MAGUIRES TOBACCO GROWERS GUIDE

As Recommended by the Tobacco Research Board

Please remember to always read the label before using any chemical

TOBACCO CURING

Tobacco curing is an extension of senescence (ripening). Therefore, the metabolic deterioration that is senescence must be occurring when the leaf is removed from the plant and placed in the curing structure. During ripening, enzymes in the leaf start to break down chlorophyll and the leaf begins to lose its green colour. Also starch, accumulated following the end of the growth phase is broken down gradually by enzyme action. Judging the correct stage of this process to achieve the optimum yield and quality is the challenge that faces growers. Leaf colour, leaf angle, leaf appearance are subjective means of determining ripeness and tend to vary with season and leaf position. The most reliable assessment of ripeness is barn colouring time as follows:

Lower third of plant	60 to 72 hours
Middle third	48 to 60 hours
Top third	36 to 48 houts

The shorter the period the better the quality, especially in the middle and top reapings.

Flue curing tobacco requires manipulation of air and heat in such combinations that the leaf is kept alive until specific chemical changes (activated by enzymes) occur. Thereafter, the leaf is preserved by drying. Different leaves (plant position, maturity/ripeness, growing conditions – climatic, soils and/or management) require differing changes in this process to achieve the best result. Recognizing these differences and adjusting accordingly is the “art” of curing. A number of key stages are identifiable and successful control of these will ensure a high-quality product.

COLOURING

- Historically, colouring in traditional hand stoked flue barns is started at 28 to 30ºC usually for the first 24 hours. Temperature is then increased to 32ºC until a third to half the leaf is coloured and colouring is then completed at 35ºC. This regime minimizes fixing green on the bottom tiers, a consequence of radiant heat from the flues at higher temperatures.

- This procedure is less than ideal because the optimum temperature for the enzyme chlorophyllase, responsible for breaking down the green colour in leaf, is 35ºC to 38ºC. It therefore stands to reason that colouring will be most efficient in this temperature range. The regime outlined above would take longer to complete because at lower temperatures the enzyme’s activity is significantly slower.

- ***In a forced air system, where radiant head is not an issue, it is therefore logical to start the cure at 35ºC and colour at 35 to 38ºC.***

WILTING

- Curing is a process of controlled drying, albeit very slowly in the beginning to allow necessary enzyme activity to be completed.
- To ensure that the next stage can be successfully managed, curing leaf must lose at least 25 to 30% of its moisture during the colouring stage.
- Typically, at the end of colouring the leaf should have the appearance and feel of a **wet cloth.**
- ***The Wet and Dry Bulb Thermometer is a useful tool to monitor this. At the start of the colouring the wet bulb will be 1ºC below the dry bulb, increasing gradually through the colouring phase until at the end of colouring the deficit will be 3ºC.***

LAMINA DRYING

- Arguably the most important phase of the curing process because it is during this stage that damage to quality is most likely. However, it is worth noting that this can be successfully completed only if the previous two are managed correctly.

- *THE RATE AT WHICH LAMINA IS DRIED IS DEPENDENT ON THE NATURE OF THE LEAF.*
  Ignore this and quality may be severely compromised.
  As a general rule, the thicker the cell wall, the slower the drying. As reaping moves up the plant, leaf becomes more bodied and therefore should be dried slower. This is especially important for upper leaf that has been subjected to moderate moisture stress during expansion and tends to be close grained. Typically, this type of leaf is very susceptible to sponging.

- Normally sponging is associated with drying leaf at high temperatures, causing the moisture to be evaporated from the leaf too rapidly. However, it is also possible to cause sponging when the drying capability of air moving over the leaf surface is too aggressive. This too, may remove moisture too rapidly. (Growers with tunnels will have seen that the leaf tends to sponge on the sides of trolleys in the passages, because the air moves more freely down these passages. Curtains in the passages tend to reduce this problem.)

- The ability of air to dry is dependent on the energy that is supplied to it. Obviously, the higher the air temperature the quicker it will dry. Similarly, the higher the mechanical energy imparted on that air the greater its ability to remove moisture. Therefore it is important to moderate both heat and air to ensure the correct drying regime. Even then, in a forced air continuous system (cascade ("chongololo") or tunnel), modifying heat and air only may not be sufficient, air humidity also plays a role. (See diagram below).

- In an individual forced air system (billy barn, downdraft, bulk curer) air in the barn is recycled by manipulating ventilation, even during lamina drying. Research has demonstrated that keeping the web bulb temperature between 35 and 38ºC during this stage provides the ideal drying regime (for a well grown, correctly fertilized and ripe leaf). Therefore, it stands to reason that in a continuous system recycling humid air from the colouring end will provide a better drying regime. The diagram below clearly illustrates this.

- In summary, for thin lower reapings or fast grown tobacco the web bulb should be maintained at 34ºC to 35ºC whereas for more bodied leaf, especially if close grained, the wet bulb should be 38ºC to 40ºC. In the continuous system this is done by regulating the amount of humidity recycled.

