REDUCED COMPRESSION FORCE FOR 6 AND 8-TIE PLATENS

W. Stanley Anthony
Cotton Ginning Research Unit
Agricultural Research Service
U. S. Department of Agriculture
Stoneville, MS

Abstract

This study determined the relationship between the force required to compress cotton with a standard platen as compared with platens that had six or eight raised compressive inserts, either 1-inch, 1½ -inches, or 2-inches wide across the width of the platen. The experimental platen inserts were installed on top of the standard bottom platen. Twenty-two bales of Suregrow-125 cotton were ginned using a dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, and two stages of lint cleaning at about five bales per hour. Bales weighing about 500 pounds each were compressed at about 5% moisture content to about 40 pounds per cubic foot density. Seven platen types (6-tie, 1-inch wide; 6-tie, 2-inches wide; 6-tie, 1½ -inches wide; 8-tie, 1-inch wide; 8-tie, 1½ -inches wide; 8-tie, 2-inches wide; and standard) were evaluated. Least square means for compressive forces (adjusted for bale weight and lint moisture) ranged from 854,021 pounds for the standard platen to 685,197 pounds for the 6-tie pattern with 1½-inch compression inserts. The 6-tie, 1½-inch wide inserts installed on one of the two opposing platens required about 21% less force to achieve the same compression density as the standard platen. The 1½-inch wide inserts are suitable for use with the 3/4-inch-wide traditional strapping that is in use in the industry today, and the 1-inch wide inserts are suitable for use with wire ties.

Introduction

Over 95% of the cotton bales produced annually in the U.S. are packaged at universal density (UD) to obtain reduced freight rates and to reduce storage space. These 500 lb. bales are compressed to about 42 lbs/ft^3 in a 54" long by 20" wide by 19" deep (direction of compression) space before six to eight 86" to 89" restraining ties (straps or wires) are applied to restrain the bale at a density of 28 lbs/ft^3 within dimensions of 55" by 21" by 28". The two platens that compress from the top and bottom of the bale are 20" by 54" in cross-section with six or eight 1" wide by 1.5" deep slots spaced across the width of the platens. The slots are sufficiently narrow that they are bridged by the cotton and the compressive area is 1,080 in.^{2}. Depending upon actual density, fiber moisture, fiber distribution, fiber length, micronaire and other factors, about 800,000 lbs of compressive force is required to compress the lint and each strap must be able to sustain over 2,000 lbs of force. The UD press requires about 300 horsepower to supply adequate compressive force. High initial costs, large connected horsepower and the associated hydraulics are problems for the cotton industry; still with these compression and bale restraint capabilities about 0.5% of the bales experience tie failures and create a financial burden due to repackaging requirements as well as a safety hazard for operators.

Anthony (1997) developed methods to reduce compressive forces 35% by using specially configured inserts. These inserts affix inside the existing slots in the platen and protrude beyond the platen surface about 3" and are shaped as a truncated inverted V. In effect, the devices preform the bale and allow the compressive force to be applied primarily in the area where the ties are to be placed so that the compressive area on each platen is reduced about 85%. The cotton assumes the shape of the platen so that the density at maximum compression is 42 lbs/ft^3 in the tie area but decreases to about 32 lbs/ft^3 between the inserts. Since compressive forces are exponentially related to density, the compressive force is reduced to about 520,000 pounds. Hydraulic pressure and thus horsepower requirements and energy requirements are reduced dramatically--over 35%.

Expanding this concept to using different widths of platen inserts that would be required to employ different widths of bale restraint materials such as wire, synthetic strapping and steel strapping as well as different numbers of bale ties per bale has not been investigated. The purpose of this study was to establish the force reductions achieved due to the different widths and spacings of the inserts.

