Energy Conservation Procedures in Bulk Barns

summer we measured the LP gas used in four bulk rack barns on the C.L. Talley farm in Chula, Georgia. Barns 1 and 2 were insulated with 1.5 inches of polystrene board insulation (R= 4.17/in) in the wall cavity between the metal siding and the plywood inner skin. They had six inches of batt fiberglass insulation (R= 3.1/in) in the ceiling. Barn 3 was an uninsulated, unmodified barn, and Barn 4 was a new model barn with factory installed insulation in the wall cavity, ceiling and furnace room. No insulation was used under the concrete slab except for Barn 4. This barn was installed just prior to the 1977 season and we were able to place 1.5 inches of polystrene board, sealed between two sheets of 3 mil polyethylene film, under the concrete slab

The fuel consumption for seven cures in these barns expressed as gallons of LP gas per pound of cured leaf coming out of he barn, is given in Table 1. If we use Barn 3 as a base for comparing the over-all performance of all four barns we see that Barn 1 used 94% as much fuel, Barn 2 92%, and Barn 4 83%. The savings for the season were then 6% Barn 1, 8% Barn 2 and 7% Barn 4

Fuel Required for Different Stalk Positions

It is interesting to note the different amounts of fuel used to cure leaf from different stalk positions In Barn 1 it took 111% more fuel per pound of cured leaf for cures 2-3 than cures 6-7 In Barn 2 it took 67% more, in Barn 3 74% more and in Barn 4 51% In round figures it took 50-100% more fuel to cure tobacco from the lower third of the stalk than from the upper third Note that this comparison does not include the first priming tobacco (Cure 1). Cure 1 took 142% 95%,114% and 118% more fuel than cures 6-7 in Barns 1-4 respectively. It is quite expensive to cure the sand ugs

Benefit from Insulation

It is disappointing that Barns 1 and 2 showed only a 6-8% saving over the uninsulated barn (Barn 3). These barns were adjusted at the beginning of the season and all three had combustion efficiencies of 88-90%. They all had the same automatic control to open the vents and maintain a set wet bulb temperature. They were loaded in the same way from the same crop of tobacco. Each basically received the same cure management, same wet bulb and thermostat settings. Some variable interfered with the insulation comparison. The comparison between Barns 3 and 4 does show a substantial benefit for the factory insulated barn with insulation under the concrete slab. From this data it seems that a 10-20% fuel savings can result from the proper use of insulation. It appears that R factors in the 5 to 10 range are, all that can be justified for bulk barns. This of course will change if fuel costs triple or quadruple

Air Leakage Losses

The four barns were run empty for seven days using the same thermostat settings used for a "typical" cure. The fuel used in Barn 1 was 37% of that used when the barn was filled with tobacco. In Barns 2-4 it was 42, 39 and 23% respectively. The fuel consumption when the barn is empty represents the total maximum losses. These losses include not only the heat losses from the structure, but also maximum losses due to the leakage of heated air. Our calculations show that a 1% air leak (air leakage equal to 1% of the total circulated air when the barn is empty) accounts for 18-20% of the total losses

During curing, an air leak from the return plenum at the top of the barn does not represent a pure loss since this air has passed through the tobacco, and has picked up some moisture. When it escapes it takes

this moisture out with it, just as the air released from the front vent. An air leak from the bottom plenum, however, is critical. This is heated air which is never used. It escapes without passing through the tobacco and picking up moisture. It does no drying and represents a direct energy

To minimize air leakage losses make sure that the barn is sealed to the foundation. Plug all holes in the side of the bottom plenum Insure that the floor of the furnace room fits tightly and no leaks occur through it into the furnace room. Replace the gasket material around the front doors every other year, and use care in loading the barn to insure that it is not ripped and torn

Excessive Venting

All barns on the Talley farm were vented with an automatic vent control using procedures described in the operators manual. This is the main reason for the excellant over-all performance. The data on the rate of fuel consumption during the various cures did show instances when there was excessive venting. These instances occured during stem drying near the end of the cure. Apparently the wet bulb reservoir ran dry and the wick dried out. This is a common problem. Make sure that the wet bulb reservoir is always filled with water, and that the wet bulb temperature setting is correctly advanced during the cure as the thermostat is advanced. The wick should be replaced every season without fail, and it would be better to replace it at mid season also

The recommendation for manual venting used to be .....make sure you vent enough, fuel is cheaper than tobacco. This recommendation is still valid, however it should not be used to justify the very wasteful venting procedures commonly used in the field. It is practical to cure tobacco

and never exhaust more than 10% of the circulated air at any time during the cure. Excessive venting really wastes energy. Most people over vent when they vent by hand. For this reason it is beneficial to use the automatic vent control if it is operated and maintained in the proper way.

