United Oilseeds

Growing Oilseeds

OILSEED RAPE

CLEANING, DRYING, HANDLING AND STORAGE ON THE FARM

12 January 2009

MARKETING AND HARVESTING THE CROP

MARKET REQUIREMENT

The crushers require rapeseed which is of good merchantable quality, sweet, dry and sound and which complies with the following standards:-

The basis for payment is based on 40% oil:

The maximum admixture without deductions is 2% by weight (chitted or cracked seed is included in the admixture);

Moisture content should not exceed 9%.

HARVESTING DATES AND MOISTURE CONTENT AT HARVEST

Winter rapeseed is usually harvested in early August and comes off the combine at between 11% and 15% moisture. Under hot, dry harvest conditions moistures as low as 4% have been recorded. Under poor harvest conditions rapeseed has been harvested at around 20-23%. Winter rape in the North of England can be expected to be on average 1-2% higher in moisture than in the South. Spring rape, because it is harvested in September, is usually 2-3% higher in moisture than Winter rape.

DUST CONTENT

Dust can be a problem, especially where rain has fallen on the crop in the field during the ripening process, thus causing fungal growth on the stalks and pods. The activity of moulds and mites on rapeseed in store will also create dust, this being accentuated by warmth and moisture.

HANDLING

Rapeseed is a very small seed and may cause leakage problems in all machinery involved in harvesting and handling from the combine to the final delivery lorry.

All machinery should be checked for leaks at the beginning of harvest with particular attention to :-

1.	Combine	Base of returns elevator Base of grain elevator Delivery auger joints and grain tank Sieve pans and lower augers
2.	Trailer	Generally
3.	Elevator and Conveyors.	All joints, particularly slides on blanking-off outlets
4.	Driers	Generally
5.	Delivery Lorries:-	(a) Check that they are empty (b) Tailgates and outlets are sealed.

Sealing off joints can be achieved by using masking tape, cloth or vinyl faced adhesive tape or "Syglass" tape. Mastik has been used successfully for this purpose.

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Handling under very dry conditions where moisture contents are below 10% may cause damage to the seed in the form of split seed and loose husks. Drum speed should be reduced as low as possible to prevent losses of this nature. Combining early in the morning and late in the evening is quite practical and beneficial in these conditions.

CHAIN AND FLIGHT CONVEYORS

No problems have been encountered in handling rapeseed with any make of chain and flight conveyor. All manufacturers products that have been successfully used for cereals can be considered satisfactory. Throughput is similar to that obtained when handling cereals. The following manufacturers' products have been used for rapeseed and are known to be satisfactory. However, where the conveyor has not been installed horizontally problems have arisen. Dry rape of 9% m.c. tends to fall back over the flights and a blockage occurs.

BELT CONVEYORS

No problems have been encountered in handling rapeseed with any make of belt conveyor. All manufacturers' products that have been successfully used for cereals can be considered satisfactory. Throughput is similar to that obtained when handling cereals.

Both flat and dished belts have been found to be satisfactory for oilseeds when used in the horizontal position.

Throughputs will fall below those of cereals if the belt is working on an incline.

Bulk loading buckets are used successfully for handling the crop. Care should be taken to avoid crushing the seed with the bucket or wheels of the loader. Both tractor fore-loader and fork-lift truck buckets are suitable for handling the crop.

SEED DRYING

In most seasons it will be necessary to carry out some drying of the crop before it can be safely stored. Typical harvesting moisture contents may range between 15% and 20%. This will need to be reduced to 8% for safe storage.

Deterioration of undried seed can be very rapid. The rate of deterioration depends both on moisture content and on temperature. For example, seed at 18% moisture content and 20^{o}C would have started to deteriorate seriously after only 24 hours. Table 3 shows how moisture content and temperature affect the rate of deterioration.

TABLE 3
The effect of temperature and moisture content on storage life (weeks)

Storage Temperature ºC	Moisture content % wb					
	8	9	10	12	14	17
25	16	9	5	2.5	1	
20	32	19	10	5	2	0.5
15	65	40	20	10	4	1
10	160	90	50	21	8.5	2

The above table is only a guide, particularly at high moisture contents and temperatures, where other factors like the proportion of damaged seeds and trash may have a significant effect on the safe holding period. Conditions within a bulk of moist seed are not static. The activity of fungi will result in quite rapid heating of the seed bulk, and the rise in temperature will accelerate the rate of deterioration.