Discussion

This study was conducted with the Continental BESPRESS at the U.S. Cotton Ginning Laboratory (USCGL) at Stoneville, MS. The study involved compressing 22 bales of cotton weighing about 500 pounds each at about 5% moisture content to about 40 pounds per cubic foot density. Platen inserts were constructed that consisted of either 6 or 8, 3.375-inches high by either 1 inch, 1½ inches, or 2-inch wide steel bars. The standard platen is shown in Figure 1 and the experimental platen inserts that were installed on top of the standard bottom platen are shown in Figures 2 and 3. Twenty-two bales of Suregrow-125 cotton were ginned in the full-scale gin at the Stoneville Lab using a dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, and two stages of lint cleaning at about five bales per hour. Each bale was pressed to a platen separation of 20 inches at the tip of the compression point, which for the standard platen, was the bottom of the platen but was the top of each one of the steel bars for the platen inserts. The hydraulic pressure required to compress the bales was measured with a 3,500 psi pressure transducer. The platen separation was determined by installing a reference tape measure along the guide that is used in conjunction with microswitches to control the platen separation. Final

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pressures were verified with a pressure gauge and final platen separation were verified with manual measurements.

The study was evaluated using the General Linear Models procedure for SAS with seven platen types (6-tie, 1-inch wide; 6-tie, 1½ -inches wide; 6-tie, 2-inches wide; 8-tie, 1-inch wide; 8-tie, 1½ -inches wide; 8-tie, 2-inches wide; and standard) and three replications. Five moisture samples were taken at the lint slide for each bale. The variation in bale weight and lint moisture was removed as covariants during the General Linear Models analysis of variance. The compressive forces measured by the transducer were significantly affected by platen type and bale weight, but not by lint moisture (Table 1). Least square means (adjusted for bale weight and lint moisture) ranged from 854,021 pounds for the standard platen to 685,197 pounds for the 6-tie pattern with 1½-inch compression inserts at a moisture content of about 4.4% (Table 2). Least square means for the seven platen types are as follows:

Platen type	Force, pounds (transducer)
6 tie, 1 ½”	685,197
6 tie, 1”	704,265
8 tie, 1 ½”	726,904
8 tie, 1”	730,294
6 tie, 2”	752,395
8 tie, 2”	771,956
Standard	854,021

The unadjusted means for transducer force ranged from 651,873 pounds for the 6-tie, 1½-inch wide inserts to 864,482 pounds for the standard platen.

In summary, the 6-tie, 1½-inch wide inserts required about 20% less force than the standard platen. The 21% reduction in force was achieved with the use of one platen equipped with inserts rather than both platens. Previous studies have shown that a 35% reduction in force could be achieved when both platens were modified. It should be noted that the 1-inch wide platens (both 6- and 8-tie) required slightly more compressive force than did the 6-tie, 1½-inch wide platen. This may be because the 1-inch wide platen inserts are sufficiently high and far enough apart to allow the cotton to reach the base of the standard platen at high compression forces and short insert heights. These data indicate that compressive forces increase as the width of the platen inserts increase and generally decrease as the number of ties decrease. The 1½-inch wide inserts are suitable for use with the 3/4-inch wide traditional strapping that is in use in the industry today. The 1-inch wide inserts are suitable for use for the wire.

Summary

Platen inserts were constructed that consisted of either 6 or 8, 3.375-inches high by either 1-inch, 1½-inch, or 2-inch wide steel bars welded to a base plate. The experimental platen inserts were installed on top of the standard bottom platen. Twenty-two bales of Suregrow-125 cotton were ginned using a dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, and two stages of lint cleaning at about five bales per hour. Bales weighing about 500 pounds each were compressed at about 4.5% moisture content to about 40 pounds per cubic foot density. Seven platen types (6-tie, 1-inch wide; 6-tie, 2-inch wide; 6-tie, 1½ -inch wide; 8-tie, 1-inch wide; 8-tie, 1½ -inch wide; 8-tie, 2-inch wide; and standard) were evaluated. Least square means (adjusted for bale weight and lint moisture) ranged from 854,021 pounds for the standard platen to 685,197 pounds for the 6-tie pattern with 1½-inch compression points. The 6-tie, 1½-inch-wide inserts required about 20% less force than the standard platen. The 1½-inch wide inserts are suitable for use with the 3/4-inch wide traditional strapping that is in use in the industry today. The 1-inch wide inserts are suitable for use with wire ties.