It is impossible to recommend specific vent settings in this article. Each model barn has a different airflow through the furnace and consequently exchange different amounts of air for a given vent opening. The best recommendation is to "be a student" of your equipment. Learn how it operates, keep good fuel and total tobacco cured records, and find out how it is performing. An LP gas meter costs about $130.00. It could pay for itself in one season if you have a multi-barn site and are to learn enough on one barn to correct your vent procedures on all the other barns

Good Management

Very few growers can use commercial equipment and better Mr. Talley's seasonal average on Barn 3, the conventional, unmodified barn. He averaged slightly less than 0.1 gal LP per pound of cured leaf for seven cures, his entire crop. However, this is a good standard of comparison and sets a reasonable goal for all growers. Some are now averaging 0.2 gal LP per pound of cured leaf, or twice the standard. (0.1 gal LP per pound of cured leaf is approximately 0.07 gal No 2 fuel oil per pound of cured leaf for those will oil burners.) I estimate that we can reduce our total Georgia consumption of petroleum fuels for tobacco curing by 20% if everyone practices good management techniques

1. Use careful vent control particularly during stem drying. The vents should be almost closed during this period Never stem dry above $165^{o}F$.

2. Properly maintain the wet bulb sensor for an automatic vent control. Replace the wick at least once each season and twice is preferred. With some of the new controllers coming on the market it will be necessary to change this wick each cure. Don't let the reservoir run dry, and don't forget to advance the wet bulb setting as the thermostat is advanced.
3. Replace gasket material around the front doors whenever it is torn. Check it during the winter prior to the busy time that precedes harvest in June.
4. Stop all air leaks in the furnace room and around the lower plenum These leaks cannot be found when the barn is operated empty because no static pressure is developed. The resistance of the tobacco develps the static pressure which causes air to seek out the cracks

   Have your furnace checked to see that it is firing with the maximum possible combustion efficiency. This is particularly necessary if you have changed the settings yourself a few times Ask your gas supplier to test it with a combustion testing kit.
6. Consider buying a gas meter to keep records on the gas used in one of your barns for a given management system. Change the management and see what effect this has. Remember that the fuel consumption per pound of cured leaf normally goes down as the harvest moves up the stalk. Compare data with your neighbors and find out what he is doing that is better than your procedure. Remember, 0.1 gal LP per pound of cured leaf is a good seasonal average for a normal crop.
7 It has always been important to not overload racks or containers It is equally important to not underload a barn. The data in Table 1 shows the affect this has on fuel consumption Mr

Talley had a new man loading the racks when he loaded Cure 5. Note particularly in Barn 1 this resulted in a high fuel consumption per unit of cured leaf. The heat losses for a lightly loaded barn are approximately the same as those for a normally loaded barn, consequently since less tobacco is cured in the light barn the fuel consumption per unit cured leaf is higher.

8. If you keep good fuel and marketing records and can show that you beat the 0.1 gal LP (0.07 gal fuel oil) per pound of cured leaf, please give this data to your county agent and request him to send it to Robert L. Miles, or William H. Hogan, Extension Specialists - Tobacco. This data will allow us to project a challenging but realistic standard for the state.

Table 1. LP gas consumption[1] in 4 bulk rack barns during 1977 season.

Cure No.	Barn 1	Barn 2	Barn 3	Barn 4
1	.131	.123	.139	.120
2	.131	.103	.129	.085
3	.097	.107	.097	.082
4	.072	.081	.100	.084
5	.086	.073	.071	.074
6	.050	.063	.073	.049
7	.059	.062	.057	.060
Average	.089	.087	.095	.079
Average Cures 2-3	.114	.105	.113	.083
Average Cures 4-5	.079	.077	.085	.079
Average Cures 6-7	.054	.063	.065	.055

[1] Not corrected for combustion efficiency.