



Aerating stored grain

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Aeration passes controlled amounts of air through stored grain. It keeps temperature and moisture levels throughout the grain mass more uniform.

Performance depends on air temperature and humidity, grain temperature and moisture content, and air flow rate.

Aeration protects stored grain against three major causes of quality loss:
Moisture, Insects, and Moulds

Moisture migration

Uneven temperatures throughout stored grain cause air movements that carry moisture from warm areas to cool areas.

Aeration minimises moisture migration by reducing temperature differences

Spoilage occurs in the high moisture areas of grain as shown in Figure 1.

► Why aeration?

Grain handlers use aeration for a range of quality related reasons, including to:

- store damp grain longer;
- reduce condensation and caking;
- avoid 'hot spots' in stored grain;
- maintain seed viability;
- retard grain insect development;
- slow mould and fungal growth; and
- avoid use of chemical protectants.

Aeration reduces insect activity in stored grain very effectively, but does not usually kill insects. Extra treatment may be needed if totally insect-free grain is needed.

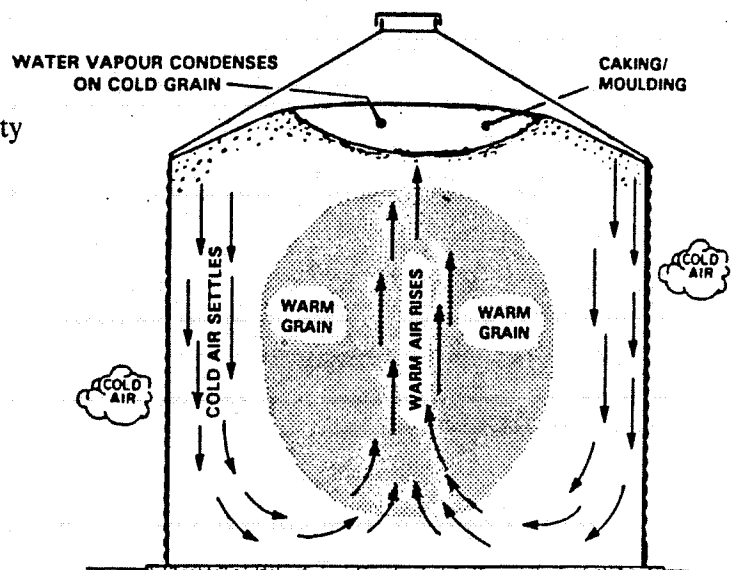


Figure 1 Example of moisture damage in a non-aerated silo. cont'd

► Insects

Insects eat stored grain, and encourage further damage by releasing heat and moisture.

Aeration controls temperature and moisture levels in stored grain, and therefore decreases insect problems

► Moulds

Mould growth depends on temperature and moisture, but between 15°C and 40°C moulds need much more moisture than insects to develop.

Aeration gives short term control of mould in high moisture grain

► Equipment

Aeration systems usually include:

- fan and motor;
- ducting to carry air to the storage;
- perforated ducting to distribute air within the storage; and
- a controller to switch the fan on when air conditions are favourable.

Openings are needed at the top of storages to allow exhaust air out and prevent excessive back-pressure. This is especially important if aeration is used on sealed storages - a venting system must be provided on the roof.

**Reduce heating from sunshine by:
shading the storage;
painting the external surfaces white; or
using Zinalume® silos.**

Poorly-matched equipment seriously reduces aeration performance.

Buy your equipment from experienced aeration firms that supply detailed operating instructions.

► How does aeration work?

The temperature and relative humidity of air, and the moisture content of the grain determine the effect of aeration on grain. Grain temperature has little effect.

Low air temperatures provide a good guide to conditions that are suitable for aeration. Aeration cools grain by transferring heat from the grain to the air - this heat is carried out of the grain bulk with the exhaust air.

The air may also remove a small amount of moisture from the grain, causing an evaporative cooling effect. As a result, high moisture grain usually cools more than low moisture grain.

► Controlling aeration

Automatic controllers

Automatic controllers are efficient, convenient and need little operator supervision. The CSIRO-developed time-proportioning controller (TPC) changes its thermostat setting automatically to select the coolest available air.

The cost of an automatic controller is offset by its benefits, particularly the lower risk of grain loss due to poor storage conditions

Automatic controllers add little to the initial cost per tonne of most storages but can quickly pay for themselves through better grain quality and less supervision.

Manual control

Selecting the best operating conditions is very difficult if a system is manually switched on and off, or controlled using thermostats or timers.

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The most favourable cooling conditions are usually sometime between midnight and dawn.

