

Conventional Round Baler Evaluated for Biomass Recovery

The potential of producing round bales of woody biomass using conventional farm equipment was evaluated in a study by the Tennessee Valley Authority (TVA), U.S. Forest Service, and White's Inc. Baling of young, small-diameter stems may be a solution to handling this type of material in specialized conditions such as rights of way; Short Rotation Intensive Culture (SRIC) plantations; and dense, stagnated stands. Improved in-woods forwarding by densification and reductions in power consumption and capital expenditures are possible advantages of a baling system.

Test Material and Equipment

Stems in the 1-3 inch class were crushed/split with compression rollers on an experimental bench crusher and air dried for several weeks. Previous TVA tests indicate that crushing improves the drying rate of stems as well as improves their flexibility. The trees were segregated by diameter class but were of mixed species including sweet gum, loblolly pine, and a few oaks. An additional test included freshly cut, uncrushed trees of the same size. The lengths of all the trees ranged from 6 to 16 ft. The moisture contents at the time of baling were:

Crushed - 38 percent (dry weight basis)

Uncrushed - 89 percent (dry weight basis)

The crushed trees were fairly brittle and would partially break when bent. As expected, the larger diameter trees were more rigid than the smaller diameters. The green (freshly cut) trees would bend; however, they were too resilient for the initial bending needed to facilitate baling. The small diameter crushed material bent and broke easier to enable baling.

The baler tested was a Claas Rollant 62*. The conventional round baler uses eighteen 1 1/4 inch steel rollers to encompass and produce large, high-density bales. A baler of this style was chosen

over belt type balers which have not proven feasible in handling tree length material and are not as rugged as the roller design. The baler was equipped with a typical hay spring tine head with a feeder assist rake to help pack material into the baling chamber. It was also equipped with a Rolletex high-speed net wrapping system to replace the old twine-tying method of holding the bale together. The baler was powered by a farm tractor with 57 pto horsepower. The only modification to the baler was on the steel rollers, which were too smooth to adequately rotate the stems within the baling chamber. A single bar 1/4 inch thick by 1 inch wide was welded on five separate rollers on the bottom-rear of the baler. These bars, when sharpened on the feeding side, aided the rollers in attempting to rotate the biomass.

Procedures and Results

The objective of the study was to determine the feasibility of baling woody biomass. An attempt was made to determine if the hay pickup system could feed stems on the ground into the baler and begin the bale core. However, this approach proved unsuccessful. Although stems did feed through the pickup system and into the baler, the trees would not climb up the back wall of rollers and loop over without positive feeding.

The only way to develop a core and get the core spinning within the baling chamber was by hand. This approach was successful after several attempts, using different techniques. The most successful method was to use the 1-2 inch dbh, crushed material to develop a core. To help with the initial feeding, the stems were bent manually with some breakage of the fibers before feeding into the baler. The material would feed, using

Continued on p. 9



Round Baler

Continued from p. 8

positive hand pressure, and loop or fold into the chamber. After feeding enough volume to exert pressure on a sufficient number of rollers, the core would start to rotate.

Methods that were not successful for developing a core were the use of green material and the 3 inch dbh, crushed stems. The green material was so resilient it would not conform to the chamber geometry without some form of applied force. A stronger, positive feed mechanism might supply this additional applied force. When the large, crushed material was used to develop a core, the large butts would stop the rotation of the core after a 1/4 to 1/2 turn. It is believed a few simple modifications would alleviate this problem.

Another method involved cutting the trees into bolts and feeding the material crossways into the baler. This also proved unsuccessful because the material would not act as one unit of mass within the chamber but rather individual particles and, therefore, would not start rotating.

After a core was developed and started rotating, the feeding system became

very aggressive an actually self-feeding. When spinning, any size stem (up to the tested 3 inch dbh) would easily feed into the baler at the rate of approximately 8 feet per second. Short lengths and chunks also fed easily. Even material laid out to simulate a windrow was picked up off the ground and baled.

Stems were piled into windrows with all butts in one direction and tops overlapping the butts. This was done to simulate a continuous harvester working in a plantation planted in rows. The tractor was then driven straddling a row.

The pickup mechanism successfully fed the stems, even the 3 inch dbh class into the baler when operated top to butt. When operating butt to top, the pickup mechanism was unsuccessful. It was not readily apparent whether the weight of the butts was too much or whether the spring tines were spaced too far apart.

Only two bales were made due to the lack of desirable crushed material. A partial bale weighed 470 pounds. The full bale weighed 715 pounds. A hydraulic pressure gauge was used to determine when the baling chamber was supposedly full. The full bale consisted entirely of crushed material with an average moisture content of 38 percent dry weight basis. The dry weight of the bale would then be 519 pounds; and with a volume of 72.6 ft³, the density of the bale was 7.1 OD lbs/ft³. The density of both bales was much greater toward the outside surface compared to the inner core.

Conclusions and Recommendations

The Claas Rollant 62 round hay baler with steel rollers was successfully used to bale small-diameter woody biomass. Crushed stems were hand-fed to develop a bale core. Once the bale began spinning, the pickup and infeed system became aggressive enough for self-feeding of stems laid in a windrow.

Observations from the test were that small, crushed stems are better for developing a bale core. The conventional tine pickup system can successfully remove biomass in windrows if gathered from the top. However, for reliability and production use, additional modifications would have to be made. A more positive infeed system and aggressive rollers are needed for better baling and developing a bale core other than manual methods. A future possibility is to have an expanding baling chamber to increase the density of the core and the overall bale density.

*The use of tradenames is for reader association and identification only and does not constitute or imply endorsement by TVA or U.S. Forest Service.

The publication of the "Regional Biomass Energy Program Reports" was prepared as an account of work sponsored in whole or in part by the U.S. Department of Energy through the CONEG Policy Research Center, Inc. Neither the United States Government nor any agency thereof, nor any of their employees, nor the CONEG Policy Research Center, Inc., makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, any agency thereof or the CONEG Policy Research Center, Inc. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government, any agency thereof, or the CONEG Policy Research Center, Inc.

BIOLOGUE

And the Regional Biomass Energy Program Reports

Vol. 4 No. 2

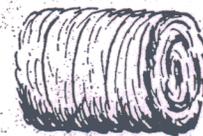
BIOMASS ENERGY NEWS AND INFORMATION

March/April 1987

SOUTHEASTERN REGIONAL

BIOMASS

ENERGY PROGRAM



PHILLIP C. BADGER, PROGRAM DIRECTOR • TVA • MUSCLE SHOALS, AL 35660 • (205) 386-2927