Drying of the seed involves its ventilation with a drying air stream, whether in a continuous drier or a bulk drying system. The seed offers approximately twice the resistance to air flow of barley. In bulk systems this effectively limits the maximum depth to which the seed may be loaded for drying and will reduce the throughput of a continuous drying system. Physical data on the resistance to air flow of the seeds are included in the section on physical properties.

DRYING SYSTEMS

The whole range of cereal drying techniques may be applied to rapeseed. The most important differences are those of seed size, equilibrium moisture content and the typical moisture content reduction required.

Care must be taken before loading rapeseed into a grain drying installation that the seed will not leak into the air ducts or other inaccessible places where it may become a hygiene hazard. It is important to avoid contaminating the rapeseed with cereal grain, so driers, cleaners and storage facilities must be thoroughly cleaned before they are used.

The equilibrium moisture content for rape is much lower for a given rh than for cereals. 18% is very wet, equivalent to 23% in barley, 9% is dry, equivalent to 15% in barley. 30% more moisture must be removed from the rape during drying because 9% reduction in moisture content is required. This will have an important effect on the rate at which cereal drying systems can dry the crop.

TABLE 4
Equilibrium moisture content - % wb

Equilibrium relative humidity %	Seed		
	Oilseed Rape	Barley	Wheat
30	4.5	8.5	9
40	5.5	10	10.5
50	6.2	11.5	12
60	6.9	13	13.5
65	7.4	14	14.5
70	8	15	15.5
80	10.6	17	17
90	14.8	23	23

Rapeseed in bulk is known to exert considerably greater pressures than cereals and for this reason it is recommend that loading depths in bulk systems do not exceed 2.44m level loading, unless the structure has been approved for greater depths by a structural engineer.

CONTINUOUS DRIERS

GENERAL CONSIDERATIONS

Those continuous driers which are not suitable for rapeseed because of leakage problems are identified in Section 6.8 below. Because of the ease with which the seed flows, drier throughput control maybe unable to maintain the required seed flow rates. The higher resistance to air flow offered by the seed makes it likely that the air flow through the drier will be restricted. On driers where the bed depth can be adjusted independently of throughput control, it would be an advantage to reduce the seed depth to about two-thirds of that normally used for cereals.

The seed gives up its moisture relatively easily to the drying air. However, drier output will be reduced for three main reasons:-

1. The resistance to air flow is roughly twice that of cereals thus less drying air will flow through the drier.
2. When drying rape from, say 15% down to 8% which is often a normal situation, 7% of moisture must be removed. This is often twice as much as would be removed in normal cereal harvest.
3. The depth of seed on the drier is usually less than for cereals.

The control of seed temperature in the hot air section is important. Too high a temperature will result in seed being killed. The safe maximum seed temperature reduces with increasing moisture content, (See Table 5 below). The temperatures refer to the seed. The air temperatures needed to achieve these will vary widely between different makes and categories of drier:-

Table 5.
Continuous Drier Maximum seed temperature to preserve germination

Moisture Content %	17	19	21	23	25	27	29
Max Seed temperature °C	65	60	55	49	43	38	32

These temperatures should be observed if the rapeseed is not going to be crushed almost immediately.

In continuous driers where the air flow rate may be reduced by the high resistance of rapeseed it is important to check that the burner controls are functioning correctly and that the drying air temperature and hence seed temperature is not too high.

The deterioration of the seed at high temperature, even when dry, can be quite rapid. The cooling section of most continuous driers will be inadequate to reduce the seed temperature to a safe level for long term storage. The principal cause of this problem is again the reduced flow caused by the high resistance that the seed offers. Warm seed in bulk tends to cool only relatively slowly, again because the resistance to air flow limits the volume of air that may be moved by convection. This difficulty may be overcome by making provision in the storage installation for low volume ventilation.

Design ventilation rates of 5-10cfm / tonne should prove adequate. Where low volume ventilation is provided, the seed temperature can be controlled at or below 10°C.

PRE-DRYING HOLDING OF SEED

In many installations the continuous drying system will not be able to handle the seed at the same rate at which it is being combined. Temporary holding of the wet seed will be necessary and if the storage period is likely to exceed 12 hours, it is very important to make provision for cooling in the pre-drying store. Ventilation with ambient air at the rate of 0.6-0.8M^3/min/tonne should be adequate. At a depth of 1.5M this would require 2.5-5cm w.g. pressure.

