Because the land is your life.

January 2006

NITRATE FERTILISER GUIDANCE NOTES

Dealer and Agent Guidance Notes for the Transport, Storage, Sale and Use of Nitrate Fertilisers

These Guidance Notes have been prepared to assist Agents and Dealers with regulatory and product stewardship issues pertaining to nitrate fertilisers.

The Guidance Notes summarise some of the more important legislation on the handling and storage of Class 5.1 Oxidising Agents, and those products that are classified as SSAN (Security Sensitive Ammonium Nitrate), but are not a complete guide, and should not be used as such. Relevant State Acts and Regulations, national codes and guides should be used as the primary source of information. These are subject to change, and should be reviewed regularly.

Fertilisers that are classified as Oxidising Agents must be transported in accordance with the Sixth Edition of the Australian Code for the Transport of Dangerous Goods by Road and Rail, and stored in accordance with Australian Standard AS 4326. Potassium nitrate is the only Class 5.1 Oxidising Agent presently marketed by Incitec Pivot.

A license has been required to manufacture, import, store, sell, transport or use SSAN in Queensland and the ACT since 1 July 2005 in Queensland and the ACT, and since 1 January 2006 in New South Wales and Victoria. The likely enactment date in South Australia is 1 July 2006. SSAN fertilisers are banned in Tasmania.

Cal-Am, and Custom Blends containing more than 55% Cal-Am, are classified as SSAN. Separate Guidance Notes are available of the transport and storage of SSAN products.

Diligence is also required with some other fertilisers.

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SUMMARY

These Guidance Notes outline transport, storage and security arrangements for nitrate fertilisers. Key points are:

- Incitec Pivot no longer markets straight Ammonium Nitrate (**Nitram** and **Liquifert Pinnacle**) or uses these products as ingredients in dry solid blends.

- Other ammonium nitrate fertilisers are available, including **Cal-Am** (Calcium Ammonium Nitrate or CAN), which contains approximately 80% ammonium nitrate and 20% calcium carbonate; and **N-Sure** (Ammonium Sulfate Nitrate or ASN), which contains approximately 40% ammonium nitrate and 60% ammonium sulfate. Of these, Cal-Am most closely resembles Nitram in its nutrient content. Like Nitram, Cal-Am contains equal proportions of ammonium and nitrate nitrogen. Cal-Am is unsuitable for application in solution, e.g. in fertigation programs. Urea Ammonium Nitrate or UAN Solution (**EASY N**) may be used where nitrogen is to be applied in solution.

- Fertilisers containing more than 45% ammonium nitrate are classified as **SSAN** (Security Sensitive Ammonium Nitrate. Because of concerns that SSAN fertilisers may be misused as raw materials for explosives, the Council of Australian Governments (COAG) has implemented a licensing system to ensure these products are not freely available to members of the public. Licenses are only available to those who can demonstrate a legitimate need for SSAN, who will transport and secure it securely, and who are not of security concern. Dealers, Agents, transport operators and farmers who do not have a license to store, transport or use SSAN will not be supplied. **Cal-Am** is the only SSAN fertiliser listed on the Incitec Pivot product Range.

- In those States and Territories in which the SSAN licensing system has not yet been implemented, e.g. **South Australia**, Agents and Dealers should ensure nitrate fertilisers are stored securely, and be on the lookout for suspicious customers. It is prudent for Agents & Dealers to be mindful of the environment in which they operate and if they have any reason to believe a fertiliser is being purchased in suspicious circumstances they should report it to the police and to Incitec Pivot.

- **Potassium Nitrate**, which is classified as a **Dangerous Good**, must be transported in accordance with the Sixth Edition of the Australian Code for the Transport of Dangerous Goods by Road and Rail, and stored in accordance with Australian Standard AS 4326 - 1995.

- Potassium nitrate is not subject to the same licensing arrangements as SSAN. Ammonium nitrate fertilisers were considered the first priority, and have been acted on accordingly. Security arrangements with other fertilisers, including potassium nitrate, are being reviewed, and it is possible that some additional controls may be imposed on a few products in the future.

1. NITRATE FERTILISERS - WHAT MAKES THEM DIFFERENT?

Fertilisers contain nitrogen (N) in various forms, including amide (urea), ammonium (NH_4) and nitrate (NO_3). Each has their place and role in agriculture.

Nitrate is the form in which nitrogen is most commonly taken up by plant roots.

Nitrate fertilisers have a number of chemical and physical chemical characteristics that makes them different from other fertilisers.