At this time of the night, operators are unlikely to manually switch fans on and off at ideal times. Fans are often started during the evening and run through the night, so the first hours of aeration are likely to warm previously cooled grain.

Time clocks switch fans on and off at preset times. This is convenient, but unless they are adjusted regularly their performance is likely to be worse than manual switching.

Air conditions at a particular time of day can vary widely from one day to the next, resulting in reheating or moistening of grain.

Timers are best avoided unless you are willing to reset them each day.

Thermostats have similar drawbacks to timers. They start aeration fans when air dry-bulb temperatures fall below a set temperature.

But picking a suitable temperature is not simple - too low, and the fans may not run at all; too high, and the air will reheat grain that has already been cooled.

► When to aerate

Excessive fan operation reduces the benefits of aeration. Operators who allow their systems to run continuously are headed for trouble - grain may not cool as rapidly, and temperatures or moisture levels may increase.

Automatic controllers based on the CSIRO system are currently the most reliable method of maintaining long-term aeration performance. If a controller is not used, the following guidelines will help you to get most benefit.

Whatever system you use, check the grain condition regularly.

The smell of air exhausting from the grain during aeration is a good guide to grain condition.

Freshly harvested, low moisture grain

Start aerating immediately after freshly-harvested, low moisture (10-15%) grain enters storage, even if air temperatures are high.

Run the fans for the coolest 80-90 hours each week during the first few weeks when grain is warmest. This intensive period of aeration evens out temperatures, avoids moisture migration, and prevents 'hot spots'.

Then reduce the number of fan hours, typically to 20 -30 hours of the coldest hours each week, to lower grain temperature.

The CSIRO controller performs the above two functions automatically. It has two settings:

- **'rapid'** to allow initial stabilisation of temperature and moisture levels; and
- **'normal'** to progressively cool the grain during the coldest 20 to 30 hours each week.

Moist grain (15-20%)

Moist grain must be dried if it is to be stored.

**Inspect damp grain daily
for signs of deterioration
when holding
under aeration**

Grain type and moisture content affect the safe holding period. By following the aeration guidelines below you will be able to extend the time that moist grain can be held before drying.

Aerate moist grain 24 hours a day to remove field heat and prevent rapid development of 'hot spots'. Full-time aeration may be needed for 2-3 weeks.

Then aerate for about half the time during the coldest periods for several more days.

If grain still appears to be in good condition after the initial rapid aeration period, continue aerating during the coldest 20-30 hours of each week. Inspect regularly!

► Costs

Equipment costs vary greatly with the type, number and capacity of storages. As an example (1992 prices), equipment for three 120 tonne capacity elevated silos would cost around \$2000 for fans and ducting and about \$1500 for on-site wiring and installation.

A basic CSIRO controller costs around \$700 - more expensive, but much more effective and convenient than manually-set thermostats or timers.

Aeration costs around 5 cents/tonne/month when using an automatic CSIRO-type controller on the normal setting.

► How effective is aeration?

During winter in Queensland, aeration will usually cool most of the grain in storage to levels that will preserve grain quality and prevent insect and mould growth.

Some insect activity may occur in the warmer surface layers during summer. This can be reduced by painting the roof and walls of the storage white, or by using a storage built from Zinalume® or white Colorbond®.

If no live insects can be tolerated the grain surface could be sprayed with dichlorvos, or Dryacide® could be mixed with the grain during in-loading.

Before doing either of these things, check that your customers will accept them.

During summer in Queensland, aeration slows but does not usually prevent insect activity. If minor insect activity is acceptable, guidelines to follow include:

- use an efficient automatic controller such as the CSIRO-developed TPC system;
- discourage insect entry to storages - hygiene standards must be high;
- minimise heating from sunshine - use a white or reflective coating on the storage.

If total control of insects is essential, alternative methods such as protectant insecticides, fumigating in sealed storages, or controlled atmospheres (CA) must be considered.

► Drying and aeration

If moist grain is not dried immediately after harvest it may deteriorate rapidly.

**Aeration holds moist grain
safely for short periods
before drying**

Some growers claim to 'dry' damp grain using aeration. Aeration removes only small total amounts of moisture (typically less than 0.5%), but does redistribute moisture through stored grain. This very beneficial evening-out of moisture is sometimes confused with drying.

Prolonged running of aeration fans during the day at higher temperatures might remove greater amounts of moisture from damp grain.

But uncontrolled drying using low temperature air will probably produce very uneven temperature and moisture levels throughout the storage. This makes the grain more susceptible to moulding and insect damage.

**Short-term holding
under aeration,
followed by artificial drying is the
most effective method
of protecting moist grain**