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Harvesting and Curing Flue-Cured Tobacco

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Tobacco cover photos from Bugwood.org by David Jones, Universiry of Georgia

Introduction

There are two major objectives for curing flue-cured tobacco: (1) to provide temperature and humidity conditions that will encourage certain desirable chemical and biological changes, and (2) to preserve the leaf and retain quality through timely drying. Curing is more than drying the leaf. It improves chemical and physical changes that are necessary for high-quality cured leaf.

Harvesting and curing are important phases of tobacco production. In the past, when old stick-type barns were used, harvesting and curing required more than 200 hours per acre. With the machines available today, the time required for harvesting and curing is less than 50 hours per acre. When you use these machines, you need to make some management decisions before entering the field to harvest. First, decide which type of harvester you will use and if the barns you are using are adequate. Also, decide whether to clean up primings or leave them in the field. You must make these decisions far enough in advance of harvesting to assemble the necessary people and equipment to make the first harvest on time.

Harvesting

Uniformly ripe tobacco is essential for selling top-quality leaf. Under normal conditions, flue-cued tobacco ripens two to four leaves per week; therefore, a harvest rate of two to four leaves per plant per week for five to seven weeks is required. Several factors can influence the maturity and harvest rate. Tobacco grown with recommended fertilizer requirements will tend to ripen normally and produce sufficient pounds. It is recommended that sand lugs (the first two to three leaves to ripen) not be harvested. This tobacco has low level of solids' content and is considered undesirable by the manufacturers. Timely harvest is essential to obtain a quality leaf for market. Harvest primings when the leaves appear to be the same color as those of field peas. Another indicator of ripeness is a uniform color (pale green) throughout the leaf when it is held up in sunlight.

Harvest Only Mature, Ripe Leaves

Tobacco leaves reach full maturity a few days before ripening. Mature leaves exhibit a slight yellowing and puckering between veins and break off the stalk easier than immature leaves. Fully mature leaves cure easily, and the quality, color and weight are usually good. The best quality cures occur when the tobacco is allowed to mature in the field. The stages of maturity are: premature, mature, ripe and overripe. Tobacco harvested in the ripe stage may be cured to give better color, quality and weight than tobacco harvested in the overripe stage. Overripe tobacco does not color, yield or sell as well as tobacco harvested and cured at proper maturation. You should let the tobacco mature but not become too ripe before removing leaves from the stalk.

Cured leaf quality depends on having uniformly mature leaves in the barn. Quality cured leaf is nearly impossible to achieve if several leaf stages of maturity are in the same barn. Tobacco in any one stage of maturity (except premature) can be successfully cured if attention is focused on that one maturity group. Premature tobacco is nearly impossible to cure under any condition. If tobacco of several maturity groups must be harvested at once, a good cure is possible if you keep maturity groups separated using multiple harvests.

Container Loading

The introduction of bulk curing barns has led to problems with properly loading bulk containers. Laborers often do not uniformly load containers such as racks, big boxes and medium-sized boxes. When you pack, do not leave air tunnels or pack lumps of tobacco. Spread tobacco evenly over the entire container as it is being filled. Lumps or wads of tobacco cause tight spots, and the tobacco will not cure properly. Fill the corners and edges of bulk containers first and pack these slightly tighter than the center. Unless there is uniform air flow to all leaves in the container, there will be leaves or pockets of leaves that do not cure properly.

To a large extent, the type and condition of the tobacco determine how tightly it can be packed in bulk contain-ers. Lugs (the bottom quarter of the stalk) should not be packed at all.

You can get good results by packing good quality, upstalk, dry tobacco to a density of 15 pounds per ft3. Remember, the tobacco density may increase from morning to afternoon. Tobacco is usually turgid (swollen with moisture) in the morning, but it may be completely wilted in the afternoon; therefore, do not pack wilted tobacco as tightly as turgid tobacco. Also, containers should fit snugly together so air does not pass between them. Use a board or other material to block air movement between the doors and the outside container.

Curing

Historically, tobacco curing has been considered an art. Since the use of bulk barns began, growers have had much more control over the curing process. Management skills include understanding the principles of controlling airflow, temperature and humidity in a controlled environment.