Disclaimer

Mention of a trade name, proprietary product, or specific machinery does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply approval of the product to the exclusion of others that may be available.

References

Anthony, W.S. U.S. Patent Application Number 08/890,890. Device to reduce bale packaging forces. Filed July 1997.

Table 1. Summary data for one standard and six experimental platens.

Platen type	Platen sep., in.	Lint moisture, % (CTL)	Force, pounds
standard	20	4.4	864,482
8 tie, 2"	23.4	4.5	781,682
8 tie, 1"	23.4	4.3	728,050
8 tie, 1 1/2"	23.4	4.3	741,787
6 tie, 2"	23.4	4.4	754,275
6 tie, 1"	23.4	4.5	699,328
6 tie, 1 1/2"	23.4	4.6	651,873

Table 2. Analyses of variance, General Linear Models procedure, SAS.

Source of variation	Degree of freedom	F-value (Force)
Bale weight	1	48.59**
Lint moisture	1	1.95ns
Platen type	6	47.98**
Error	13	

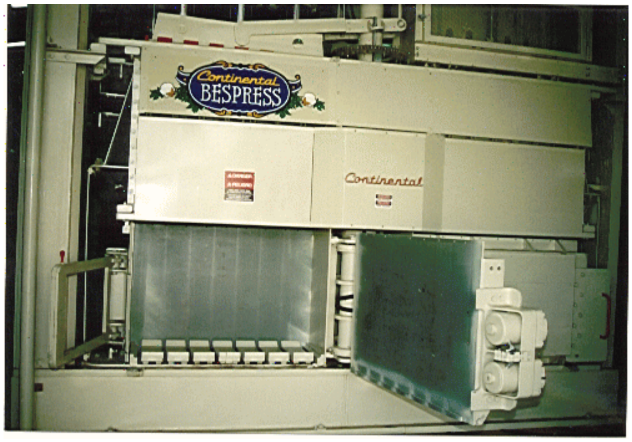

Figure 1. Standard platen installed.

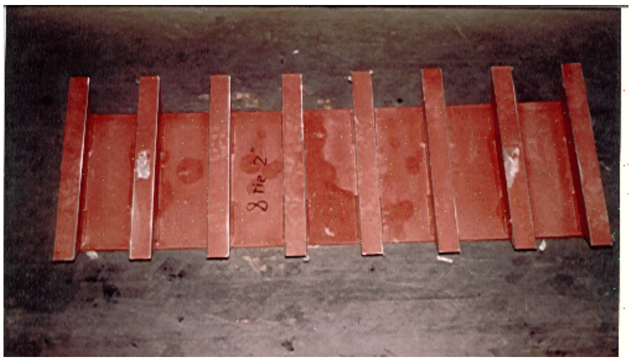

Figure 2. Eight-tie, 2-inches wide by 20-inches long compression insert for platen.

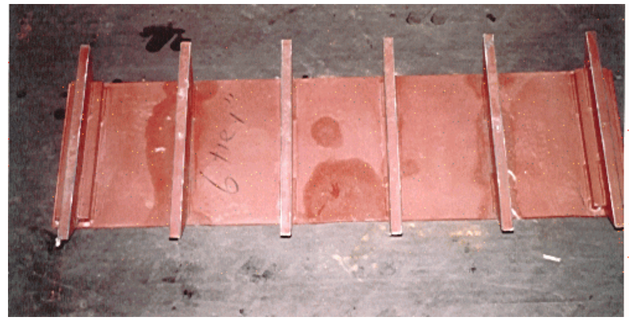

Figure 3. Six-tie, 1-inch wide by 20-inches long compression insert for platen.