Aeration increases marketing choices

Growing numbers of farmers are installing aeration systems on-farm to maintain the quality of stored grain and suppress mould and insect pests. This article explains how aeration works and outlines the harvesting and marketing benefits it provides.

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Growers who use aeration to cool or dry farm stored grain can start harvest earlier and achieve greater marketing flexibility.

Over moist grain can be cooled and safely stored until drying facilities become available or can be dried in-store where a suitable aeration drying system is installed.

Harvesting early avoids potential grain damage from late rainfalls and catches the grain closer to its quality peak. Safe storage of grain using aeration on-farm allows it to be sold later in the year when prices could be higher.

What is aeration?

Aeration involves pumping the air from outside a silo through a grain bulk using an arrangement of ducts, exhaust vents and fans. The grain can be either cooled or dried depending on how fast the air is pumped through (see Figure 1).

As well as cooling or drying grain, aeration can be used to even out the moisture content of grain, suppress self-heating of grain and prevent moisture migration in grain stored long-term.

Aeration also can be used to maintain the oil quality of oilseeds during storage, preserve the germination rate and vigour of malting barley and retain the colour of pulses.

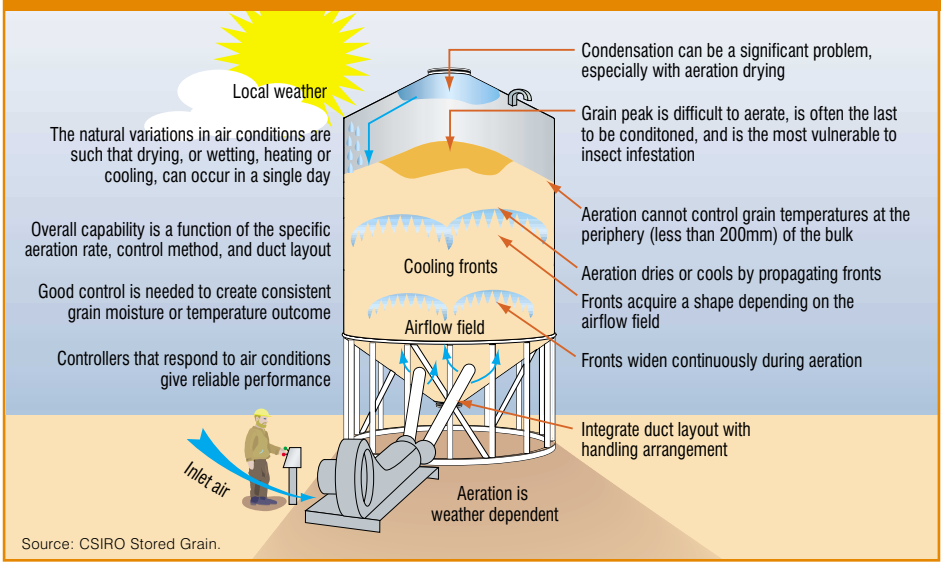
The effectiveness of aeration depends on the temperature and humidity of the surrounding air. Air conditions are cyclic and grain can absorb or lose moisture and heat within a single day. Grain only will be dried or cooled if the air being pumped through the grain is drier or cooler than the air surrounding the stored grain.

Cool air of low humidity will cool and dry the grain quickly and an effective aeration system will use a controller to select the most suitable air.

At a glance

- Aeration allows grain to be stored safely without risk of quality loss, moulding or insect attack.
- Safe storage of moist grain enables harvest to start earlier and run for longer each day.
- Grain can be stored on-farm and sold throughout the year when prices could be higher.
- Aeration can be used to cool or dry grain but aeration drying is more expensive and complicated than aeration cooling.

FIGURE 1 Aeration system for on-farm grain storage



The aeration process

Aeration gradually changes the moisture content and temperature of a grain bulk through the progression of air fronts pumped through the grain.

Two types of fronts occur — temperature and moisture — and these pass through the grain bulk from the air inlet to the outlet at different speeds. The dimensions and shape of these fronts depend on the location of the ducting and the formation of the grain pile.

The rate at which the temperature and moisture fronts pass through the grain depends on the airflow rate of the fan used relative to the amount of grain being aerated and is known as the specific aeration rate.

The time taken to complete an aeration process is proportional to the specific aeration rate and the time the fan is operated.

Technical requirements

Fan size and output and the duct type and arrangement determine the rate of delivery and effective distribution of air into the grain bulk. Grain type, bulk density and condition and the percentage of fine screenings all influence the rate at which fan forced air moves through the grain bulk.

