran ranks among the largest exporters of urea globally. Major customers of Iranian urea include India, Turkey, and several European countries. Iranian urea has consistently attracted international attention due to its high quality and competitive pricing. In 2019 alone, Iran exported approximately 2,489,000 tons of urea, reflecting its significant role in the global urea market.

Forecasting the Future of Urea Production and Export With the rising global demand for urea, Iran's production and export of this key commodity are expected to grow in the coming years. According to projections, the global urea market value will increase at an annual growth rate of 4.8%, reaching nearly \$165 billion by 2030. This growth is fueled by the increasing demand for chemical fertilizers in agriculture and the expanding industrial applications of urea.

Challenges and Opportunities Iran's urea industry faces challenges, particularly due to international sanctions. These sanctions can restrict access to global markets and raw materials, potentially affecting exports. However, numerous opportunities exist for growth:

- **Adopting Advanced Technologies:** Innovations in urea production can improve efficiency, reduce costs, and enhance product quality.
- **Improving Processes:** Streamlining production methods can increase productivity and support environmental sustainability.

New Technologies in Urea Production The implementation of advanced technologies has transformative potential for urea production. These innovations can:

- Reduce waste and environmental pollution
- Improve product quality
- Enhance the effectiveness of fertilizers, such as with slow-release coating technologies, which reduce the frequency of application

The Impact of Sanctions on Iran's Urea Industry International sanctions have significantly impacted Iran's urea industry by limiting access to global markets and raw material supplies. Nevertheless, Iran has leveraged domestic resources and technological advancements to maintain



production. While sanctions have driven up production costs and reduced competitiveness, the industry has demonstrated resilience and adaptability.

Target Markets for Iranian Urea Exports Iran's strategic geographical location grants it access to vast markets, including India, China, South America, and Africa. Iranian urea exports are highly appealing to buyers in these regions, thanks to their superior quality and competitive pricing. Each market has unique requirements, which can be met through thoughtful planning and tailored strategies.

Conclusion Iran's abundant natural gas reserves and industrial expertise position it as a key player in the global urea market. With strategic investments in new technologies and improvements in production processes, Iran has the potential to strengthen its global standing as a leading urea producer and exporter. By increasing productivity and reducing costs, Iran can enhance its competitiveness and continue to play a vital role in meeting global demand.

Urea-Producing Companies in Iran by early 2025, Iran operates seven urea production plants with a combined nominal capacity of 10.4 million tons. These facilities are integral to the country's urea production industry. The major urea-producing companies in Iran are outlined in the table below:

No.	Logo	Petrochemical Complex	Production Capacity (KTons/ Year)	License	Year of Operation	Website
1		Pardis Petrochemical Company	3225	Stami Carbon, H.F.T	2009	www.paupc.ir
2		Khorasan Petrochemical Company	495	Stami Carbon, H.F.T	1996	https://khpc.ir
3		Kermanshah Petrochemical Company	660	Stami Carbon, H.F.T	2007	https://kpik.ir/



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4		Masjed Soleiman Petrochemical Company	1075	TOYO	2021	https://www.misipcc.com
5		Shiraz Petrochemical Company	1567	Stami Carbon, H.F.T	1990	www.spc.co.ir
6		Razi Petrochemical Company	594	Stami Carbon, H.F.T	1990	http://www.razip.com
7		Lordegan Urea Fertilizer Co.	1075	Stamicarbon	2021	https://www.lufc.ir/
8		Jam Ehtemam Co.	48	Alder (Italy)	2011	-----