Firstly, nitrate fertilisers may decompose when heated to release oxygen. This may cause fires to burn more intensely.

Secondly, when mixed with certain other products, the blend may be subject to self-sustaining decomposition. If exposed to heat, the blend may start to smoulder, releasing toxic gases in the process. This will continue until the entire mass of the fertiliser has been consumed, even if the original heat source is removed. It is Incitec Pivot's policy not to market any blend that is capable of self-sustaining decomposition.

Thirdly, nitrate fertilisers may be misused as a raw material in the preparation of explosives in politically motivated acts of violence. This has led the Council of Australian Governments (COAG) to classify a number of fertilisers as Security Sensitive Ammonium Nitrate (SSAN). Strict controls on their storage, transport and use have or are being implemented.

Finally, nitrate fertilisers typically do not store as well as other nitrogen fertilisers, such as urea and granulated ammonium sulfate (Gran-am). They are usually more hygroscopic, and take up moisture from the atmosphere more readily. While this does not influence their safety, it does have implications on how the products should be handled and stored.

While many factors influence the safety and security risk associated with nitrate fertilisers, the nitrate content is an important parameter. Straight ammonium nitrate is considered the highest risk product.

Examples of solid fertilisers containing nitrogen in the nitrate form that have been marketed by Incitec Pivot Limited are listed in the following table. Incitec Pivot has withdrawn Nitram, Liquifert Pinnacle and SQM Chili Borium Plus from sale.

Table 1 Fertilisers containing more than 10% nitrogen as nitrate.

Product	Name	% N (Total N)	% N as NO_3 (Nitrate N)
Ammonium Nitrate	Nitram* Liquifert Pinnacle	34	17
Sodium Nitrate (Nitrate of Soda)	SQM Chili Borium Plus	16	16
Calcium Nitrate	Yara Calcinit	15.5	14.4
Calcium Ammonium Nitrate (CAN)	Cal-Am	27	13.5
Potassium Nitrate	Prilled Potassium Nitrate Liquifert K Nitrate	13	13
Ammonium Sulfate Nitrate (ASN)	N-Sure	26	7

Nitram® is a registered trademark of Orica Australia Pty Ltd.

2. DANGEROUS GOODS LEGISLATION (OXIDISING AGENTS)

2.1 Oxidising Agents, what are they?

Nitrate has the chemical formula of NO_3. It contains three atoms of oxygen (O) to every one atom of nitrogen (N).

Ammonium nitrate, the fertiliser with the highest nitrate content, is actually comprised of 60% oxygen. The oxygen content of the fertilisers listed in Table 1 is shown in the following table.

Table 2. Oxygen content of commonly used nitrate fertilisers.

Product	% Oxygen (O)
Ammonium Nitrate (Nitram)	60
Sodium Nitrate	56
Calcium Nitrate (Yara Calcinit)	49
Calcium Ammonium Nitrate (Cal-Am)	46
Potassium Nitrate	45
Ammonium Sulfate Nitrate (N-Sure)	24

When subjected to heat, nitrate can decompose to release gases, including oxygen. In the event of a fire, this can cause the fire to burn more intensely.

Because of this characteristic, some compounds containing nitrate are classified as Oxidising Agents, and are given a Dangerous Goods (DG) code.

The nitrate (and oxygen) content is not the sole determinant of whether a product is classified as an Oxidising Agent. What other constituents are present is also of importance. Some constituents, such as calcium carbonate in Cal-Am, stabilise the product, others sensitise it to decomposition reactions.

Fertilisers that are classified as **Class 5.1 Oxidising Agents** include:

- Ammonium nitrate,
- Sodium nitrate and
- Potassium nitrate.

Depending on the concentration, blends, mixtures or compounds containing any of these fertilisers as ingredients may also be classified as Oxidising Agents.

Note: Urea contains 27% oxygen, but oxygen is not one of the decomposition products of urea. The gases that are liberated when urea is heated include ammonia and oxides of nitrogen. Urea does not contain nitrogen as nitrate. The nitrogen in urea is present in the amide form.

2.2 Transport and Storage of Oxidising Agents

On their own nitrate fertilisers are not combustible. However, if caught in a fire, they will decompose, releasing oxygen, which adds to the intensity of the blaze. This has important implications on how the products can be transported and stored.

