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Curing and Cutting Chaff

What is chaff?

Chaff is hay cut into small pieces for feeding to livestock. It is a good fodder, and at its best is cleanly and evenly cut, free of dust, of good colour and with a fresh aroma. Other materials are sometimes described as chaff, such as:

- The husks of grain separated by threshing or winnowing, often known as cocky chaff
- Portions of the flowers of grasses
- Chopped green or dry fodders.

Chaff can be purchased from commercial chaff cutting mills. Some people are starting up their own private cutting operation and this Agriculture Note provides advice to such people.

Why cut chaff?

Hay is cut into chaff for the following reasons:

- Chaff, because of its small size, mixes well with other feeds to balance a ration.
- When hay is chaffed, grains and heads are mixed with leaf and stalk, so that livestock are encouraged to eat more, with less chance of selecting particular parts of their ration, and so there can be less wastage.
- Chaff is easy to handle in bags or bulk. There are usually 24-28 bags of chaff to the tonne but the number can vary, so chaff should be bought and sold by weight. Its bulk density is about 150-170 kg/m³ depending on species, moisture content, cut length and settlement. For comparison, hammer milled hay and chopped hay are less dense at 100-150 kg/m³.

Chaff is usually cut into 6-10 mm long pieces. Cereal chaff can be up to 20 mm for sheep and horses, or even slightly longer for cows. Oaten cereal chaff is preferred for horses, fed either mixed with or before grain or other feeds. The quantity fed varies from about 4 kg/day for ponies to 12 kg/day for working horses, and is best fed at three separate times per day. For higher feed value, lucerne chaff can be used.

Quality

Any straw or well-cured hay can be cut into chaff but the quality will depend on the crop, its stage of maturity when harvested, and how the hay was cured and stored. Nutritional value is not changed by the cutting from hay to chaff but utilisation by the animal may be better.

An unevenly cut chaff lacks appeal to the eye and so may be downgraded in value. An excess of fines or dust particles is detrimental to animal health.

If the hay has been well cured and is undamaged by weather or storage, chaff from cereals is generally low in crude protein (less than 10% dry basis) while from lucerne it is high (15-25%). Chaff cut from pastures varies in protein content between 10 and 25%, depending on species.

Two standards for oaten chaff are set annually by the Victorian Chaff Standard Committee, "Victorian No. 1 chaff" and "Good sound chaff". These standards are mainly for the export industry but they are also a guide for the local trading of oaten chaff.

Crops

Historically, cereals have been the main species used for chaff because of the need to feed the working horse population. In recent years chaff has been made from other crops as well, mainly lucerne and some pasture. Chaff is now used more extensively for other types of livestock.

Cereals

Oats for chaff are the most common. Use the variety recommended for growing in your district. Finer-stem varieties make the better chaff. For highest yield, oats should be cut for hay and for subsequent chaffing when the grain is at the early milk stage. The crop can be cut earlier if the weather is stable enough for satisfactory curing or if the chaff is for sheep. Later cutting will produce a tougher, more fibrous chaff of less feed value. Much of the more mature grain will be shed, taken by birds during curing or lost during handling.

Barley and wheat can also be used for chaff. It is better to avoid heavily awned cereals. Early cutting is advised to avoid strong awns, which are often only partially cut during

chaffing. Uncut awns can be riddled out but many cut awns remain and can be troublesome to livestock. If vermin are a problem, cut earlier to reduce the quantity of grain and hence the appeal to the vermin.

Lucerne

Use good haymaking procedures to retain leaf. Lucerne hay is best baled "on the return", that is, after the hay has dried past baling moisture and as dew or night air brings the hay back to a wetter and tougher condition. This reduces the brittleness of the hay, improves the retention of leaf and ensures that the stems are sufficiently dry for baling.

Pastures and grass hay do not make good chaff. Grinding and mixing them with other feeds may be more appropriate. The larger the percentage of grasses or the more mature the species, the more dust is produced when chaffing. Thorough riddling during cutting is necessary to keep dust to a minimum. Weeds should be avoided. They show up in chaff and lower the quality. Weed seeds, burrs, thorns and thistles can be dangerous in the mouth and eyes of livestock.

Curing

All hay for chaff should be as leafy as possible with a minimum of thick stems. The hay should not be weather damaged, discoloured, bleached or smelly from rain. Musty or mouldy hay is not suitable for chaff since these characteristics in the hay are reflected in the chaff.