Purpose of Curing

Curing develops and preserves the potential quality, flavor and aroma of tobacco. Once the tobacco is in the curing barn, a concerted effort should be made to bring the tobacco to a brilliant color (lemon orange). Once you achieve the desired color, dry the leaf to preserve that color. Color is important; it indicates that certain chemical changes have taken place, and it is used as an index of leaf quality. It is estimated that 75 percent of the market value of the leaf is based on its color. The first objective is to maintain life in the leaf until the biological processes are complete (yellowing phase) and starch is converted to sugar. Next, stop bio-chemical activities by removing leaf moisture (leaf drying). Finally, preserve the leaf by drying the stem.

Closely monitor tobacco temperature, humidity and color throughout the curing process. Periodically look through the observation ports to check the wet-bulb, dry-bulb thermometers and notice the color changes. Care should be taken when opening the loading doors, which may release too much moisture and harm the curing process, especially during yellowing. For updraft barns, place the dry-bulb thermometer under the tobacco near an observation port so you will not have to open the door. Place the wet-bulb thermometer in between racks or on top of the tobacco to get a more accurate indication of wet-bulb temperature. Reverse the location of the thermometers when using down-draft barns.

Temperature Advance Schedule

Depending on the condition of the tobacco, there is considerable variance in advancing the temperature. The following wet-bulb, dry-bulb temperature schedule (Figure 1) should prove effective with mature, good quality tobacco.

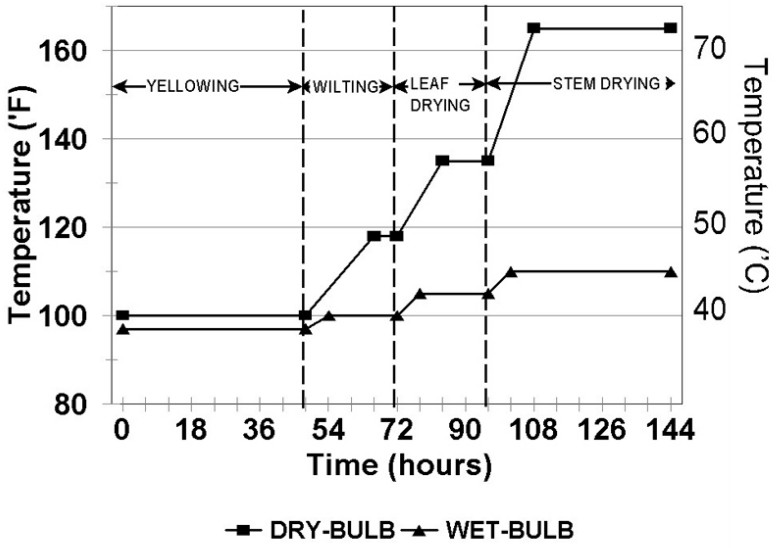

Figure 1. Bulk curing schedule for mature, ripe tobacco.

Humidity

During the yellowing and leaf-drying phases, humidity control is essential to success. Keep in mind that the relative humidity drops as the curing advances. Humidity is controlled through the vent system by adjusting the fresh air exchange rate. Controlling humidity can extend or shorten the coloring time to get the most desirable color. If the tobacco is drying too quickly (e.g., drying preceding yellowing), close the vents. Opening the vents will hasten drying.

Remember these points about air and humidity:

1. Air at higher temperatures has more drying potential at the same relative humidity, and
2. At a constant relative humidity, 105°F air will hold twice as much water as 85°F air.

Use of Wet-Bulb, Dry-Bulb Thermometers

The wet-bulb thermometer measures the temperature of the leaf during the early stages of cure; the dry-bulb thermometer measures air temperature. Most growers are familiar with and use the dry-bulb thermometer, but you also need a wet-bulb thermometer. Since the humidity and the dry-bulb temperature must be controlled, a wet-bulb thermometer is needed to indicate when adjustments in the vents are necessary. Thermostats should not be used as thermometers because they may not be calibrated to sense the same temperatures as thermometers.

You can buy wet-bulb thermometers a local fuel supply dealer, or you can make one at a fraction of the cost. A homemade wet-bulb thermometer designed especially for a bulk tobacco barn can be used. See Appendix A for details on constructing a homemade wet-bulb thermometer.