Oxidising Agents such as ammonium nitrate, sodium nitrate and potassium nitrate must not be confined or mixed with combustible or flammable materials. They must not be carried with or stored near fire risk substances, e.g. fuel, hay, grain, agricultural chemicals, and timber. If wooden pallets are used, these must be hardwood, and periodically washed to remove all traces of nitrate.

Transport

Dangerous Goods such as ammonium nitrate, potassium nitrate and sodium nitrate must be transported in accordance with the **6th Edition of the Australian Code for the Transport of Dangerous Goods by Road and Rail.**

Licensing

A Dangerous Goods License is required for the transport of Dangerous Goods in bulk.

For solids, bulk transport occurs if the net contents of the cargo exceed 450 L or 400 kg.

A Dangerous Goods license is not required for the transport of
- Up to 3 000 L of dangerous goods in Intermediate Bulk Containers (IBCs), e.g. three standard 1 000 L bulk bags);
- Packaged fertilisers, i.e. small packs of 25, 40 or 50 kg, in any quantity.

Dangerous Goods driver licensing and training is subject to State Regulations.

Placarding.

If one tonne or more of a class 5.1 Oxidising Agent is carried, irrespective of the pack size, the vehicle must be placarded, showing:
- The Hazchem Code,
- The United Nations Number, and
- The DG Class 5.1 Oxidising Agent Diamond.

This means that placarding is necessary if the load consists of one pallet of bagged fertiliser or a single tonne bag.

Potassium Nitrate is the only fertiliser marketed by Incitec Pivot that is classified as an Oxidising Agent. The relevant codes and numbers for Potassium Nitrate are listed below.

- **Hazchem Code**: **1[Z]**
- **United Nations (UN) No**. **1486**
- **Packaging Group** **III**.

The Packaging Group denotes the type of packaging to be used. Incitec Pivot ensures that the packaging it uses for Potassium Nitrate complies with the necessary standards.

Source: Australian Dangerous Goods Code, Volume 2, Technical Appendices, 1998; written by Federal Office of Road Safety; published by the Australian Government Publishing Service, Canberra.

EPG

A **Transport Emergency Procedure Guide** (EPG) must be carried at all times when a Dangerous Good is being transported on public roads.

The EPG summarises some of the information in the Material Safety Data Sheet (MSDS) - see Section 6, and contains instructions on what to do in the event of an emergency.

The relevant EPG for Potassium Nitrate in the Australian and New Zealand Standard: SAA/SNZ HB76:1997 is **31**.

Storage

Class 5.1 Oxidising Agents such as potassium nitrate must be stored in accordance with **Australian Standard AS 4326 – 1995 (The storage and handling of Oxidising Agents).**

Various State and Local Government regulations may also apply. These vary, and are subject to change.

Above certain quantities, stores carrying potassium nitrate must be placarded, showing the Hazchem Code, UN No., and the Dangerous Good Class 5.1 Oxidising Agent Diamond.

“Outer Warning Placards” are required at all main entry gates and doorways.

Exemptions may apply to rural places, but there is still a “Duty of Care” to ensure workers and visitors are properly protected, and emergency personnel can respond in an appropriate manner in the event of a fire or other mishap.

Storage facilities should be made from materials that do not readily burn, and must be dry and well ventilated. The property should be fenced and secured to prevent unauthorised access. Inspect regularly.

Concrete floors are recommended, but the surface should be kept clean and spillage cleaned up promptly. Ammonium nitrate can react with calcium compounds in the concrete to form calcium nitrate and calcium nitrate aluminate. This can leave the surface pitted and pot-holed, which can endanger the safety of fork-lift drivers.

An epoxy coating can be used to protect concrete in areas that are not subject to heavy traffic.

Asphalt floors are more resistant to corrosion. These should contain no more than 7% bitumen as a binder.

Do not keep vehicles, including fork-lifts, overnight in storage sheds used for Class 5.1 Oxidising Agents. Equipment should be well maintained and checked regularly for leaks, e.g. of oil or hydraulic fluid. Servicing of equipment, e.g. grease and oil changes, should be done outside the building.

Oxidising Agents must be kept away from fires and other sources of heat. Keep them away from driers, and do not allow smoking or the use of naked lights in storage areas.

2.3 Primary Producers and Rural Places

Primary producers are not exempt from Dangerous Goods regulations applying to the transport of ammonium nitrate, potassium nitrate or sodium nitrate on public roads.

On farm, primary producers may be exempt from storage provisions provided they comply with the legislative definition of a Rural Place.