Small grains such as canola restrict airflow more than coarser cereals such as wheat.

To cool grain, air within the grain bulk needs to be changed up to 1500 times while grain drying can require up to 100,000 air cycles to remove moisture trapped between individual grains.

The grain in the bulk core will be cooled or dried more quickly than grain on the outer edge.

The top of a grain bulk is often the last part to be dried or cooled and because of this can be vulnerable to insect infestation or quality loss. This is particularly true when high moisture grain is stored.

The success of aeration will therefore largely depend on effective cooling and drying of the outer edges of the grain pile to avoid quality loss.

Capacity of the aeration system

The capacity of an aeration system to deliver air into a grain bulk is based on the specific aeration rate, the control method used to select air from outside the silo and the duct layout within the silo.

The specific aeration rate (litres of air per second per tonne of grain) determines the amount of air a fan can potentially force through a grain bulk.

The control method used to select air determines the suitability of incoming air to cool and dry a grain bulk.

The rate at which grain is cooled or dried depends on the rate of airflow through the grain and the air selection. A well designed

duct layout will improve the rate and uniformity of air distribution to all parts of the grain bulk.

Using an aeration controller enables the coolest, driest air to be selected from outside the silo and increases the rate at which the grain is cooled or dried. The rate at which the grain is conditioned will determine the success of the particular aeration system.

Cooling grain

Aeration cooling systems cool grain during summer to a target temperature and are used to maintain grain quality, suppress insect pests and prevent moisture movement and condensation.

Aeration cooling also can be used to store moist grain safely within limits.

The aeration system used will differ depending on the type and initial condition of the grain stored.

For example, the safe storage of moist grain can require a different aeration process and canola and malting barley are likely to differ in their requirements.

Benefits of aeration cooling

Aeration cooling of stored grain evens out the moisture and temperature of the grain pile and suppresses mould and insect growth.

The ability to even out moisture enables the crop to be harvested earlier at slightly higher moisture levels and then outturned to the market requirement.

Other benefits of grain cooling include stabilising oil quality in oil seeds, maintenance of malting grade in barley, preserving germination and seed vigour and reduced need for chemical control of insects in grain.

Drying grain

Aeration drying removes moisture from grain which improves marketing flexibility during harvest by enabling growers to decide when and where they will deliver their grain for sale.

Using aeration to dry grain allows grain to be harvested at higher moisture levels than those accepted at grain receival points.

Crops can be harvested at higher moisture contents, rapidly cooled for safe storage, and then dried gradually over several months.

The amount of drying achieved during storage depends on the capacity of the aeration system and the availability of suitable air.

Rapid cooling using a high capacity system also enables wet grain to be safely stored short-term until grain drying facilities become available.

Used successfully, aeration drying maintains the quality of over moist grain but wet grain will rapidly self heat and spoil if not managed properly.

Aeration drying is of particular benefit to growers in humid areas who regularly experience wet finishes to the season and subsequent downgrading of their grain.

By harvesting early, coastal growers can lessen the risk of rainfall spoiling their crops and then use aeration to store the moist grain safely and gradually dry it to receival limits.

Aeration drying more demanding

Aeration drying requires faster drying rates (greater than six litres of air per second per tonne) and costs more to install and operate than aeration cooling systems.

Based on the first season of use, aeration cooling costs can range from $7–$15 per tonne of grain to establish while aeration drying costs $10–$40/t. Operating costs range from $0.20–$2/t for cooling and $2.50–$15/t for drying.

Successful aeration drying requires a better technical understanding of aeration than aeration cooling. Aeration drying takes longer to dry grain than a heated air dryer.

Grain will become mouldy within weeks if over moist grain is not cooled quickly and it is critical the drying front is distributed rapidly throughout the grain bulk in drying systems. Such systems require an adequately rated fan, good airflow distribution and dedicated automatic control.

