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Silo Management

April 2007

Incitec Pivot

Bulk Saves!

- Packaging Costs
- Handling
- Time

Dealers, Agents & Graingrowers often use silos to store fertiliser.

- Back-loading fertilisers in bulk saves on freight.
- Fertiliser can be stored in advance of peak demand periods, e.g. planting, safeguarding against short supply should everyone order at the same time.
- Use can be made of existing bulk handling equipment, e.g. augers.
- Grain silos, however, are not suitable for fertiliser:
 - Fertilisers are more dense, requiring a sturdier silo design;
 - Fertilisers do not flow as readily, requiring a steeper angle on the cone (minimum of 45°);
 - Fertilisers are corrosive, requiring protective coatings or corrosion resistant materials, e.g. stainless steel.

Australian Standards relating to Silo Design

- **AS 1170** **SAA Loading Codes**
- **AS 1170.1** **Part 1: Dead and live loads and load combinations**
- **AS 1170.2** **Part 2: Wind loads**
- **AS 3774** **SAA Loads on bulk solids containers**
- **AS 3773** **SAA Bulk solids containers - safety requirements**
- **AS 1657** **SAA Fixed platforms, walkways and ladders**

AS 3773 states that “containers (silos) shall not be used or modified for the storage of materials other than that for which they were designed”, and requires that a plate be fixed to the silo displaying the:

- **Manufacturer’s name**
- **Model type**
- **Maximum load in tonnes**
- **Cubic capacity, in m³**
- **Serial number**

Base Cone Angle

- Most fertilisers have an angle of repose of around 35° ;
- A cone angle of at least 45° is required to ensure the fertiliser will flow from the silo.

Grain silos have a cone angle of $35 - 40^{\circ}$.

Top Cone Angle

- 30° required to accommodate a load where belt conveyors are used.

Belt Conveyors should not exceed 30° in elevation.

The Bulk Density of fertiliser varies!

Product	Bulk Density (kg/cubic metre)
Granulated Urea	700 – 780
Gran-am	850 – 900
MAP	900 – 1 050
Triple Super	1 050 – 1 150

The Bulk Density of all fertilisers likely to be stored in the silo must be known to determine:

- A.** The volumetric capacity (cubic metres) required to take a given quantity (tonnage) of fertiliser - use lowest figure in range;
- B.** The maximum load (weight) of fertiliser that may be placed in the silo - use highest figure in range.

BLENDS

- The Bulk Density of a Blend can be calculated if the Bulk Density of the various ingredients is known;
- Incitec Pivot can advise you on the formulations of Blends if this information is required.

Don't Overload Silos.

- Do not completely fill the silo if higher density products than those originally contemplated are used in the future;
- The silo must only be filled within its design strength.

Fertilisers are Corrosive!

- Two coats of epoxy paint are required on internal surfaces to minimise corrosion.
- Silos constructed of stainless steel or fibre glass do not require internal protection.

Other Considerations in Silo Design

- Clearance of about 1 metre is needed under the outlet to accommodate a load-out conveyor.
- The outlet slide gate should be 300 mm square and made of stainless steel, as too should bolts and nuts.
- It is recommended that an “inspection opening” be designed into the base cone. The cover should be a flush fit with the internal surface.
- The lid at the top of the silo should be able to be opened by links or cables from the ground, avoiding the need to climb the silo.

Foundations

- Seek qualified advice on their construction.
- Must be designed and correctly installed to support the maximum possible load.

Locate silos away from powerlines so that conveyors, augers and bulk tippers do not come in contact with live wires.

Not all fertilisers
can be stored
in silos!

Some factors that affect storage characteristics of fertilisers.

- Critical Relative Humidity (CRH);
- Level and type of impurities in the fertiliser, e.g. magnesium, iron;
- Dryness and hardness of the fertiliser granules;
- Fertilizer coatings, over/under oiling;
- Fines and dust;
- Atmospheric conditions (humidity, temperature).

Given the length of the supply chain, many of these factors are beyond the control of individuals, farmers and companies, e.g. Fertiliser Suppliers and Dealers.

Fertiliser manufacturers may also be restricted in their choice of raw materials.

Critical Relative Humidity

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.