MIDRIB DRYING

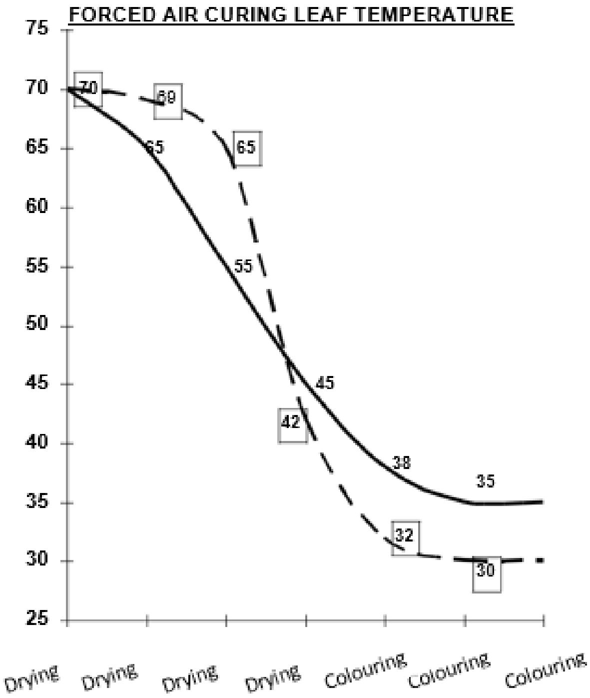
- The dense, woody nature of leaf midrib, especially on middle and upper leaves, requires high temperature and relatively little air to remove moisture. Therefore when this stage is reached, temperature is increased to 70 to 75ºC and ventilation significantly reduced to "sweat" moisture out the midrib. The continuous system is different only in so far as air moving through tobacco during midrib drying is used efficiently later in the cure and therefore reducing air in unnecessary.

CURING CURVES

The diagram below identifies two different scenarios found in continuous curing systems. It should be noted that the "ideal" curve (solid curve) is applicable to any curing system from traditional barn (with the provisor that colouring temperatures are lower to reduce risk of fixing green on the bottom tier when flues are not shielded) to bulk curers.

The "common" curve (dotted line, temperatures in squares) describes the continuous system when inlet temperature (70ºC) is correct and sufficient air is employed to ensure wilt at the end of colouring (around 43ºC). Rapid cooling of the air as the leaf dries results in colouring temperatures of around 30ºC or less depending on ambient conditions, significantly slowing enzyme activity. The tobacco is cold and turgid during (often prolonged) colouring. Towards the end of this phase, temperature begins to rise as moisture is gradually lost, and then accelerates rapidly as drying air removes moisture from the leaf. This is not usually a problem on this leaf (lower reapings, tobacco from fast growing areas and/or seasons, especially if soil nitrogen is on the high side). However, on bodied leaf, particularly if growing conditions results in close grained tobacco, this steep curve frequently causes sponging, often severe.

Research has demonstrated that by introducing humidity into the inlet air, drying capacity of that air may be considerable influenced. The same research also showed in a continuous system that by recycling humid air from the exhaust end, colouring temperatures will be raised. By managing this recycled air it is therefore possible to ensure that colouring temperature are maintained at the ideal for colouring viz. 35 to 38ºC. Also recycling, by modifying the drying rate of the air, will mean a more gradual increase in temperature through the drying phase. This is well illustrated by the "ideal" curve (solid line, temperatures open) – below:



Higher colouring temperatures result in more rapid colouring. Also, despite the fact that the air stream is carrying more moisture, higher energy levels contribute to a more efficient wilt at end of colouring.

Under certain conditions the air at the start of colouring may become saturated (wet and dry bulb temperatures the same). If this continues well into the colouring phase, barn rot (particularly fungal) becomes a problem. This is more likely if colouring is longer than normal, e.g. unripe reaping.

Both forms of barn rot (fungal – "hairy" and bacterial – "dripping") are more aggressive at higher colouring temperatures which is why they often appear worse using the ideal curve. This problem is solved by bleeding hot air into the saturated air stream. In the cascade system this is done by cracking hot vents into day 2 or 3 after loading and in the modern tunnel design, judicious use of the auxiliary hot air duct and vent system during colouring. Bacterial barn rot is increased significantly if leaf is loaded wet after rain. Again introducing hot air to dry the leaf surface immediately following loading will help.

As outlined above, the slower drying of the ideal curve is critical in avoiding sponging of bodied tobacco. Growers' experience has demonstrated that tobacco cured using this curve resulted in a richer coloured leaf with more "lustre" and less blemish. A word of warning, in thin, low starch tobacco (usually heavily fertilized tobacco in good growing conditions, especially from the lower half of the crop) slower drying may increase losses through overcolouring. In this case, it is advisable to bleed hot air into the end of the colouring phase to accelerate enzyme activity and wilt, but to restrict recycling to dry as rapidly as possible.