Chaff should be cut when the moisture content of the hay is 14% or less, so hay baled at a higher moisture should be stored and protected until it dries to this level. Above this moisture content chaff will heat and mould could set in; food value may be lowered if heating continues. A lower moisture content is desirable. Lucerne hay, for example, can be 8-10% moisture content, then steamed to produce chaff at 12%.

Handling

To cure and handle the hay before chaffing, three methods are used, using either the binder, rectangular baler or roller (big round hay baler).

Binder

This is ideally suited for tall long-stemmed crops such as cereals. The binder cuts the crop, bundling and tying it into sheaves and dropping them to the ground. The sheaves are stooked for field curing for 2-3 weeks, as the hay would have too high a moisture content for immediate storing or chaffing. Stooking is usually done by hand, and can be done at 1.5 tonnes per man-hour. A machine can be built to assist with mechanical stooking, though there is none in commercial production.

The sheaves are collected from the stooks, individually with a pitchfork, or as a stook using a large fork mounted on a tractor front-end. The sheaves can then be ready for chaffing, although in practice it is usually more convenient to stack and cut chaff later.

Bale

A mower cuts the crop, lucerne or pasture. The hay is cured in the usual windrow method, baled and stored. The bale twines are removed when cutting the hay into chaff. Sometimes small bale wads are fed into the chaff cutter by hand, but it is better for the bale to pass through mechanical teaser, which breaks up the wads, before passing into the steamer or cutter. Chaff cut from the bale is not as regular in length as sheaf chaff, due mainly to the irregular manner in which the hay lies in the bale, and consequently the way the hay approaches the cutting knives.

Roller

Hay is made in the same way as for the baler. When the roll is required to be unrolled, a made-up or purchased roller delivers a steady stream of hay onto a conveyor. A teaser is not necessary but some operation is desirable to eliminate large lumps. When cutting cereals for a roller, it may be better to use a windrower, which can deliver the hay into the windrow in a more regular manner than the mower and rake.

Cutting equipment

Hay is delivered onto a conveyor which carries it into a laser, forming a regular flow for smooth cutter operation. Much hay requires steaming to toughen and hold the leaf to avoid its shattering to dust. The steamer is placed between the teaser and chaffcutter

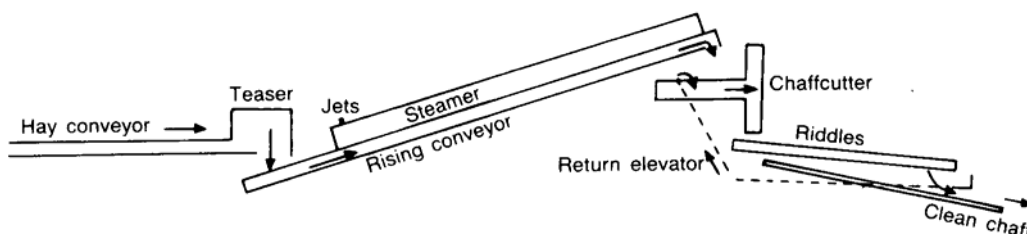


Figure 1. General layout of equipment for chaff cutting.

Teaser

This consists of a rotating shaft or drum on which there are spikes or fingers; these break open or unravel lumps or wads of hay. The teaser is usually driven by an electric motor but can be pto- or engine-driven. A moving-chain hay-conveyor provides automatic feeding.

Steamer

This consists of steam generating equipment and the steamer box. Depending on the quantity of steam required and the throughput of the cutter, the size of the generator can range from a small 2kW portable steam cleaning unit to a large boiler. The steam rate would be near 70-100 litres of water converted to steam per tonne of hay, depending on the condition and quality of the hay. Use a steam generator of sufficient capacity for maximum throughput, the recovery rate of a small unit could slow the whole operation. The steam should be dry, and at a pressure of 600 kPa (90 psi) or more for best results. Steam at a lower pressure can be used and taken from the upper areas or take-offs on some boilers, but ensure that it is dry steam. Do not use wet steam as this could cause mould in the chaff.

It is possible to cut chaff without steam, provided that the moisture content of the hay is sufficient and it is free of dust. Hay taken from the inside of a stack requires less steam than hay from the top of a stack where moisture content may be lower.

The steam is delivered by jets or small pipes to a few sites in the hood over the rising conveyor, on which the hay is carried up to the cutter (figures 1 and 2). Jets at the lower, or entrance, end of a 3-6 metre hood allow the steam to rise with the hay, providing sufficient contact time, after being jetted into the hay.