As an example, in Queensland, a rural place must meet the following requirements:

- > 5 ha;
- Used by the occupier for agricultural purposes;
- DGs and combustible liquids stored on the property must not be offered for resale.

However, in a practical sense primary producers have to comply with Dangerous Goods legislation, as they are required to reduce the risk associated with ammonium nitrate, potassium nitrate and sodium nitrate. This involves:

- Risk Assessment,
- Worker Training,
- Provision of PPE (personal protective and safety equipment),
- Keeping MSDS on hand,
- Preventing interaction between incompatible goods, and
- Preventing unauthorised access.

2.4 Blends

Depending on the concentration, blends in which Oxidising Agents such as Potassium Nitrate are used may also be classified as Dangerous Goods.

Dry solid blends containing ammonium nitrate can decompose when subjected to heat or a fire. Some formulations will continue to decompose when the fire or heat source is extinguished or removed, even when air is excluded. These fertilisers are said to be capable of “self-sustaining decomposition” and are called “cigar burners”. Toxic fumes are given off in the process.

N-Sure, when mixed with Muriate of Potash, may be subject to self-sustaining decomposition.

It is Incitec Pivot's policy not to sell any blend that is classified as being a Dangerous Good or is subject to self-sustaining decomposition.

Maximum concentrations have been set for the use of potassium nitrate in blends, and Blending Guidelines developed for the use of N-Sure to ensure that blends in which it is used are not capable of self-sustaining decomposition.

3. SECURITY SENSITIVE FERTILISERS

3.1 Security Sensitive Ammonium Nitrate (SSAN)

Nitrate compounds are used in the preparation of explosives for the mining and construction industries. Some of these compounds are also used as fertilisers.

Because of concerns that fertilisers may be misused by politically motivated terrorists, the Council of Australian Governments (COAG) has determined that any solid fertiliser containing more than 45% ammonium nitrate will be classified as Security Sensitive Ammonium Nitrate (SSAN).

The only fertiliser on the Incitec Pivot Product Range that is classified as SSAN is Cal-Am (Calcium ammonium nitrate).

Liquid fertilisers such as Urea Ammonium Nitrate Solution or UAN (EASY N) are excluded.

So too is Ammonium Sulfate Nitrate or ASN (N-Sure), which contains approximately 40% ammonium nitrate. This is below the threshold at which the product is classified as SSAN.

Under the new legislation, a license is required to manufacture, import, store, sell, transport or use SSAN.

These are additional requirements to those applying to any fertiliser classified as a Dangerous Good or Hazardous Substance.

The Dangerous Goods status of any product classified as SSAN will not change.

Cal-Am, for example, is classified as SSAN, but it is not classified as a Dangerous Good.

Further details are provided in the **Incitec Pivot "SSAN Storage and Transport Notes".**

3.2 Other Nitrate Fertilisers, including Potassium Nitrate and Calcium Nitrate

The COAG Review of Hazardous Materials is also considering security arrangements for other chemicals, biological agents and radiological materials.

Ammonium nitrate was considered the first priority, and was the first to be acted on.

It is possible that some controls, not necessarily as stringent as those applying to SSAN, may be implemented for other fertilisers, including potassium nitrate, and possibly calcium nitrate, in the future.

Incitec Pivot markets two grades of potassium nitrate, Prilled Potassium Nitrate and Liquifert K Nitrate. Solid calcium nitrate is marketed as Yara Calcinit.

Irrespective of the outcome of this review, those of us involved in the distribution and sale of fertilisers need to be aware that politically motivated terrorists, denied access to SSAN products, may turn to other less effective alternatives. We need to do whatever we can to prevent such unauthorised use.

In the interests of Australia's domestic security, potassium nitrate and calcium nitrate should only be sold to farmers.

These fertilisers should not be sold to home gardeners or anyone who does not have an account and is not known to the reseller. Establish the credentials of all new customers before supply.

Maintain records of who has been supplied with these products and the quantities involved.

Be on the watch for cash customers who are seeking to purchase one or two bags of any of these products. Refuse supply, and report suspicious inquiries to the police or on the National Terrorism Hotline (1800 123 400).

Theft of product either in transit or storage that may be misused for the preparation of explosives should also be reported to the police.

Suspicious inquiries for non-SSAN fertilisers, e.g. N-Sure or blends containing Cal-Am at concentrations up to 55%, may also be a signal that the purchaser does not intend to use the product as a fertiliser. These too should be reported.