The relationship between the wet-bulb and the dry-bulb temperatures determines the relative humidity within the barn. The closer the wet-bulb temperature is to the dry-bulb temperature, the higher the relative humidity. The relative humidity within the barn determines the drying rate of the leaf. The lower the humidity, the faster the leaf dries; the higher the humidity, the slower the leaf dries. Maintaining the proper wet-bulb temperature not only results in the best possible cures but also minimizes the amount of fuel necessary to cure the tobacco.

Advancing Temperatures During Yellowing

Advancing the dry-bulb temperature and wet-bulb temperature in relation to each other is a critical feature of curing. When starting a barn, close air intake dampers before turning on the heater. Turn the heater on and gradually raise the temperature to the yellowing range (Figure 1). Do not raise the temperature more than 5°F at any one time. Allow about 30 minutes between temperature rises to provide time for the curing air to become humid.

Yellowing Considerations

Curing each succeeding barn of tobacco as the season progresses requires adjustments in the curing schedule. For example, tobacco grown under varying climatic and field conditions calls for different yellowing schedules, with dry-bulb temperatures varying from 95° to 105°F and wet-bulb temperatures varying from 93° to 97°F.

After each barn of tobacco is harvested, first decide the best way to yellow the tobacco. Consider leaf moisture content, maturity and thickness. Then make a decision at each step along the way about

how long to maintain a given temperature and humidity so the tobacco will complete its yellowing process. Failure to do this may result in dry leaf tips with a set green color. Tobacco with a high moisture content requires considerably more moisture removal before color setting than droughty or low-moisture tobacco.

Alter the yellowing schedule throughout the season as the tobacco varies from thin to thick and/or turgid to wilted tobacco with a minimum amount of moisture. For example, immature, wet-weather or drought-grown tobacco should be yellowed at lower temperatures.

Length of Time Required for Yellowing

Normal tobacco is yellowed at varying lengths of time, depending on the stalk position. For example, primings and lugs should be completely yellowed in 20 to 30 hours. On the other hand, upstalk tobacco may require 60 or more hours to obtain the desired color. The quality of certain varieties may be improved by extending the yellowing period. Certain varieties may sometimes yellow before starch is converted to sugar, resulting pale, slick, immature tobacco.

Other Yellowing Suggestions

Remove as much moisture as possible during the yellowing phase of curing. With good tobacco, as much as 20 percent of the moisture can be removed during yellowing.

When the yellowing phase is almost complete, the tobacco should show a good yellow color at the leaf tip with slight green-tinged colors running along the main stem and veins to the butt. Also, the leaf tips and edges should begin to tuck and dry to a bright yellow. When the tobacco throughout the barn reaches the desired color, increase temperature and drying rate. At the end of yellowing, some wilting should have occurred. Avoid flash temperatures that can dry the leaf before yellowing is completed. This sets an undesirable green color.

Wilting

Some wilting occurs before the end of yellowing at the 105°F dry-bulb temperature, but most of the wilting should take place as the dry-bulb temperature advances from 110° to 118°F. The rate of temperature advance from 105° to 110°F should be 1° to 1.5°F per hour with a wet-bulb temperature of 100°F. During the wilting phase, the tobacco loosens considerably and the air can move through readily. Do not advance the temperature beyond 118°F dry-bulb temperature until wilting is 100 percent complete.

Leaf Drying

When the tobacco leaves have reached the desired yellow color and are thoroughly wilted, the leaf must be dried. The drying stage is critical because tobacco is sensitive to temperature change. Impatience to capture a good color often results in advancing the temperature too rapidly and producing a browning or barn scald. If the temperature is advanced too slowly, sponging may occur. There must be positive control of air-flow and temperature during leaf drying to prevent undesirable color in the cured leaf. To prevent sponging, dry the leaf as rapidly as possible, yet not so rapidly as to cause scalding.

Wet-Bulb and Dry-Bulb Temperatures

Maintain the wet-bulb temperature near 100°F during leaf drying. Once the tobacco is dry enough (30 to 40 percent of the moisture removed) to take dry-bulb readings above 135°F, the wet-bulb temperature is not critical to the quality of the cured leaf. Maintaining a wet-bulb temperature of 110°F or higher, however, tends to conserve fuel.

