



Energy Efficiency for Bulk Grain Drying

INTRODUCTION

This guide explains how arable farmers who dry grain can save money by being more energy efficient. Energy efficiency is of primary benefit as it both reduces costs and cuts harmful emissions which cause global warming and pollution.

WHERE DOES THE ENERGY GO?

The main uses of energy in grain drying are for operating fans and heaters. Fans are mostly powered by electricity and although heaters can be fuelled in a number of ways, liquid petroleum gas is most commonly used.

PRINCIPLES

Drying grain in bulk, using large volumes of air with little or no added heat (near ambient temperature drying) can be a cost effective and energy efficient system if managed well. Dryer efficiency can be compromised if it is not serviced and properly maintained and managed. If operated in poor condition the dryer will not only cost more to run but also may deliver spoiled grain through the development of moulds and micro-toxins or through insect infestation.

Bulk grain dryers rely mainly on the availability of suitable ambient air to drive moisture from the grain. This air is only available during certain hours of the day and is less available as the drying season progresses and winter approaches. Correct management of the store - the grain, fans, heater ducts and controls, is therefore essential if you are to 'win the race' against the weather and dry your grain successfully and at reasonable cost.

These following pointers may help in the challenge:

Before Harvest

Store preparation is the first key to success.

- Clean the store - as well as being un-marketable, contaminated grain is more difficult to dry.
- Unblock ducts and floors - essential to achieve design airflow. Floors are often so blocked that they only deliver 50% of intended airflow.
- Number laterals inside and out - to help in locating accurately batches of grain and deciding which laterals need opening or shutting.
- Check fan and heater controls are working - controllers should be calibrated every year and replaced if obsolete. Heaters may need to be refurbished if they have not been used for a few years.

Loading

Loading affects airflow and therefore efficiency of drying.

- Keep grain level and avoid heaps - coned grain produces uneven airflow and drying so change the position of the discharge point regularly to spread the load evenly along each lateral. Level the store at least once a day.
- Stick to the maximum grain depth - the deeper the grain the higher the resistance to air flow and the lower the output of the fan. Recommended depth varies with grain type but for wheat and barley, 2.5 to 3m is the maximum, even in round bin drying systems.

Airflow

Achieving the correct airflow during drying is probably the most important single factor in achieving successful drying.

- Is the fan up to the job? - many fans were installed when harvests were smaller and

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grain depth was lower. Recommended airflow is 0.05m³/s for each tonne of grain being dried at the same time.

- Air speed through the crop - should be about 0.1m/s (20 ft/min) for a 2.5m depth of grain - check this with an airflow meter.

Pressure

The greater the air pressure in the main duct, the lower the airflow from the fan.

- Check this - by using a manometer.
- Reduce fan pressure - by cleaning the floors, reducing the grain depth or opening more lateral doors.

Humidity

Wet air won't dry grain.

- Use a controller to switch the fan off if humidity is too high
- If using a fan alone, set the controller to the equilibrium RH corresponding to grain 30 cm (1 ft) below the surface of the heap.
- When using heat, set the controller to the required equilibrium moisture of the crop and let the system get on with the job - even if this means that heat is used during dry ambient conditions. Heat is better used at this time than when air is wet at the end of the drying season. Best results are obtained by keeping the system running 24hours per day, irrespective of weather conditions.
- Use controlled heat or dehumidification to reduce RH - this will accelerate drying and keep costs down.
- Monitor humidity - using a low cost wet and dry bulb hygrometer.

Heating

Many installations get away without heating in drier years, but have problems when the drying time is wet. Even in good weather some heating can be effectively used. Any form of heating will accelerate drying.

Control heaters - to achieve the RH corresponding with the final target moisture content

Electric heating - used during cheap night rate tariff periods can be as cheap as using the fan only during the day.

Dehumidification

This lowers humidity by directly removing water from the air using electrical equipment based on refrigeration technology. It offers the following benefits:

- cheap to run compared with heaters
- consistent drying times and drying costs each year
- fast drying
- works well with 'under-fanned' installation
- no fear of 'capping' when drying wet grain
- electrical rating considerably lower than the equivalent heater bank.

Grain Stirring

Grain stirring has become increasingly popular in recent years both for floor stores and in-bin driers. Stirring changes the rules of bulk drying somewhat by redistributing the strata of dry/wet grain as the stirrer passes through the bed. This allows more intensive use of heat and lower airflows than conventionally recommended, as the potential for spoilage and bottom over drying is reduced.

Because limitations of the use of heat are much less important, control systems can be much simpler and based on temperature control rather than humidity. Compared with con-



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ventional bulk drying, stirred systems with heat will be quicker, more consistent from year to year and much less dependant on weather conditions. Energy costs should generally be similar to a properly sized and well managed conventional system. However in wetter colder conditions, ease of management and speed of drying is likely to make stirred systems cheaper to run. Also, where airflows are below optimum and grain depths are higher than normally recommended, stirring will also provide a cheaper and more reliable drying solution.

Store Log

Good records are a useful aid during drying.

- Record - crop type, tonnage, position in store, moisture, controller setting, drying progress, laterals opened.

Finishing Drying

For long term storage moisture and temperature must be down to acceptable levels.

- Restart fan - 2 to 3 days after drying and check for any smell of deterioration.
- Check - the stack temperature for local overheating.
- Cool - grain by ventilating for short periods overnight to below 12°C.
- Use low volume ventilation - to cool periodically during winter and reduce temperature to around 5°C
- Use a differential thermostat to control the cooling fan.

IS YOUR DRYER IN GOOD CONDITION?

Here are 10 check points for good drying performance.. Carry them out well before harvesting and the beginning of drying, check and remedy any faults as follows:

1. Store should be clean and dry. Vacuum up all loose grain, dust, chaff and straw from the floor, ducts, from under the laterals and from the fan and heater bank. If the floor has been driven over make especially sure that the air outlets are clear of pressed-in grain.
2. Disinfect where necessary.
3. Check for entry of any wetness, moisture or damp air, seal up any holes in floor, walls and roof.
4. Check for rodent entry and seal up any holes.
5. Have the fan, heater bank, controls and other electrical equipment serviced by a competent electrician. Some regional electricity companies offer this service as a packaged deal.
6. Check the air ducts for leaks and seal any found. Air will escape through these in preference to passing through the grain and thus lower the drying performance.
7. Mark and number the positions of all laterals both inside and outside the main duct and walls. Check that the shutters are working well and make effective seals when closed.
8. Use a whirling hygrometer to check the calibration of the drying controller.
9. Instrumentation - Have ready a moisture meter, a grain sampling spear, and a grain thermometer. Also useful will be an airflow meter, a whirling hygrometer, and a manometer. Where these instruments are battery powered such as the moisture meter and electronic thermometer, check that new batteries are fitted.
10. Store records - produce store log sheets to help you plan and record the drying progress. This will help:
 - record the moisture content of each load
 - record the distribution of different loads within the store
 - each day, record moisture content readings from three different depths to check on drying progress, and provide you with information to decide your best drying strategy.