Genuine inquiries for explosives should be referred to the Orica Explosives Group, (Phone 1300 302 784).

4. MATERIAL SAFETY DATA SHEET (MSDS)

Material Safety Data Sheets (MSDS) are available for all Incitec Pivot products.

MSDS contain information on the product's physical and chemical properties; transport, handling, storage and clean-up procedures; toxicological data and first aid.

It is a legal requirement that MSDS be made available for Dangerous Goods and Hazardous Substances

Ammonium nitrate, sodium nitrate and potassium nitrate are classified as Dangerous Goods.

Calcium nitrate is classified as a Hazardous Substance. Incitec Pivot markets calcium nitrate in two forms, a solid fertiliser known as Yara Calcinit, and a calcium nitrate solution known as EASY Cal.

A MSDS must be supplied on the first occasion a Dangerous Good or Hazardous Substance is supplied to a new customer; thereafter on any occasion the product is re-supplied after any change has been made to the MSDS; and on request.

While it is not a legal requirement to have MSDS for products that are neither a Dangerous Good nor a Hazardous Substance, it is Incitec Pivot's policy to have MSDS for all products that are offered for sale, and that these be made available on request. This is also a requirement of PACIA (Plastics and Chemicals Industry Association).

Increasingly, many companies and Government organisations will not buy from companies that cannot supply MSDS for their products.

In summary, it is a legal requirement that a MSDS be supplied for potassium nitrate (Prilled Potassium Nitrate and Liquifert K Nitrate) and calcium nitrate (Yara Calcinit and EASY Cal).

5. STORAGE & HANDLING CHARACTERISTICS, MAINTENANCE OF EQUIPMENT AND SAFETY CONSIDERATIONS

5.1 Critical Relative Humidity

The Critical Relative Humidity (CRH) is the relative humidity (at a given temperature) above which a fertiliser readily absorbs moisture from the atmosphere, and below which it will not absorb atmospheric moisture.

Ammonium nitrate fertilisers such as Cal-Am and N-Sure have a lower Critical Relative Humidity than many other commonly used nitrogen fertilisers such as urea and Gran-am (granulated ammonium sulfate).

Typically, the Critical Relative Humidity of blends is depressed further than that of the ingredient with the lowest Critical Relative Humidity.

Critical Relative Humidity values for various nitrogen fertilisers marketed by Incitec Pivot are shown in the following table.

Table 3: Critical Relative Humidity of various Incitec Pivot products.

Product(s)	%
Potassium Nitrate	90
Urea, Gran-am.	70 - 75
Nitram Blends	45 - 60
Cal-Am Blends	40 - 55

Cal-Am, N-Sure, and blends containing Cal-Am or N-Sure should be ordered as required and used quickly. They should not be stored for any length of time.

5.2 Heat Cycling

Ammonium nitrate and blends or compounds containing ammonium nitrate are subject to heat cycling.

If fertilisers containing ammonium nitrate are subjected to diurnal changes during which the temperature exceeds 33^{o} C, phase changes in the crystal structure of the ammonium nitrate will occur. In the evening or night, when the temperature falls, the ammonium nitrate reverts to its original crystal structure. This results in gradual and irreversible breakdown of the fertiliser particles. Eventually the granules will shatter and degrade to dust.

The degradation will be most evident towards the edges of the packs, which have been exposed to more heating.

This occurs in all solid fertilisers containing ammonium nitrate, including calcium ammonium nitrate (CAN), ammonium sulfate nitrate (ASN), and blends containing these products as ingredients.

Fertilisers containing ammonium nitrate should not be stored in the open, placed in sheds so that they are exposed to direct sunlight, or against the walls or rooves of buildings where extreme and fluctuating temperatures are experienced. They should be stored in a cool shaded part of the building. Do not store outside under tarpaulins.

5.3 Care of Equipment

All fertilisers are corrosive, but nitrate fertilisers tend to be more so than most.

Following application, machinery should be thoroughly cleaned by pouring sufficient water through it to dissolve any fertiliser particles or residues. Moving parts should be lubricated as recommended by the manufacturer.

Nitrate solutions may be corrosive to some metals and alloys, e.g. phospho-bronze and yellow brass. Stainless steel fittings may be required where concentrated solutions are prepared and used. Rinse all equipment thoroughly after use.

Flush irrigation lines by irrigating for some time after the fertiliser has been applied. Metering devices should be dismantled and thoroughly cleaned.

5.4 Maintenance

Nitrate fertilisers are not explosive, but there may be a violent reaction if they are heated while confined.