Stem Drying

Advance the dry-bulb temperature from 135° to 165°F at a rate of 2° to 3°F per hour. Close dampers gradually during stem drying. Maintain a damper opening sufficient to hold wet-bulb temperature down to 110°F during the first 12 to 18 hours of stem drying. Dampers are usually closed completely about the time the leaf is completely dry and the temperature has reached 165°F. Stems should be killed out at a temperature of 165°F. Due to sugar caramelization, tobacco will turn red when the dry-bulb temperature is more than 165°F.

Curing Problems

Most curing problems are caused either by improper packing of containers and/or by wet tobacco. Problems occur with all makes of containers packed with wet (from rain or dew) primings or lugs. The problem with wet tobacco has been especially bad with low-stalk tobacco.

Soft Rot

Low-stalk tobacco (primings and lugs) is especially susceptible to soft rot damage during wet harvest conditions. These leaves are close to the ground in the field and are contaminated by barn rot organisms that stem from bacteria found in many fields. Once the tobacco is in the barn, the moisture and warm temperatures provide an ideal environment for bacterial growth and barn rot to damage the tobacco. When dry, affected areas develop a black color and follow irregular patterns on the leaf. Prevent soft rot by harvesting tobacco that is completely dry.

Barn rot can be lessened on wet tobacco by operating the fan with dampers wide open and heat off until the surface moisture is removed from the leaf. This may require as long as 48 hours. If heat is added to remove surface moisture (100 percent relative humidity outside), set the thermostat no more than 5°F above the outside air temperature and provide maximum ventilation without setting green color in the leaf. The object is to keep the leaf as dry and cool as possible to prevent multiplication of the barn rot bacteria.

Sweating

Sweating of tobacco is caused by overcrowding and insufficient and ineffective ventilation during the yellowing and wilting phases, resulting in too much moisture remaining in the leaf when the temperature is raised. This causes super-saturated stagnant air. To prevent sweating, the drying rate should be as fast as possible once the color is set. Remove as much moisture as possible during the yellowing phase. Increase ventilation as the temperature increases. If water is condensing on the top tiers, close vents until the tobacco is warm, then flush.

Brown Spot

Tobacco damaged by brown spot should be yellowed at a high yellowing temperature. Early, rapid leaf drying will usually stop the spread of brown spot.

Immature and Slick

Immature, slick tobaccos are described as lacking in grain and other elements of quality. The surface of the leaf is smooth and does not have the desirable crepe-like texture, and the leaf is papery, with little or no elasticity or oiliness. Such tobaccos lack richness of color, are deficient in aroma and have a flat, undesirable taste. They may be compared with fruits that have been harvested green and allowed to ripen in storage – the "field-ripened" flavor is not there. This condition is associated with: (1) improper fertilization, (2) close spacing or topping too high, with attendant shading and greater competition for plant food, water and sunlight, and (3) excess rainfall or over-irrigation, which leaches out the fertilizer and upsets normal growth processes. These conditions often cause yellowing before ripening, and immature leaf harvesting. Varieties differ in their tendency to produce tobacco of this type.

Green

Green color in the cured leaf results from a failure to break down all the chlorophyll during the curing process. There are several causes of green tobacco:

1. Harvesting the leaves before they are ripe, as happens when too many leaves are pulled at once. Tobacco leaves sometimes acquire a faded-out yellow color, suggesting ripeness that is not true ripeness.
2. Severe drought conditions, which prevent ripening. Leaves that are harvested under such conditions will generally cure with a greenish cast.
3. Excessive nitrogen supply, which prevents proper ripening. Tobacco grown with too much available nitrogen will cure out green or brown.
4. Insufficient yellowing of the leaves before drying.

There are other deficiencies associated with green color, and such tobacco has a harsh, bitter taste Lighter shades of green will improve on aging, but pronounced green grades are most undesirable.

Sponged

The term "sponged" is used to designate those well-grained, porous, overripe tobaccos that have a dull, grayish-brown color. This type of cured leaf is caused by allowing tobacco of good quality to become overripe in the field, or by holding low temperatures too long in the early part of the curing process (occurs at high humidity and low temperature (105^{o} - 125^{o}F)). If the moisture in the leaves is not removed quickly enough, sponging is likely to take place and result in grayish and brownish blotches on the leaf surface. In normal curing, the color breakdown proceeds from green to yellow. By drying, the color may be fixed at either of these stages. In the case of sponging, the color breakdown has gone beyond the yellow stage to the gray or brown stage. Color alone is not the basis for designating tobaccos as sponged. Some brown tobaccos may be slick, dead, "toady" or otherwise very undesirable. Slight sponging may not result in serious detriment to quality.