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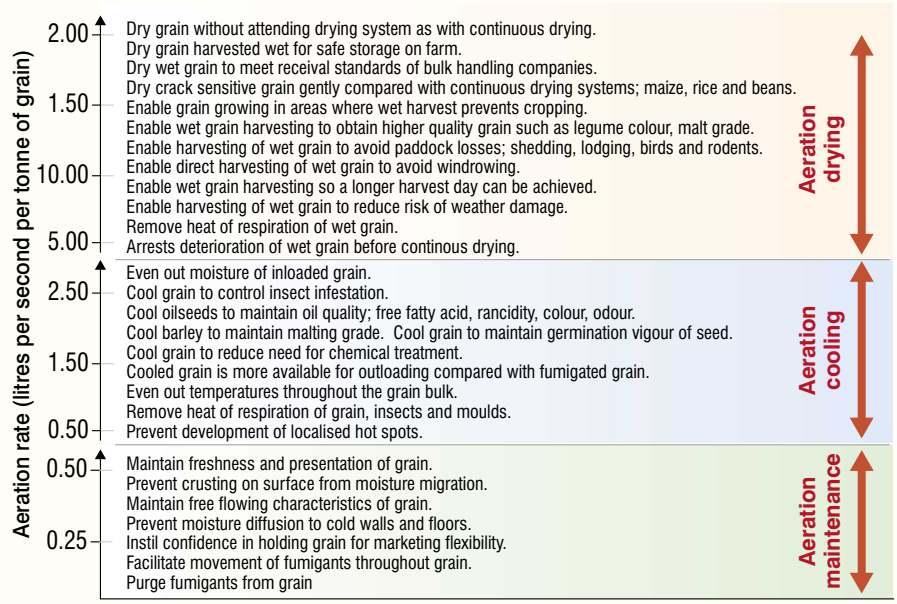
FIGURE 2 Characteristics of different aeration systems



Source: CSIRO Stored Grain

Seek advice from manufacturers and distributors of specialised aeration equipment before installing an aeration drying system.

Choosing an aeration system

Before investing in an aeration system it is important to identify the outcomes required.

For example, where grain cooling is the main requirement it might not be cost-effective to install equipment with the capacity to dry grain.

To select an aeration system (see Figure 2), identify the store and seed type to be aerated and define the benefits and opportunities.

Determine the harvest and store loading patterns (wet versus dry grain) and establish duct and venting options to match.

Establish if local weather conditions will permit drying and cooling to the required targets. Investigate aeration system options and costs to determine if the system will be cost effective for the farming system.

A well-designed aeration system will take into account the time required to complete the aeration process, the likely moisture and temperature conditions of the incoming grain and the quality conditions that could change in the grain pile under certain conditions.

An aeration system might perform inefficiently if the moisture content and temperature of the grain exceed the planned harvest and store loading patterns. Selecting an aeration system with a larger capacity than required will achieve aeration outcomes more rapidly, with improved flexibility.

Positioning and selection of the fan, ductwork and vents requires careful consideration, especially for aeration drying systems. Seek the advice of an experienced aeration equipment supplier when selecting aerating equipment.

For more information contact Len Caddick by email at Len.Caddick@csiro.au, phone (02) 6246 4214, fax (02) 6246 4202 or visit http://sgrl.csiro.au.

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System allows grain to be sold when prices peak

Farm information

Farmers
Brett and Lorraine and Gavin and Sue Roberts

Location
Balaklava, South Australia

Property size
3500ha

Enterprise
Cropping

Annual rainfall
400mm

Soil type and pH
Mallee loams

Installing an aeration system has allowed Brett and Gavin Roberts, Balaklava, South Australia, to store grain on-farm and take advantage of higher prices throughout the year.

Before storing aerated grain on-farm, the Roberts had to offload their grain, as it was harvested, at the local grain receival point 30km away. Aeration also has given the Roberts improved flexibility during harvest.

Harvest now starts earlier in the season and lasts about two hours longer each day as aeration enables the Roberts to store over moist grain for several months without risk of moulding or insect attack.

Aeration retains the colour of the Roberts' faba beans, preserves germination and vigour of their malting barley and maintains oil quality in canola.

Better returns from stored grain

The Roberts estimated that grain downgraded at the local receival point was costing them 10 per cent of their gross margins.

Since installing aeration equipment to cool stored grain, the Roberts have not received any discounts for their grain when sold later in the season either directly to Adelaide Port or locally.

Aeration cooling enables the Roberts to harvest cereals at 14–15% moisture content and then gradually even out the moisture and dry the grain over several months to industry receival limits of 12–12.5%.

Initial rapid cooling of the grain prevents quality loss. Harvesting early minimises the risk of rain damage to the crop and also captures the grain at its quality peak.

Aeration of stored grain provides Brett and Gavin Roberts with greater harvest flexibility and marketing choices.

The Roberts have recouped the minor cost (about $700 per silo) of setting up their aeration cooling silos through freight savings at harvest.

Four, 1000-tonne capacity silos have been fitted with a 3.7 kilowatts fan system to pump air through the silos.

The fans are connected to a computer-driven controller that ensures only cool, dry air is pumped into the silo. This speeds the cooling process and evens out the temperature of the grain bulk to about 20 degrees Celsius.