BULK DRYING

Conventional on-the-floor and in-bin drying systems, including radial bins, can be used for the drying of oil seeds. Bulk ventilation by suction is not recommended. The principal points to which attention must be paid are loading depth and ventilation control.

THE BULK DRYING PROCESS

It is important to understand the way in which the drying process occurs in a bulk drying system. When the drier is loaded, all the seed will have a similar moisture content. As soon as the drying air enters the lower layers of the seed bulk, drying will commence. Moisture is given up to the drying air by the lowest layers of seed. This evaporation of water will result in the seed being cooled.

The drying air very quickly reaches a condition which is in equilibrium with the seed and can absorb no more moisture. This wet air then passes through all the remaining layers of seed and is exhausted at the top of the bulk. After a while the seed nearest the source of air will be dry and will cease to wet the air as it passes through. In this way, successive layers of seed are dried until, when drying is almost complete, the seed at the top surface of the bulk will begin to dry.

It is important to realise that the seed in the top layers of the bulk will remain wet until drying is almost complete, but because of the evaporation of moisture from seed in the lower layers, these upper layers will at the same time remain cool.

In order that the bulk drying process is successful, it is necessary to be able to control the final moisture content reached by the seed. The final seed moisture content in bulk drying system is determined by controlling the relative humidity of the drying air. The relationship between relative humidity and seed moisture content is given in Table 4 (Section 5.3)

For example, if it is required to dry a bulk of seed to 9% moisture content, drying air should be supplied at 70% relative humidity. The seed in the lower layers would then cease to add moisture to the drying air when its moisture content had been reduced to 9%. Humidity control often involves the addition of heat to the drying air stream. Good control of the heat input is essential, since the application of too much heat will result in the lower layers of the bulk being over-dried and the drying of the upper layers being delayed.

The use of too much heat, particularly when the incoming seed is cool and wet, can result in condensation of moisture in the upper layers of the crop which can cause crusting and further delay the completion of drying.

SAFE LOADING DEPTH

The concept of safe loading depth is a practical way of ensuring that the top layers of the bulk start to dry before any important deterioration can occur. In general, the wetter the incoming crop, the more thinly must it be spread if it is to be dried successfully.

The total amount of drying that must be put through the crop to dry it will depend upon the amount of moisture to be removed and its drying power. Drying must be completed before serious deterioration of the seed can occur so the rate of ventilation required will increase with seed moisture content. Table 6 shows the relationship between initial moisture content and ventilation rate.

Store Hygiene

Store cleanliness and hygiene is the first considerartion before any crop is dried and stored. The start point is store cleanliness. All residues of the previous crop must be thoroughly cleaned out of the store and burnt. All conveying and elevating machinery must also be thoroughly cleaned. Once this stage has been completed an approved store surface chemical should be applied to the surfaces of the entire store including the insides of bins and any other surfaces that come into contact with grain.

Chemicals approved for use include Actellic 50 EC, Prostore 420EC, Reldan22, KillgermULV

Where buildings are used for livestock and grain storage they must be thoroughly cleaned and disinfected before use. They need to be powerwashed to remove all traces of FYM and then disinfected with an appropriate product such as peroxides. Finally it must be allowed to dry thoroughly before being used for grain storage.

TABLE 6
Ventilation rate -v- initial moist content

Initial mc %	10	12	14	16	18	20	22	24
cfm/tonne Cmm/tonne	38 0.98	77 2.16	119 3.33	163 4.56	208 5.8	256 7.17	307 8.6	360 10.1

The fans used to supply this drying air are normally expected to operate in the range 7.5-12.5cm wg. The resistance to air flow offered by the seed depends on the air speed through it and its depth. (The deeper the seed, the greater its resistance). The maximum depth to which the seed can be loaded for a given initial moisture content will be that which gives the highest acceptable resistance to air flow. The full range of conditions likely to be encountered in practice is illustrated in Figure 1. The ventilation rates used for constructing these diagrams are those of Table 6 based on the drying performance of 'on-floor' systems drying cereals from 21% to 15%. It is assumed that air at 65% rh is supplied continuously during drying. No account of the resistance to air flow of the distribution duct work has been taken (see later for allowances for this).

Figures 1a and 1b or Table 7 may be used to determine the safe depth in which the bulk may be dried in an on-floor drier or in bins ventilated from the bottom.

