

Applications using Urea

Agriculture

More than 90 percent of world **Urea** production is destined for use as a nitrogen-release fertilizer. **Urea** has the highest nitrogen content of all solid nitrogenous fertilizers in common use (46.7%). Therefore, it has the lowest transportation costs per unit of nitrogen nutrient.

In the soil, it hydrolyses back to ammonia and carbon dioxide. The ammonia is oxidized by bacteria in the soil to nitrate, which can be absorbed by the plants. **Urea** is also used in many multi-component solid fertilizer formulations. **Urea** is highly soluble in water, therefore, very suitable for use in fertilizer solutions (in combination with ammonium nitrate: UAN), e.g., in 'foliar feed' fertilizers. For fertilizer use, granules are preferred because of their narrower particle size distribution, an advantage for mechanical application.

The most common impurity of synthetic **Urea**, biuret, must be present at less than 2 percent of the time, as it impairs plant growth.

Urea is spread at rates between 40 and 300 kg/ha, but actual spreading rates will vary according to farm type and region. It is better to make several small to medium applications at intervals to minimize leaching losses and increase efficient use of the Nitrogen applied, compared with single heavy applications. During summer, **Urea** should be spread just before, or during rain to reduce possible losses from volatilization (process wherein nitrogen is lost to the atmosphere as ammonia gas). **Urea** should not be mixed with other fertilizers, as problems of physical quality may result.

Because of the high nitrogen concentration in **Urea**, achieving an even spread is important. The application equipment must be calibrated correctly and used properly. Drilling must not occur on contact with or close to seeding due to the risk of germination damage. **Urea** dissolves in water to be applied as a spray or through irrigation systems.

In grain and cotton crops, **Urea** is often applied at the time of the last cultivation before planting. In high rainfall areas and on sandy soils (where nitrogen can be lost through leaching) and where good in-season rainfall is expected, **Urea** can be side or top-dressed during the growing season. Top-dressing is also popular on pasture and forage crops. In cultivating sugarcane, **Urea** is side-dressed after planting, and applied to each ratoon crop.

For irrigated crops, **Urea** can be applied dry to the soil, or dissolved and applied through the irrigation water. **Urea** will dissolve in its own weight in water, but it becomes increasingly difficult to dissolve as the concentration increases. Dissolving **Urea** in water is endothermic, causing the temperature of the solution to fall when **Urea** dissolves.

When preparing **Urea** solutions for fertigation (injection into irrigation lines), dissolve no more than 30 kg of **Urea** per 100 L of water.

In foliar sprays, 0.5 to 2.0 percent concentrations of **Urea** are often used for horticultural crops. As **Urea** sprays may damage crop foliage, advice for specific amounts should be sought before use. Low-biuret grades of **Urea** should also be used if **Urea** sprays are to be applied regularly or to sensitive horticultural crops.

Like most nitrogen products, **Urea** absorbs moisture from the atmosphere. Therefore it should be stored either in closed/sealed bags on pallets, or, if stored in bulk, under cover with a tarpaulin. As with most solid fertilizers, it should also be stored in a cool, dry, well-ventilated area.

Chemical industry

Urea is a raw material used in the manufacture of many important chemicals, such as:

1. Various plastics, especially the **Urea**-formaldehyde resins
2. Various adhesives, such as **Urea**-formaldehyde or the **Urea**-melamine-formaldehyde used in marine plywood

3. Potassium cyanate, another industrial feedstock
4. **Urea** nitrate, an explosive

Urea has the ability to trap many organic compounds in the form of clathrates. The organic compounds are held in channels formed by interpenetrating helices comprising of hydrogen-bonded **Urea** molecules. This behavior can be used to separate mixtures, and has been used in the production of aviation fuel and lubricating oils, and in the separation of paraffin.

As the helices are interconnected, all helices in a crystal must have the same molecular handedness. This is determined when the crystal is nucleated and can thus be forced by seeding. The resulting crystals have been used to separate racemic mixtures.

Automobile systems

Urea is used in SNCR and SCR reactions to reduce the NO_x pollutants in exhaust gases from combustion, for example, from power plants and diesel engines. The BlueTec system, for example, injects water-based **Urea** solution into the exhaust system. The ammonia produced by decomposition of the **Urea** reacts with the nitrogen oxide emissions and is converted into nitrogen and water within the catalytic converter.

Other commercial uses

1. A stabilizer in nitrocellulose explosive
2. A component of animal feed, providing a relatively cheap source of nitrogen to promote growth
3. A non-corroding alternative to rock salt for road de-icing, and the resurfacing of snowboarding half pipes and terrain parks
4. A flavor-enhancing additive for cigarettes
5. A main ingredient in hair removers such as Nair or Veet
6. A browning agent in factory-produced pretzels
7. An ingredient in some hair conditioners, facial cleansers, bath oils, skin softeners, and lotions
8. A reactant in some ready-to-use cold compresses for first-aid use, due to the endothermic reaction it creates when mixed with water
9. A cloud seeding agent, along with other salts
10. A flame-proofing agent, commonly used in dry chemical fire extinguisher charges such as the **Urea**-potassium bicarbonate mixture.
11. An ingredient in many tooth whitening products
12. An ingredient in dish soap
13. Along with ammonium phosphate, as a yeast nutrient, for fermentation of sugars into ethanol
14. A nutrient used by plankton in ocean nourishment experiments for geoengineering purposes
15. As an additive to extend the working temperature and open time of hide glue
16. As a solubility-enhancing and moisture-retaining additive to dye baths for textile dyeing or printing

Laboratory uses

Urea in concentrations up to 10 M is a powerful protein denaturant as it disrupts the noncovalent bonds in the proteins. This property can be exploited to increase the solubility of some proteins. A mixture of **Urea** and choline chloride is used as a deep eutectic solvent, a type of ionic liquid.

Urea can serve as a hydrogen source, for subsequent power generation in a fuel cell. **Urea** present in urine/wastewater can be used directly (though bacteria normally quickly degrade **Urea**.) Producing hydrogen by electrolysis of **Urea** solution occurs at a lower voltage and uses less energy than by electrolysis of water.

Medical use

Urea is used in topical dermatological products to promote rehydration of the skin. If covered by an occlusive dressing, 40 percent **Urea** preparations may also be used for non-surgical debridement of nails. This drug is also used as an earwax removal aid.



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Like saline, **Urea** injection is used to perform abortions. It is also the main component of an alternative medicinal treatment referred to as urine therapy.

The blood **Urea** nitrogen (BUN) test is a measure of the amount of nitrogen in the blood that comes from **Urea**. It is used as a marker of renal function.

Urea labeled with carbon-14 or carbon-13 is used in the **Urea** breath test, which is used to detect the presence of the bacteria *Helicobacter pylori* (*H. pylori*) in the stomach and duodenum of humans, associated with ulcers. The test detects the characteristic enzyme **Urease**, produced by *H. pylori*, by a reaction that produces ammonia from **Urea**. This increases the pH (reduces acidity) of the stomach environment around the bacteria. Similar bacteria species to *H. pylori* can be identified by the same test in animals such as apes, dogs, and cats (including big cats).

De-Icer

Urea is a safe, non-corrosive fertilizer alternative for de-icing. The chemical is easy to use on runways and walkways as well as on landing gears and other vital parts located on the under-carriage of aircraft that must always be protected from corrosion. Airports in many areas that can't use highly corrosive chloride salts for de-icing operations use **Urea** as the preferred alternative.