HGCA

Bulk storage drying of grain and oilseeds

Topic Sheet No. 16
Summer 1998

Background

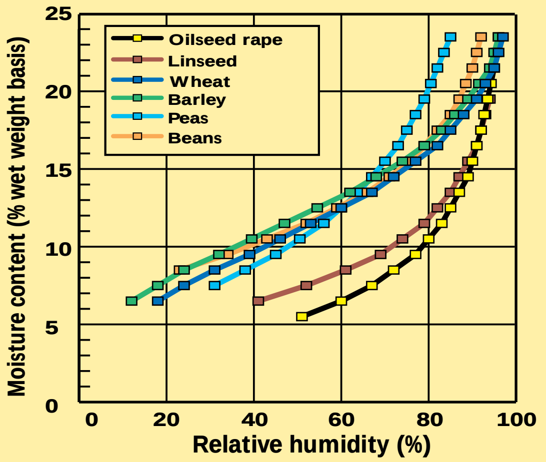
Bulk storage drying, sometimes called 'near-ambient drying', uses either unheated air or air heated to no more than 5°C above ambient temperature. Potentially it is a cheaper alternative than drying in heated-air batch or continuous-flow dryers but drying may take several days or weeks and needs careful control.

Drying basics

The moisture content (m.c.) of any seed is usually, but not always, at equilibrium with the relative humidity (r.h.) of the air trapped in the surrounding bulk. Given time and with adequate ventilation, the two will reach an equilibrium. Figure 1 shows the relationship between r.h. and m.c. for six crops. Each curve can be used to determine whether the grain will absorb or lose moisture - in this case at 15°C - without extra heat. For example, at an r.h. of 90%, wheat has a m.c. of 19.6%. The m.c. falls to 14.6% at 70% r.h.

Because of their high oil contents, oilseed rape and linseed have high equilibrium relative humidity levels. Oilseeds need to be dried to 8-10 per cent compared with 14.5-15 per cent for cereals, before each crop can be safely stored.

Figure 1. Relative humidity / moisture content relationships for six crops at 15°C



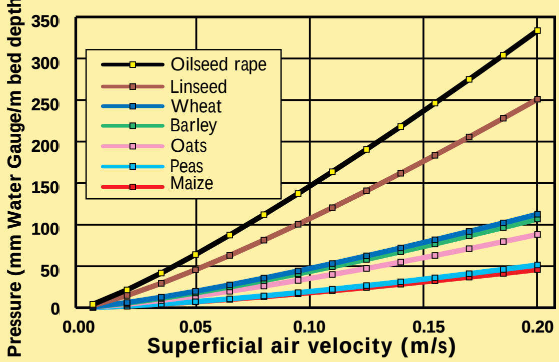
Practice in stores

In the UK, bulk storage drying is commonly practised in 'flat' stores with grain beds from 2 to 4 metres deep. Experiments and computer modelling have helped us understand how air flow through grain influences rate of moisture loss. Air flow can be managed using fans of different sizes and power, and by heating, ventilation and control systems.

Drying must proceed sufficiently quickly to avoid spoilage. Rate of spoilage depends on crop type, but is most rapid at higher moisture contents and warmer (but not very high) temperatures.

Resistance to air flow is determined by seed size, packing density and contamination

Figure 2. Pressure resistance curves for seven crops



with rubbish. Higher pressures are required to dry oilseed rape and linseed than, for example, maize (Figure 2).

Flow requirement may be specified as cubic metres of air per second per tonne; 0.05 is often used for planning purposes. To convert this to the superficial air velocity (metres per second), the measurement more often used by store keepers, multiply by the grain depth in metres and the bulk density in tonnes per cubic metre (ie hectolitre weight divided by 100).

Avoiding problems

Air used to dry grain should be as dry as possible because r.h. is more important than temperature in determining evaporative capacity. Average relative humidity increases as autumn progresses and cooler nights lead to dew formation. The lower the temperature, the less moisture is removed. However, heating the air by only 5°C significantly increases moisture removed, whilst reducing air volume required.

The aim is to achieve a uniform moisture content throughout a grain bulk. However, drying progresses as a 'drying zone' which passes from bottom to top of the bulk, taking excess moisture with it. When deep beds of grain are dried using ambient air, there is a risk that the grain at the bottom will be over-dried while the grain at the top will be too wet and at risk of moulding. This is inefficient as the cost in weight loss of over-drying of the bottom layers in order to reduce the moisture contents of the upper layers to safe moisture contents, can be as expensive as the cost of energy for drying.

Future developments

Recent research at Silsoe Research Institute has shown that a computer model of grain drying can be used within a dryer controller to provide ongoing estimates of grain moisture contents from regular and automatic sampling of grain temperatures. This system has the potential to improve the performance of conventional control systems.

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Action:

- **Ensure that stores are suitably equipped. Consider bulk storage drying for cereals at 20% or less or oilseeds at 14% or less harvested no later than the end of September.**
- **Grain can be dried at higher m.c. if bed depth is reduced. Also consider use of an over-sized store, supplementary batch dryer or stirrers. Make contingency plans for a wet harvest.**
- **Is the drying proposed possible? Calculate air flow volumes required. Take account of fan pressure and resistance of crop and ducting systems.**
- **Increase the speed of air flow to dry a deep bed as quickly as a shallow bed.**
- **Control fan running in relation to r.h. with manual, semi-automatic or automatic control.**
- **Monitor drying progress and be ready to take any corrective action if necessary by heating, stirring or using dehumidifiers.**

Further Information:

Research Review No. 38
Project Report No. 168

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