They become explosive if mixed with carbon (fuel) sources and detonated.

Knowledge of these characteristics helps ensure maintenance work can be done safely.

In machinery, fertiliser dust can come in contact with and mix with oils and lubricants. Fertiliser can also build up in confined spaces, e.g. around shafts and bearings.

Extreme care must be exercised when undertaking hot repair work such as welding, cutting, or straightening of machinery which has been used to handle or apply nitrate fertilisers, particularly when welding on hollow shafts of screw conveyers, augers and applicators. A thorough washing/cleaning of machinery is essential to remove all build up, deposits and caking before undertaking repair. If practical and safe, a vent should be provided as an additional precaution.

Serious accidents (including fatalities) have been recorded where nitrate fertiliser residues have been heated under confinement causing explosion and subsequent rupture of shafts or screws.

5.5 SH&E (Safety, Health and Environment)

Like other fertilisers, the dust from nitrate fertilisers can irritate the eyes, nasal passages and skin.

If ingested, nitrate fertilisers may cause nitrate poisoning (methaemaglobinemia). After ingestion, nitrate is converted to nitrite. When absorbed into the blood, nitrite combines with and takes the place of oxygen in the red blood cells, interfering with the transport of oxygen throughout the body.

Nitrite reduces oxyhaemoglobin (the oxygen carrier in the red blood cells) to methaemoglobin, which cannot carry oxygen. A lack of oxygen may cause breathing difficulties, cramps, disorientation, heart beat irregularities and a loss of blood pressure. In severe cases, it can be fatal.

Precautionary and first aid measures are discussed in more detail in the individual MSDS for Incitec Pivot nitrate fertilisers.

As with other fertilisers, contamination of waterways should be avoided. Spills should be cleaned up promptly. The loss of nitrogen fertilisers into surface water bodies may result in algal and excessive weed growth.

6. AGRONOMIC ADVICE

Knowledge of the situations in which nitrate fertilisers are used is important.

Firstly, with the removal of ammonium nitrate fertilisers (Nitram and Liquifert Pinnacle) from the Incitec Pivot product range, Dealers and Agents need to be in a position to advice on alternative products.

Secondly, a good knowledge of the situations in which nitrate fertilisers are likely to be used may assist in detecting inquiries for inappropriate or criminal purposes.

Table 4. Analyses of Dry Solid Fertilisers containing Nitrate Nitrogen, excluding Blends, NPK Compounds and Liquids.

Name	Product	Analysis			
		%N	%K	%S	%Ca
Ammonium Nitrate*	Nitram* Liquifert Pinnacle*	34			
Calcium Ammonium Nitrate (CAN)	Cal-Am	27			8
Ammonium Sulfate Nitrate (ASN)	N-Sure	26		14	
Sodium Nitrate*	SQM Chili Borium Plus*	16			
Calcium Nitrate	Yara Calcinit	15.5			19
Potassium Nitrate	Prilled Potassium Nitrate Liquifert K Nitrate	13	38.3		

* Incitec Pivot no longer markets these products.

6.01 Ammonium Nitrate (Nitram)

Ammonium nitrate contains 34% N, 17% in the ammonium (NH_4) form, 17% as nitrate (NO_3).

Plants take up most of their nitrogen from the soil as nitrate, though it can be taken up as ammonium. In the soil, ammonium is converted to nitrate by soil bacteria. This process is mostly complete within a matter of days under warm moist soil conditions. The process is slowed at low soil temperatures.

Ammonium nitrogen can be lost to the atmosphere through the volatilisation of ammonia gas when fertilisers that contain or form ammonium are applied to the soil surface without incorporation, e.g. covering harrows, irrigation or rain. Ammonium ions (NH_4^+) are positively charged and are attracted to and held tightly on the surface of soil colloids (clay and organic matter). If all the adsorption sites within the vicinity of the fertiliser granules are taken or filled by ammonium, or the soil is alkaline (has a high pH), then ammonium ions can be converted to ammonia (NH_3) and lost as a gas to the atmosphere.

$$NH_4^+ + OH^- \rightarrow NH_3\,(g) + H_2O$$

Fertiliser that has been applied into the soil, e.g. by cultivation, or is washed into the soil by rain or irrigation is not subject to volatilisation. This exposes the ammonium to a lot more adsorption sites in the soil.

All the nitrogen in urea and ammonium sulfate is subject to volatilisation, and half of that in ammonium nitrate.