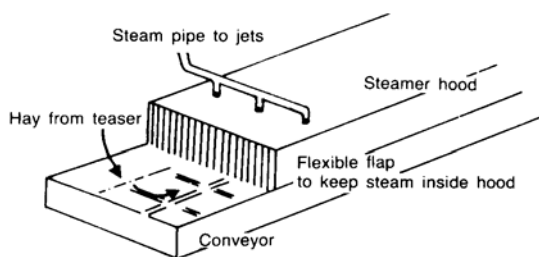


Figure 2. Steamer

If a large flow of hay is used and if it is an open type conveyor, steam jets could also be used underneath. Over-the-top jets are usually sufficient, so try these first. Jets underneath are more likely to block and cause trouble.

Chaff cutters

The size of chaffcutters is variously described either by the width of the mouth or the number of knives, with occasionally the diameter of the wheel, or the power required .

Mouth

This is the heavier cast-steel throat or opening through which the hay passes and where cutting takes place (figure 3). Cutters are made with mouths of various width, usually 130 mm to 305 mm, with numerous width models between these two sizes. In past years some very small hand-operated cutters were made and are occasionally seen.

The sides of the mouth are known as cheeks. These cheek plates should be adjusted evenly and at the same distance as the bottom cutting plate. The cutting takes place between the knives and these wear plates, so they all should have square edges for clean cutting and be in even, smooth contact with all knives and with the full length of each knife. Adjust the knives accordingly.

The main bearing of the knife wheel should be checked for wear. A worn bearing could allow the knives to move away from the cutting plates when hay is fed through the mouth. For best cutting and even length chaff, the hay should be fed to keep the mouth as full as possible.

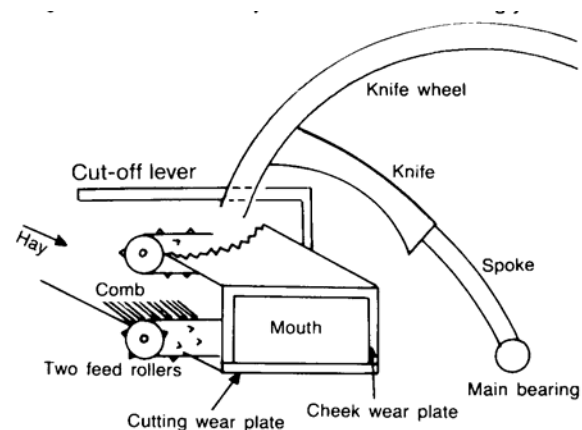


Figure 3. Parts of a chaffcutter

Knives

There may be two, three or four knives on one cutting wheel. Most knives are convex, although concave knives are favoured by some operators. The convex knives have the disadvantage of forcing the hay in the mouth to the outside cheek, causing more wear in this area; with less hay near the inner cheek it is more likely that the cutting will be less regular and there will be longer pieces in the chaff.

All knives should be kept sharp. Change or sharpen knives every two hours. When chaff is broken and not cut cleanly, it is the time to sharpen the knives.

A radial grinder is probably the best to sharpen concave knives; finish off with a hand file to remove the last of the burr. The convex sharpening is best done on a finisher belt holding the knife in the direction of the belt. Avoid overheating of the knife edge.

The bevel width on the knives should be between two and three times the knife thickness; that is, between the angles of 27° and 18°. Bevels of 2 to 2.5 times the knife thickness

provide a better 'draw' on the hay and keep their edge better. The bevel should be flat and not rounded.

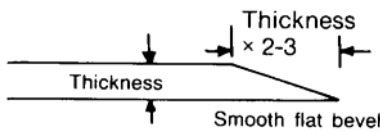


Figure 4. Bevel for sharpening knives

Power

The power required naturally varies with the throughput of the cutter. Usually electric motors with belt drives are used. Tractor pto or drive from the engine via flat belts can be used. Mobile and stationary cutters are available. Ensure that the motor does not accumulate too much dust, or that it is dust-proof, for safety against damage and fire. As an indication of the power required, a heavy duty two-knife cutter needs a 2.25 kW electric motor, a three-knife needs 3.75 kW and a four-knife cutter needs 5.5 kW. Additional power is needed for elevators, baggers, etc.