Critical Relative Humidity (%)

SuPerfect, Super (SSP),	80 – 85
MAP, Urea, Gran-am,	70 – 75
DAP, Triple Super (TSP),	< 70
Zinc sulfate monohydrate,	55 – 60
Cal-Am.	50 – 60

- DAP, Cal-Am and Blends containing Zinc Sulfate Monohydrate should not be placed in silos.
- Incitec Pivot Super (SSP), despite its high CRH, should not be placed in silos as it is not fully dried, and has a wider size range than fully granulated high analysis phosphorus fertilisers.
- SuPerfect, which is dried to a lower moisture content, can be placed in silos.

Usually, the Critical Relative Humidity (CRH) of a blend will at best be no better than that of the poorest ingredient.



Often the CRH is depressed below this point!

The Weather



- Weather conditions, e.g. humidity, and the length of time in storage can affect fertiliser quality.
- Do not fill the silo to the extent that the fertiliser comes in contact with the roof, as condensation from the roof can adversely affect the fertiliser.
- Ensure covers are tightly closed when not in use.

Some silos are fitted with vacuum top lids.

This minimises uptake of atmospheric moisture.

Such silos are preferred, if not essential in some circumstances, e.g. for blended fertilisers.

STORAGE GUIDELINES

- As problems occasionally arise with products that store well most of the time, it is not possible to assure customers that certain products can be safely stored in silos without mishap, or that they can be stored for an indefinite period of time.
- Silos should only be used for short term storage.
- Fertiliser should be ordered close to the time of intended use, and not stored from one season to the next.
- In general:
 - MAP stores better than DAP.
 - Straights > Blends
 - DAP (and blends containing it) should not be placed in silos.

Ideally, storage systems other than silos should be used to store bulk fertiliser.

Silos are used for practical reasons, e.g. availability and convenience.

Products that may be stored in silos for a limited time.	Products that should not be stored in silos.
<p>Straights</p> <ul style="list-style-type: none"> • Granulated Urea • Gran-am • MAP • Granulock* Products • Triple Super • Superfos • SuPerfect <p>Blends</p> <ul style="list-style-type: none"> • Urea + Gran-am • Urea + MAP • Urea + Granulock • Urea + Gran-am + Granulock 	<ul style="list-style-type: none"> • Cal-am • Cal-am Blends • DAP • DAP Blends • Sugarcane NPK Blends • Blends containing Zinc sulfate monohydrate • Super - ex Newcastle, and that sold in or sourced from Tasmania. • Super Potash Blends

Blends require very careful management.

They should only be ordered when required, i.e. for immediate use.

Blends should not be purchased and stored in advance of the season.

Filling & Emptying Silos

- It is preferable to use a belt conveyor, e.g. Multiveyor, rather than an auger. The latter are more likely to crack fertiliser granules, damage or remove coating agents on the fertilizer, and generate dust, thereby adversely affecting storage characteristics.
- Maintain augers in good condition. Worn augers are more likely to damage the fertiliser.
- Belt conveyors will not operate above an elevation of 30⁰.
- Do not move fertilisers around any more than is absolutely necessary.
- Do not allow fertiliser to get wet during handling operations, e.g. in the rain. Do not place damp fertiliser in silos.

Silo Operation

- Do not store fertiliser in silos for longer than is necessary, or from one season to the next.
- Keep silos locked when unattended or deny access. Ensure external ladders are above child height.
- When taking fertilizer from a silo, **ensure the top lid is fully open**. If this is not done, a vacuum may form, causing the silo to implode.
- Do not enter a silo while it is being filled or emptied.

Silo Maintenance

- Inspect foundations for signs of sinking or cracking.
- Inspect external walls and the steel base for signs of corrosion, e.g. to structural welds and joints.
- Regularly check and keep lower slide openings free of built up fertiliser.
- After use, e.g. at end of season, empty and clean the silo. Do not wash out. Check internally for signs of rust.
- Repair corrosion as it is found, to prolong the life of the silo.
- If the silo, its supports or foundations are damaged in any way, e.g. by a truck or auger while transferring fertiliser, have them inspected and repaired if necessary by a qualified engineer.

Working in Silos

- The atmosphere in confined spaces can be dangerous, while high internal temperatures can result in heat stress.
- Before entering the silo, refer to the Australian and New Zealand Standard **AS/NZS 2685:2001** on **“Safe Working in a Confined Space”**.
- At least two people must be in attendance, with one person remaining outside the silo at all times.
- Turn off conveyors and augers, and make sure they can not be started while someone is inside the silo.
- Take care on ladders and walkways. Ensure proper safety equipment is worn and used.