Ammonium nitrate fertilisers are popular:

- where a quick response to nitrogen is required, e.g. side-dressing short season vegetable crops, and top-dressing pasture and forage crops during winter, when responses to fertilisers supplying all their nitrogen in the ammonium or amide forms may be slower;
- for top-dressing rain-grown crops and pastures where ammonia volatilisation losses may be high, e.g. on alkaline soils, and surface applications over the top of trash blankets in ratoon sugarcane.

In the past, Incitec Pivot marketed two fertiliser grades of ammonium nitrate:

- **Nitram** - used where ammonium nitrate was applied dry to the soil.
- **Liquifert Pinnacle** (chemically pure ammonium nitrate) was used where ammonium nitrate was applied in solution (dissolved in water), mostly in fertigation programs (applied via the irrigation water).

Alternatives to Nitram are Urea, Cal-Am and N-Sure.

Alternatives to Liquifert Pinnacle for use in fertigation programs are urea (Liquifert N and Liquifert Lo-Bi) and Urea Ammonium Nitrate or UAN Solution (EASY N).

Incitec Pivot is not able to offer an alternative to Liquifert Pinnacle for use in hydroponic solutions.

6.02 Urea

Urea (46% N) is the most concentrated solid nitrogen fertiliser, providing savings in freight, storage and application. It is a more economical source of nitrogen than ammonium nitrate.

Urea is not classified as a Dangerous Good, and is not subject to the same storage and transport regulations as ammonium nitrate.

Urea stores better. It has a higher Critical Relative Humidity than ammonium nitrate and is not subject to heat cycling.

Consequently, ammonium nitrate is not used to near the same extent as urea.

Urea is usually the preferred nitrogen fertiliser where the product can be applied into the soil or it can be incorporated by rain or irrigation.

6.03 UAN

Urea Ammonium Nitrate (UAN) Solution is marketed as EASY N.

EASY N is a liquid fertiliser containing approximately half its nitrogen as urea and half as ammonium nitrate. It contains 425g/L N or 42.5% N on a weight/volume basis (21.5% w/v as urea, 10.5% w/v as ammonium, and 10.5% w/v as nitrate). On a weight/weight basis, EASY N contains 320 g/kg N or 32% w/w N. UAN is not classified as a Dangerous Good.

EASY N is popular in fertigation, as it avoids the need to pre-mix (dissolve) dry fertilisers in water.

6.04 Calcium Ammonium Nitrate (CAN)

Incitec Pivot markets calcium ammonium nitrate as **Cal-Am.** It is not available in Tasmania.

Cal-Am is approximately 80% ammonium nitrate and 20% calcium carbonate (lime).

Due to the dilutant effect and relatively inert characteristics of the calcium carbonate, Cal-Am is not classified as a Dangerous Good. Alkaline materials such as calcium carbonate generally suppress the decomposition of ammonium nitrate.

Cal-Am is, however, classified as SSAN. A license is required to manufacture, import, store, sell, transport or use Cal-Am.

Cal-Am has an analysis of 27% N and 8% calcium (Ca).

Of the various nitrogen fertilisers available, calcium ammonium nitrate most closely resembles ammonium nitrate, in that it contains equal amounts of ammonium and nitrate nitrogen. It is the most commonly used alternative to Nitram.

To supply the same rate of nitrogen, Cal-Am needs to be applied at a 25% higher rate than Nitram.

Cal-Am is also used in blends.

Cal-Am is only suitable for dry application to the soil. It can not be used in place of Liquifert Pinnacle, as the calcium carbonate it contains is insoluble.

6.05 Cal-Gran

Cal-Gran is a blend comprised of 55% Cal-Am and 45% Gran-am. As such, it is not classified as SSAN, and can be used in place of Cal-Am without a SSAN licence.

Cal-Gran contains 23.9% N, 10.8% S and 4.4% Ca. 16.5% of the N is in the ammonium form, and 7.4% (31% of the total) as nitrate.

To supply the same rate of nitrogen, Cal-Gran needs to be applied at a 40% higher rate than Nitram, and 10 - 15% higher than Cal-Am.

There are also a number of NPK blends prefixed with the Cal-Gran name that are not classified as SSAN, e.g. Cal-Gran Aftergraze. Cal-Gran blends are not available in Tasmania.

6.06 Ammonium Sulfate Nitrate (ASN)

Incitec Pivot markets ammonium sulfate nitrate as **N-Sure**. It is also used as a blend ingredient. N-Sure is not available ex Primary Distribution Centres in NSW and Queensland.