Cutter operation

In addition to the mouth and knives, there are numerous parts in the chaffcutter that have an influence on the efficiency of operation and the quality of chaff produced.

Combs and rollers

A toothed roller above another similar one feeds the hay into the mouth, so this is the place where full feeding is desirable. As the operator's hands are delivering the hay care should be taken. A cut-off bar or lever to reverse the drive must be mounted over this feeding area, so that if a hand is drawn in with the hay, the arm pushes the lever, disengaging the drive (see figure 3). The teeth of the feed rollers and the comb should be square and be adjusted to mesh closely with each other.

Riddles

The riddling of chaff is a most important function. Even feeding of the hay to the cutter gives an even, regular flow over the riddle, so a more regular chaff is produced. Good bearings and riddle drive provide an even shake; worn parts allow irregular action.

Different riddles are used for different crops and different chaff sizes. Cereals need stronger riddling than the more delicate leaf of lucerne, as does dirty or weedy hay. Many riddles have holes over their full area; for most uses it is better if there is a non-punched area in the riddle where the chaff falls onto it. If the riddle has holes in this area, cover them with a piece of sheet iron.

For best chaff, feed the riddle so that a small quantity about 5%, of the chaff falls off the end of the riddle to be returned to the cutter.

A good time to check for the quantity of steaming is after the chaff has been riddled. Take a handful of chaff squeeze it and then open the hand: the chaff should just hold

Similar processes

Alternative methods can be used to reduce the size of fodder into forms that are sometimes considered similar to chaff, but there are differences.

Chopping usually applies to harvesting green fodder to facilitate handling and encourage feeding. Chopping can also apply to putting hay or straw through a forage harvester; the fine-chop foragers can be adapted. The material produced can be in various lengths. Thorough riddling and efficient dust extraction are necessary to produce a reasonable chaff.

Hammer milling, as the name implies, is hammering or hitting the hay, etc., into finer pieces of varying lengths. This process produces shattered material of uneven length with many dust particles. Particles of all sizes are included unless riddled or extracted.

Grinding of grains, and sometimes hay, gives finer pieces for easier and better mixing with other feeds, as for pelleting.

Rolling of grain flattens and breaks grain for better utilisation.

Cubing is chopping the fodder into small pieces, then pressing it into cube form in the one machine operation.

Pelleting is an additional process of mixing and pressing concentrate and some of the above milled feeds to form a dense small pellet of feed.

Safety

- There must be a reversing lever at the cutter.
- Care is needed near the teaser, particularly with the automatic feeding conveyor.
- Protection should be such that no part of the limb or hand can come into contact with any moving parts, ie, teaser, conveyors, feeding rollers and knives.
- Walk round conveyors; do not step over or under moving parts.
- Guard all belt drives and shafts.
- Keep noise at a safe level; engines and tractors should be outside the shed.
- Place boilers away from cutter operation.
- Provide protection for eyes, nose and ears.
- Keep dust to a minimum. Use sufficient steam. Have well ventilated work areas. If cutting dusty material it would be essential to fit a dust extractor. The likelihood of contracting "farmer's lung" (a respiratory infection caused by dust, particularly from mouldy hay) is low if all hay is clean and free from mould. Clean up dust as a precaution against fire and explosion.

In addition to the above points about safety the relevant Occupational Health and Safety, Machinery Regulations 1985 are reproduced below.

Division 4-Chaffcutting machines

38. Every employer, occupier and self-employed person shall ensure that every chaffcutting machine shall be provided with a guard which:

(a) at all times will cover the feed-box for a distance of 625 millimetres from the centre of the feed rollers; and

(b) shall not be more than 500 millimetres (inside measurement) in height, measured from the bottom of the feed-box to the top of the guard.

39. Every employer, occupier and self-employed person shall ensure that every chaffcutting machine that is not operated solely by hand power shall also be provided with:

(a) a reversing lever, either carried over the top of the guard in line with and 75 millimetres above the edge of the guard nearest the operator, or connected with an approved foot-control device; and

(b) guards that effectively cover the upper half of the knife wheel and all gear wheels, so as to prevent bodily injury to any person.

Suppliers of chaffcutters (Sole supplier)

Cutters are imported into Australia by:

Jas Smith Machinery and Engineering., 7 View Point Drive, Ballarat,

Vic. 3350 Phone: (03) 5332 1796, Mobile 0409 321 796

Further information

Email info@jassmith.com.au

Web site www.jassmith.com.au

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