TABLE 7

Approximate variation, with initial moisture content and pressure drop through the seed, of the safe depth (M) for drying spring rape, winter rape and winter barley.

Pressure Drop Through the seed inches wg	Initial Moisture Content % wb	DEPTH (M) Oilseed rape Spring	Oilseed rape Winter	Winter Barley
	10	2.13	3.25	
	12	1.46	2.2	
5cm	16	0.97	1.46	4.96
	20	0.76	1.12	2.0
	25	0.61	0.88	1.1
	10	2.92	4.44	
	12	2.0	2.99	
10cm	16	1.34	1.98	6.78
	20	1.06	1.52	2.74
	25	0.85	1.22	1.79

CROP STORE MANAGEMENT

VENTILATION CONTROL

Because of the rapidity with which damp seed deteriorates, it is essential that drying commences as soon as possible after harvest. Ventilation should continue without a break until the moisture content of the seed at the surface of the bulk has been reduced to about 12%. After this, selective ventilation with air in the range of 60-70% rh, and if necessary by the addition of a small amount of heat, will complete the drying process by bringing the seed moisture content to 7½% and 9%. A temperature rise of 1^{o}C will reduce rh by approximately 4%. The relative humidity of air in the main duct should be monitored during the latter stages of drying by means of a well maintained hair hygrometer, and the control of any heat should be based on these measurements. Engine driven fans may give rise to particular problems since the heat from the engine may give a greater temperature rise than is required, particularly since the system pressure is likely to be higher than for cereals, and hence a lower air flow through the fan may be expected.

As soon as the drying of the seed is complete and when weather conditions permit, it should be cooled to below 10^{o}C. Ideally, cooling should be carried out using ambient air with a relative humidity of not more than 80% to avoid re-wetting the dried seed. The cooling operation can be controlled manually, or in large installations a differential thermostat may be used to initiate ventilation with a suitable temperature difference exists between the seed and the ambient air. Cooled seed will prevent the build up of mites and other storage pests.

MOISTURE MEASUREMENT

Accurate measurement of seed moisture content at harvest is vital to the success of any drying operation. Electrical moisture meters tend to give unreliable results above 12% mc. In the range 12% to 17% the error may be as great as $^{\pm}$2%. Variety and growing conditions can effect the electrical properties of the seeds, and so it is advisable to calibrate any moisture meter at least annually against an oven method. In order to increase the measuring range of electrical moisture meters it is possible to mix equal quantities of dry known moisture content with wet unknown moisture content seed, determine the moisture content of the mixture and thence find the moisture content of the wet seed. (See Table 11).

TEMPERATURE MEASUREMENT

An early warning of deterioration of the dried seed can be obtained by walking over the surface, probing and noting any 'off' odours. Where access to the seed is difficult, warning of impending trouble may be obtained by monitoring seed temperatures. Remote reading electronic thermometers with a number of sensing points can be used to keep a check on seed conditions. It is important to make a written record of the temperatures at regular intervals so that temperature trends can be noticed and appropriate action taken.

TABLE 11
Moisture content determination of wet seed by dilution with an equal volume of dry seed of known mc

Moisture content of mixture %	11	12	13	14	15	16	17
Dry seed moisture content							
8	14	16	18	20	22	24	26
9	13	15	17	19	21	23	25
10	12	14	16	18	20	22	24
Estimated error in this method		+/- 2%				+/- 5%	

STORE MANAGEMENT

MITE

Mite are the only major storage pest of oilseed rape. Surveys have shown that they are endemic in most stores but only develop into a problem when the crop is stored too warm and/or too moist. Mite are ½ millimetre long and light brown in colour. Normally they are seen as brown dust on the crop surface. If conditions are perfect they can breed five generations a week leaving hollow seed and an increased heap moisture content and rejection by the crusher!

MOULD

Storage moulds can potentially ruin the whole crop. They are capable of binding the crop into a solid block. In addition, they can cause Farmers Lung and when handling mouldy rape BSS dust masks should be worn.

Moulds cause loss in crop weight, increase in crop moisture content, free fatty acids in the seed and once again rejection by the crusher.

PREVENTION OF DETERIORATION

Growers should appreciate that drying the crop to 8% mc is the first of two steps for safe long term storage. Once dried the crop must be cooled. This must be monitored and recorded. The temperature of the seed on leaving a hot air drier will be 21-32°C. The seed dried in bulk on ducts or a drying floor will be cooler, but still needs cooling.