Toady

Toady tobacco is characterized by a slick, dense, sometimes thick and leathery leaf with a nondescript smutty, grayish-brown color. Toady leaves have no grain and are very compact. They are abnormally high in sugar content. They are usually soggy, but may be dry-natured and starchy. The cause of toadiness is not fully understood; however, certain varieties tend to produce higher proportions of this type of leaf than others. It has also been observed that in seasons of high rainfall or following over-irrigation, some toady tobacco may be found in all varieties. Rapid drying is essential to discourage the development of this condition.

Moisture Run Back

The presence of dark or reddish areas along the upper portions of the leaf midrib and larger lateral veins is known as "moisture run back" or "circle stem." It is caused by lowering the temperature after the blade of the leaf is dry, but before all moisture has been removed from the midrib. The moisture in the midrib seeps back into the leaf, causing a dark area. Refiring and drying the midrib will not remove the discoloration, but will put the tobacco in a safe keeping condition. Run back will not occur if the curing unit is fired continuously until the entire leaf is fully dry.

Barn Scald

Dark, chocolate-colored areas on cured leaves, known as barn scald, may result from excessive humidity in the curing barn. This condition is usually caused by over-crowding in the barn and inadequate ventilation. Barn scald may occur at any dry-bulb temperature above 110°F. The leaves are cooked (rather than dried) when the temperature is raised. Brown scald will also occur in properly loaded barns if killing heat is applied before drying is complete. A set green color, or green scald, may develop in the leaf tips if flash heat occurs before the tobacco is yellowed.

Swelled Stems

After colors have been set and the leaf partially dried (130° to 145°F), the remaining moisture is removed at "killing out" temperatures of approximately 165°F. Failure to remove all moisture from the midrib leaves it soft, pliable and larger than when dry. Temperature may be too low or held too briefly. Incompletely-dried midribs are called "swelled stems." Swelled stems usually mold in storage and may be the cause of considerable loss through damage to the surrounding tobacco. Swelled stems can be reduced by holding temperatures high (165°F) until the stem is dried. Some curing barns have areas of ineffective ventilation that contribute to swelled stems. Care should be taken to pack containers uniformly to ensure uniform distribution of curing air.

Scorched

This condition is associated with high temperatures, especially during the stem-drying phase. Scorched tobacco has an abnormal aroma and an off-taste when smoked. To keep scorched tobacco to a minimum, keep dry-bulb temperatures below 165°F.

Ordering

When curing is over and the stems have been killed, the moisture content of the leaves is near zero. At this stage, the leaves and stems are too brittle to handle, so enough moisture must be added to the leaf to bring the moisture content up to about 15 percent. The leaves are then pliable and can be handled easily.

The rate at which to add moisture to the leaf depends mainly on the method selected to add moisture to the barn and on the condition of the tobacco itself. A barn of 3,000 pounds cured tobacco requires about 50 gallons of water to bring the leaf into order. Running the fan with the dampers wide open usually brings the tobacco in order overnight. There are many spray-injection systems that can bring a barn of tobacco in order in a few hours. If there is a floor in the curing barn, water can be poured onto the floor. No matter which method is selected, do not apply the water directly to the leaf. The ordering method depends on the equipment available and how quickly you need to get the tobacco in order.

The best time to add moisture back into tobacco is when the leaf temperature is high (165°F). Turn the furnace off and insert a hollow cone spray nozzle operating at 100 psi (if possible) into the air stream around the furnace. Using this method, a cured barn of tobacco can be made easy to handle in one to two hours. Table 1 lists different types of hollow cone nozzles and hours of operation to add moisture to cured tobacco.)

Table 1. Number of hollow cone nozzles required to order a bulk barn of tobacco.

