FACT SHEET

October 2021

ANHYDROUS AMMONIA

Marketed by Incitec Pivot Fertilisers as “Big N”

Most concentrated nitrogen fertiliser (82% N)

Stored, transported and applied directly into the soil as a liquefied gas

AMMONIA MANUFACTURE AND USE

In Germany in 1909, Fritz Haber and Carl Bosch developed a large scale economic method for synthesising ammonia (NH_3). This event marks the birth of the modern nitrogen fertiliser industry, even though it took close to 50 years for the process to be used on a significant scale.

Up to the Second World War, the demand for nitrogen fertilisers was largely met from industrial by-product sulfate of ammonia from the coking of coal and naturally occurring Chilean Nitrate of Soda. The demand for nitrogen fertilisers increased rapidly from this time in line with world population growth, meaning that supply from traditional sources had to be supplemented with synthetically produced nitrogen fertilisers. Ammonia is the starting point for most of these fertilisers.

Sulfuric acid and ammonia are produced and traded in greater quantity than any other chemicals, with approximately 85% of the world’s ammonia production being used as a fertiliser or for fertiliser production.

While ammonia may be applied directly to the soil as a nitrogen fertiliser, most is converted to solids by reacting it with carbon dioxide to produce urea, or with nitric acid, sulfuric acid or phosphoric acid to produce ammonium nitrate, ammonium sulfate, monoammonium phosphate (MAP) and dioammonium phosphate (DAP). These synthetically produced fertilisers account for the greater part of the nitrogen applied in world agriculture, urea making up about 50% of the total. In Australia, ammonium nitrate is mostly used in the preparation of explosives. Relatively little is used as a fertiliser.

Incitec Pivot operates ammonia plants in Brisbane, where granulated urea and granulated ammonium sulfate (Gran-am®) are made, and at Phosphate Hill in northwest Queensland where MAP and DAP are produced. The feedstocks for these ammonia plants are natural gas, steam and air (from which the nitrogen is derived).

USE OF “BIG N” AS A FERTILISER

Big N is injected directly into the soil as a nitrogen fertiliser. It is mostly applied pre-plant while the land is being fallowed.

Big N is available and used where both summer and winter broadacre crops are grown, e.g. grain and cotton mainly in the states of New South Wales and Queensland. This spreads demand over more months of the year, allowing better use to be made of the specialized equipment used to transport, store, supply and apply Big N. Big N is not available in other districts, e.g. coastal areas where farm sizes are small and small crops are grown, in southern States where the rainfall is winter dominant and summer crops are not grown, and where nitrogen is usually top-dressed during the growing season rather than be applied pre-plant.

AMMONIA IN THE SOIL

Ammonia is a gas at normal temperatures and pressure. It is stored and transported as a liquefied gas in pressurized tanks. Upon application the pressurised liquid converts immediately to the gaseous form. The ammonia then combines with water in the soil to form ammonium (NH_4^+) ions as depicted in the following equation:

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$

The ammonium ions are attracted to and are tightly held on the surface of clay and organic colloids in the soil. As such, ammonium is resistant to loss to the atmosphere by reversion to ammonia gas, or by leaching deeper into the soil in the event of heavy rainfall.

This affinity of ammonia for water and the strong adsorption of ammonium ions in the soil are the reasons why anhydrous ammonia can be injected directly into the soil as a fertiliser. There will always be enough moisture in the soil for the above reaction to occur provided the soil flows freely back around the tines to prevent the loss of ammonia as a gas to the atmosphere before it has a chance to react with water in the soil.

Anhydrous ammonia has been successfully applied into fully cultivated prepared seedbeds using conventional application equipment in Australia since the 1960s. The adoption of reduced tillage practices initially stifled demand for anhydrous ammonia. With minimal soil disturbance in the field and poor soil cover behind the tines, conditions were conducive to ammonia gas being lost to the atmosphere.

This constraint was overcome by the use of **Cold-Flo®** application technology which allows Big N to be applied under soil conditions in which it could not be applied using conventional application equipment. This requires fitting Big N application equipment with Cold-Flo® converters, in which pressurised ammonia expands from the liquid to the gaseous phase, chilling the gas and converting about 85% of it to a liquid. The chilled liquid and remaining gas is applied at normal atmospheric pressure. This allows greater opportunity for the adsorption of the ammonia by the soil and reduces atmospheric loss. Application equipment (meters, flow controllers etc) run and meter more efficiency when a large proportion of the N applied is liquid using Cold-Flo® application technology.

Big N is mostly applied pre-plant. If applied at planting or as a side-dressing in row crops, Big N must be placed away from seeds and crop roots, due to its toxicity to plant tissue. The toxic effects in the soil are localised and short-lived, being confined to the soil around the point of application. With time, the ammonium is converted to nitrate by soil microbes, and moves with soil moisture away from the site of application.

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