LOW VOLUME AERATION

Seed dried in a hot air drier will need further cooling immediately to prevent deterioration. Cooling is most economically achieved by low volume aeration. This involves a very modest outlay in some form of ducting and low horse power fans to convey air through the stored crop. The fan is started immediately drying has finished. It should be situated to draw ambient air from outside the building into the crop. The fan should only run when the ambient air is cooler than the crop in store. In this way the initial storage heat will be removed and the heap temperature reduced to 12-17^{o}C.

SECOND TEMPERATURE REDUCTION

When ambient temperatures drop in September cooling should begin again to reduce the heap temperature. The aim this time being to get a heap temperature of 8-15^{o}C. Once this has been achieved mite and fungal development is reduced greatly.

FINAL TEMPERATURE REDUCTION

Once frosty weather begins in early winter the final cooling stage can take place. The aim being to get the stored crop temperature down to 5^{o}C. At this point mite activity virtually ceases.

FAN CAPACITY

Low volume aeration fans need only supply 0.17cum per minute per tonne. They are often powered by fractional horse power, single phase, electric motors. The volume of air moved is too small to cause a moisture increase in the seed. They should only run when the ambient temperature is 2^{o}C or lower than the heap temperature.

As a rough guide each cooling phase will take approximately 100 hours of fan operation.

The process can be very efficiently automated by using a differential thermostat to control the fan.

PHYSICAL PROPERTIES OF RAPESEED

The bulk density of wet seed may be around 470.67Kg/cum to 649.2Kg/cum at harvest but the seeds shrink on drying and clean dry seed has a density of 711-727Kg/M^{3} (1.37-1.4 cum/tonne). The porosity is about 39%.

1000 seed weights may vary between 4.0 and 5.7g depending upon variety and season. On average, the seeds are about 1.9-2.0mm diameter. In sieving tests, most samples lie within the range 1.2-2.5mm. The angle of repose is approximately 22 degrees (barley 22.28^{o}).

Canadian measurements of the static coefficient of friction showed that on galvanised steel surfaces there is little difference between the coefficients for rapeseed, wheat and barley. However, on concrete surfaces, the coefficient for rapeseed is much lower than it is for wheat. This could mean that pressures in deep concrete bins of stored rapeseed may be considerably higher than in similar bins of wheat.

SUMMARY

Bulk Drying Systems

- Dry rape has a bulk density of 1.37-1.4cum/tonne.
- Assume an increase in back pressure in bulk drying systems of 8.32cm/M.
- Once drying begins fans must run continuously day and night.
- DO NOT ADD HEAT

Hot Air Systems

Know the incoming moisture content and set the drier temperature accordingly.

Cool the grain by low volume aeration.

Grain Storage Calculations

SPECIFIC WEIGHT KG/HL	CUBIC METRES PER TONNE	CUBIC FEET PER TONNE	AVERAGE CROP DENSITY
46	2.17	76.8	
47	2.13	75.2	
48	2.08	73.6	
49	2.04	72.1	
50	**2.00**	**70.7**	
51	1.96	69.3	
52	1.92	68.0	
53	1.89	66.7	OATS
54	1.85	65.4	
55	**1.82**	**64.2**	
56	1.79	63.1	
57	1.75	62.0	
58	1.72	60.9	
59	1.69	59.9	
60	**1.67**	**58.9**	
61	1.64	57.9	
62	1.61	57.0	
63	1.59	56.1	
64	1.56	55.2	
65	1.54	54.4	
66	1.52	53.5	
67	1.49	52.7	BARLEY
68	1.47	52.0	OILSEED RAPE
69	1.45	51.2	
70	**1.43**	**50.5**	
71	1.41	49.8	LINSEED
72	1.39	49.1	
73	1.37	48.4	
74	1.35	47.8	
75	1.33	47.1	WHEAT
76	1.32	46.5	
77	1.30	45.9	
78	1.28	45.3	
79	1.27	44.7	
80	**1.25**	**44.2**	
81	1.23	43.6	PEAS
82	1.22	43.1	
83	1.20	42.6	
84	1.19	42.1	
85	1.18	41.6	
86	1.16	41.0	BEANS
87	1.15	40.6	
88	1.13	40.0	
89	1.12	39.6	
90	**1.11**	**39.2**	

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