		Nozzle Operation Time		
		2 hrs	4 hrs	6 hrs
Nozzle Type	**Pressure (PSI)**	**Number of Nozzles Required Per Barn**		
TX-3	40	8	4	3
TX-4	40	7	3	2
TX-6	40	4	2	1
D1-13	40	7	3	2
D3-13	40	4	2	1
D1-23	40	6	3	2
D2-23	40	4	2	1
TX-3	100	6	3	2
TX-4	100	4	2	1
TX-6	100	3	1	1
D1-13	100	4	2	1
D2-13	100	3	2	1
D1-23	100	4	2	1

Equipment and Barn Maintenance

Check and service all equipment before harvesting and curing tobacco.

Harvesters

Harvesters must be in good condition if you want trouble-free, efficient harvesting. Check all systems and parts for proper operation and remaining service life, including the engine, power train, hydraulic system, tires, etc. Check the condition and tension of drive belts and chains and replace them if you need to. Grease and oil bearings and replace if needed. All adjustment mechanisms should operate freely, so adjustments can be made rapidly and easily in the field.

The mechanical harvester operator needs to get ready for the harvest season. The operator probably last used the machine nine to 10 months ago, and operation details may have been forgotten. The operator should review the operator's manual and perform all inspections and services recommended just before the harvest season. These actions refresh memory on important operating procedures, required service and necessary adjustments. A little practice operating the machine around the machinery storage area is a good idea. This will permit the operator to become familiar with the location of control levers and the kind of reaction to expect.

Curing Barn

Successful bulk curing depends on satisfactorily working equipment. Faulty equipment can cause a bad cure and considerable financial loss. Initiate a preventative maintenance program for your tobacco-curing equipment before it is put into heavy use. The fan, thermostat and electrical controls should be cleaned. The capillary tube on thermostats should be checked for kinks and/or breaks. The wicks on wet bulb thermostats should be replaced and water reservoirs checked. Belts, bearings and shafts should be checked and replaced if needed. Burner components should be inspected, cleaned and/or replaced if necessary.

Loading Doors

Loading doors should be hung such that they will seal the entire opening. Gaskets around the door should be in good condition. Torn or frayed gaskets should be replaced. A good substitute material is thick-piled carpet, which can be easily obtained and installed to seal the loading doors. Water hoses will not withstand the high air temperatures and should not be used.

Foundation

The bulk curing barn foundation should be sealed with an asphalt sealant, which will expand and contract as the barn heats up and cools down during the curing season. A small crack between foundation and pad area can waste more money in energy loss than the small cost of sealing.

Curing Chamber and Furnace Room Areas

These areas should be examined closely. Look for small and large cracks. They should be sealed with a butyl caulk or a caulking material that can withstand 180°F air temperatures and remain flexible. One way of detecting air leaks is to go into the barn, close the door and look for daylight. Caulk these areas.

Barn Insulation

If the bulk barn is only a few years old, it probably has adequate insulation, but fuel costs for older barns could be reduced by insulating them. Money will be well spent on insulating older barns. You can reduce fuel consumption by 15 to 20 percent by adding insulation with an R-value of 3.5 to the structure. The payback for insulating varies from operation to operation, but when insulation was installed in old bulk barns, the payback for investment was one to two years.

There are several kinds of insulation to consider for tobacco barns. Use a material that has a high R-value per inch (greater than six) and does not absorb moisture. Styrofoam bead board and polyurethane are the insulations of choice. Normally, this type insulation has foil protection on one or both sides to protect the insulation from being damaged or destroyed.

Existing Uninsulated Barns

When insulating an existing bulk barn, choose a board type and be sure you get a tight fit. If the board insulation does not fit tightly, there will be heat (energy) loss at these points.

Here is a method used by a grower to insulate an existing uninsulated bulk barn: Insulation (1/2-inch material) was cut to fit between the tier rails and nailed to the interior wall. Doors and the furnace end were also insulated on the interior. The ceiling was insulated by attaching the board-type insulation to the bottom of the rafters. After all insulation had been installed, it was caulked with a flexible, heat-resistant material. For Powell barns built before 1974, the insulation should be placed between the rafters over the furnace. Care should be taken not to reduce the return air volume over the furnace.

Pad Installation

Concrete and soil are poor insulators, with an R-value of 0.08-010 per inch. If you install a concrete foundation, insulate under it. Place at least 1 inch of board-type insulation under the concrete foundation (Figure 2). Cover the insulation with a layer of polyethylene to eliminate the problem of the insulation floating up in the slab. Place 2 inches of sand under the insulation to provide adequate drainage.