If fertiliser hangs up in a silo

- Take extreme care - silos can collapse on their side if fertiliser flows from one side of the silo, and hangs up on the other.
- Refer to the Silo Manufacturer's Advice on how to deal with the situation.
- Advise people in the vicinity to remain at a safe distance.
- Before approaching the silo, ensure you have a clear exit/escape route should it be required.
- Do not work on or under the silo if there is any chance of it collapsing.

Getting fertiliser to flow again

- Tap on the cone of the silo with a rubber mallet.
- Do not use steel hammers, as they may damage the internal epoxy coat.
- If working from the bottom chute, do not open it more than necessary, to minimise the risk of large lumps striking the operator.
- Do not enter the silo.

In Summary . . .

- Only use silos designed for fertiliser.
- Belt conveyors are better than screw augers.
- Avoid excessive handling, e.g. through screw augers,
Worn auger flights will damage (grind) fertiliser.
- Purchase fertiliser close to the time of intended use,
do not store from one season to the next. Use blends
quickly.
- Ensure product does not get wet in transit or during handling,
e.g. when filling the silo.
- Keep silos locked and closed when unattended.
- Never enter a silo when the bottom chute is open.
- If you have to work in a silo, do so in accordance with **AS/NZS 2865:2001 Safe Working in a Confined Space.**

Other Considerations

- Bulk Bags should not be used to fill silos. Working beneath a suspended bag above a silo is an unsafe practice.
- If a fertiliser silo is used to store grain out of season, clean it out thoroughly between uses:
 - Unwanted grain may constitute a weed threat in crops in which the fertiliser is used.
 - Phosphorus fertiliser dust may add to cadmium concentrations in grain used for human consumption.

Grain Fumigants

- If a grain fumigant has been used to control insects while grain has been stored in the silo, refer to the following before entering the silo:
 - AS/NZS 2865:2001 Safe Working in a Confined Space
 - The Grain Fumigant Product Label
 - Instructions provided by the Silo Manufacturer
- Where Phosphine has been used, it is recommended that the level in the silo be checked before re-entry.
- In the absence of sophisticated testing equipment, the silo should be allowed to vent naturally for 7 - 10 days, depending on wind conditions and the size of the silo, before entering it.
- An approved air respirator should be worn when working in a silo that has been fumigated, i.e. full faced respirator fitted with a cartridge that provides protection against Phosphine vapour.
- Self contained breathing apparatus should also be available for emergency use by a stand-by observer.

An Agritopic is available from Incitec Pivot, its Agents and Dealers in which the storage of fertilisers in silos is discussed in more detail.



AGRITOPIC
March 2004

GUIDANCE NOTES FOR STORING FERTILIZER IN SILOS

1. BULK HANDLING SYSTEMS

These days, most fertilizers in Australia are handled in bulk.

Bulk or Tonne Bags have proven popular in the horticultural, sugarcane and dairying industries.

Most grain growers use true bulk systems, often making use of existing bulk handling equipment.

In grain crops, there is often a narrow window of time in which to apply fertilizer, e.g. at planting, whereas other primary producers may apply fertilizer over a period of many months. To ensure fertilizer is on hand when required, it is often purchased in advance of peak demand periods and stored on farm. It would be physically impossible to meet the demand, i.e. dispatch and arrange transport, if growers only ordered their fertilizer when it was needed.

On farm storage systems are required.

Ideally, bulk fertilizers should be stored in properly constructed bays in closed sheds.

Such facilities, and the equipment to handle fertilizer in this way, e.g. end-loaders, are not available on most grain farms.

Instead, most grain growers make use of silos and belt conveyors or augers to store and handle fertilizer on farm in bulk.

These Guidance Notes have been prepared to help fertilizer Agents, Dealers and farmers manage bulk fertilizer in silos.

Only certain fertilizers can be stored in silos, and then only for a short period of time. Fertilizer should be purchased as close as possible to the time that it will be needed, and not stored in silos from one season to the next.

Regrettably, due to inherent variability in fertilizer quality and other external factors, e.g. prevailing weather patterns and the condition of the silo, problems may occasionally be experienced after only a short period of time in storage, e.g. product setting and hanging up in the silo. Sometimes, this may occur within a matter of days.

Blends do not store as well as straight fertilizers. Blends should be ordered as required, and only placed in silos as an interim measure.

TAKE ALL PRECAUTIONS TO PREVENT THIS





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