N-Sure is approximately 60% ammonium sulfate and 40% ammonium nitrate, and has an analysis of 26% N and 14% sulfur (S). 19% of the nitrogen is in the ammonium form, and 7% as nitrate.

To supply the same rate of nitrogen, N-Sure needs to be applied at a 30% higher rate than Nitram.

N-Sure is not classified as a Dangerous Good, nor is it classified as Security Sensitive Ammonium Nitrate (SSAN).

6.07 Sodium Nitrate

Use of sodium nitrate was confined to tobacco in north Queensland. With the demise of this industry, sodium nitrate is no longer in demand. Incitec Pivot has deleted Sodium Nitrate from its Product Range.

6.08 Calcium Nitrate

Incitec Pivot markets calcium nitrate as **Yara Calcinit**, a soluble imported product.

Yara Calcinit has two major uses in agriculture:

- as a soluble calcium fertiliser in fertigation programs and in foliar sprays;
- as a non-acidifying nitrogen fertiliser through drip and trickle irrigation systems, and under-tree sprinklers. Straight nitrogen fertilisers such as urea and ammonium nitrate acidify the soil around the emitters. Other nitrate fertilisers such as potassium nitrate and calcium nitrate do not.

Note. Incitec Pivot also markets a liquid fertiliser containing calcium nitrate. This product is known as EASY Cal. It contains 12.6% w/w (126 g/L) N and 18.1% w/w (181 g/L) Ca. On a w/w basis, EASY Cal contains 8.4% or 84 g/kg N and 12% or 120 g/kg Ca.

6.09 Potassium Nitrate

Potassium nitrate is used as a potassium fertiliser rather than as a nitrogen fertiliser, even though the nitrogen it contains is of importance in nutritional programs. It is used in fertigation programs, foliar sprays, horticulture and cotton.

There are three commonly used potassium fertilisers, Muriate of Potash, Sulfate of Potash and Potassium Nitrate.

Muriate of Potash (potassium chloride) is the most economical and therefore the most commonly used potassium fertiliser.

Sulfate of Potash (potassium sulfate) and Potassium Nitrate are used in preference to Muriate of Potash in crops and soils in which the chloride in Muriate of Potash is likely to be detrimental, and in foliar sprays in which chloride will burn the leaves.

Potassium Nitrate is more soluble than Sulfate of Potash, and is preferred to the latter where concentrated potassium solutions are required, e.g. for injection into irrigation lines (fertigation) and low volume foliar sprays.

The solubility of the three potassium fertilisers in water is shown in the following table.

Table 5: Solubility (kg/100 L) of Potassium Fertilisers in Water at 20^0 C.

PRODUCT	Solubility (kg/100 L) at 20^0 C.
Potassium chloride	34
Potassium nitrate	32
Potassium sulfate	11

For low volume foliar sprays in crops such as cotton, there is really only one choice, Potassium Nitrate. Potassium Sulfate isn't soluble enough, while it is recommended that chloride be avoided in foliar sprays to minimise leaf burn.

Potassium nitrate is compatible in solution with calcium fertilisers, e.g. Yara Calcinit, whereas potassium sulfate is not. Calcium sulfate (gypsum) will be precipitated if potassium sulfate and calcium nitrate are added to the same mixing tank.

Incitec Pivot markets two potassium nitrate fertilisers:

- **Prilled Potassium Nitrate** – for dry application to the soil;
- **Liquifert K Nitrate** – for application in solution.

Prilled Potassium Nitrate is also used as a blend ingredient.

The maximum concentration of Prilled Potassium Nitrate used by Incitec Pivot in dry granular blended fertilisers is 60%. Above this concentration, the blend is likely to be classified as a Dangerous Good. Depending on what other ingredients are used, the maximum concentration may need to be set at a lower limit.

Incitec Pivot will not market blends containing potassium nitrate that are classified as being a Dangerous Good.

6.10 Cal-Am and N-Sure Blends

Cal-Am blends, including the Cal-Gran range, are available in most areas.

N-Sure blends are available in southern Australia, but not ex Port Kembla or Newcastle, and Incitec Pivot supply centres in Queensland.

Both Cal-Am and N-Sure can be requested as a blend ingredient in Custom Blends.

The maximum concentration of Cal-Am that can be requested in a Custom Blend by customers who do not have A SSAN licence is 55%.

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