Lower Plenum

The side walls of the lower plenum (Figure 2) of most bulk barns are difficult to insulate. The drying floor is constructed in such a way that it is difficult to remove, and exterior metal sheeting will cover most of it on the outside. This area needs to be insulated because of its construction, which usually is only an eighth-inch piece of metal. If this area cannot be insulated, you can reduce heat loss at this point by piling a foot or two of soil outside the barn to cover the area where the side wall or sheet metal meets the lower plenum (Figure 2).

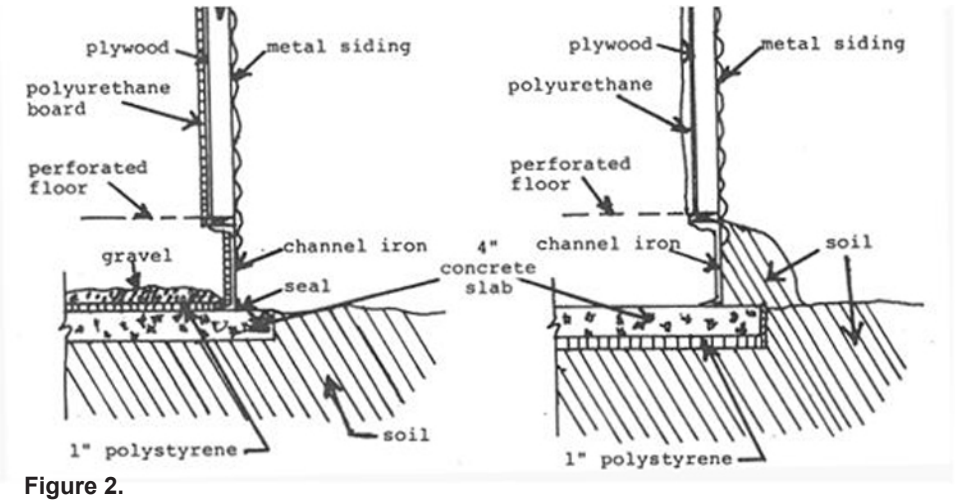

Figure 2.

Appendix A

How to Make a Wet-Bulb Thermometer

Proper management of the curing process and proper barn maintenance can reduce fuel usage drastically. No matter what type of bulk barn is used, fuel consumption can be reduced by tightening up the barn and using a wet-bulb thermometer to gauge ventilation. Caulking compound for structural cracks and new weather stripping for doors cost a small amount compared to the heat they save. You can make a wet-bulb thermometer for $3.00 to $5.00. The homemade wet-bulb thermometer shown in this photograph has been used successfully as an indicator of wet-bulb temperature in bulk barns.

Materials

2 - pieces 1" PVC pipe, 7" long (one piece with 1/4" hole drilled 1 1/2" from one end)

1 - piece 1" PVC pipe, 2" long

2 - 90° 1" PVC elbows

2 - end caps, 1" PVC

1 - piece athletic shoestring, 7" long (wick)

1 - Tobacco Curing Thermometer with bulb guards cut out

1 - wide rubber band

1 - piece of thread (not shown) 4" long to tie wick to thermometer bulb

Instructions for Construction, Filling and Using

1. Glue all PVC pipe together as shown in the figure.

2. Carefully remove glass thermometer bulb from holder and cut out in a 1 to 1 1/2" square around the bulb.

3. Replace glass thermometer bulb and calibrate according to another thermometer.

4. Secure thermometer to PVC pipe with rubber band or light gauge wire.

5. Fill with water. A large syringe or a small snout "squeeze-it"-type plastic detergent bottle may be helpful.

6. Insert wick into water. A small nail, large toothpick or kitchen matchstick may be helpful.

7. Place in curing barn where air flow is strong. In up-draft barns (e.g., Roanoke, Long, Powell), lay wet-bulb device flat on its back on the perforated floor near the loading doors. In down-draft barns (e.g., bulk tobacco), lay wet-bulb device flat on its back near the loading doors where air flow will strike the wet bulb of the thermometer.

8. Open fresh air vents only enough to maintain a wet-bulb temperature of 100° to 105°F during leaf drying and 105° to 110°F during stem drying.

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