# QUALITY OF LINT OBTAINED IN CLEANING COTTONSEED TO FACILITATE SEED COATING PROCESS

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## Abstract

Fiber test data indicates that tag cotton removed to facilitate coating cottonseed to create EASI*flo*™ cottonseed is comparable in many respects to ordinary lint but with some distinct differences. It has good upper end length properties but more short fiber. It has good fiber strength and very high fiber elongation properties. It is somewhat coarse with very high maturity. The volume of production projected for the coated cottonseed development will make thousands of bales of this new fiber available.

## Introduction

Cotton Incorporated identified a large new market for fuzzy cottonseed which has been converted into a free flowing coated product with handling properties similar to grains (House 1998). Laboratory tests showed that binding the fuzz fiber down with a gelatinized starch solution similar to sizing used in textile plants gave the desired free flowing characteristic (Laird, Wedegaertner, and Valco 1997). Cooperative work with the USDA-ARS ginning laboratory at Lubbock, Texas developed the machinery and procedure for preparing and applying the starch and drying the coating (Laird, Wedegaertner, Valco, and Baker 1997: Laird ,Wedegaertner, and Barker 1998). The product has found good acceptance by the target market and commercialization has started with one plant in operation and others on the drawing board.

A problem found in the early tests was that cottonseed from all across the cotton belt contains small amounts of long fiber that causes problems with tangles when the wet starch solution is applied and blended onto the fuzz on the seed coat. Lint tags on the seeds and some loose fiber exhibited a strong tendency to be spinnable when wet and quickly formed strings. The fiber caused tangled clumps to develop within the seeds similar to grape clusters and would also hang up in the mixing machinery used to distribute the starch. The seed clusters are a potential hazard that could defeat the free flowing property. Buildup on the mixing machinery required frequent cleanup which is a costly problem for plant operation. We found that gin run seeds from all across the cotton belt with residual lint in the 10 to 12 percent range, which is typical, all had the problem. Testing seeds with laboratory delinter machines showed that about 2 to 3 percent of the dry seed weight is long fiber that had to be removed to control the tangle problem.

We developed modifications to a conventional gin stand to allow rerunning ginned seeds to remove only the residual long fiber tags at high production rates necessary for an economical cottonseed coating operation. Only the small amount of long fiber that causes tangle problems needs to be removed because the fiber is a desirable component of the nutritive value of whole cottonseeds (Wedegaertner 1995). We are presently working with the third generation of tag removing gin stand machinery and have essentially controlled the problem. As a result we have found that the cottonseed coating process will generate an appreciable quantity of spinnable fiber. Removing the tag fiber adds a small amount of cost to the process so this fiber needs to find a market to defray the cost. One gin stand processes 4 tons or more cottonseed per hour at the present stage of development. The tag removal process currently takes off about 2.25 to 2.5 percent of the seed weight as fiber. The projected market level is 500,000 tons of coated cottonseed within five years and the potential supply of tag fiber will be between 22.5 and 25 million pounds per year or 46,875 to 52,083 bales (480 pound) per year. The gin stand technology is still developing and a patent has been applied for through the USDA-ARS patent division.

## Purpose

This paper gives the data for fiber quality evaluations for a number of samples of the lint generated in the pilot plant and also the first commercial plant. The fiber quality tests are all from the Cotton Incorporated lab in Raleigh. The tag lint came from mingled cottonseeds that were brought back from storage or the oil mill, and the region of origin of the seeds is the main known quantity. These seed lots include all regions except the West. Most of the data is for tag lint directly from the gin stand but a few of the latest samples from the pilot plant in the gin lab have included one stage of saw type lint cleaning. To give a frame of reference we have included the average data for 15 upland varieties of 1997 crop Texas cotton that we extracted from “Texas Cotton Quality Evaluation, Crop of 1997" (International Textile Center, Texas Tech University).

## Results

All of the Texas varieties used for comparison were from gins using one or more lint cleaners and the tag cotton was not subjected to lint cleaning except for three of the lots from the pilot plant. The tag cotton was very neppy, probably because rerunning the seeds through a gin stand is a much more rigorous treatment than conventional ginning. Neppiness could also be a property of the residual cotton remaining on the seeds as tags. The tag cotton had high

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foreign matter but cleaned up very well in one saw type lint cleaner without a lot of weight loss.

The tag cotton is all high micronaire by the HVI method (Table 1). The upper half mean length overlaps the low end of the Texas varieties, just less than one inch length (Figure 1). Uniformity index is lower and short fiber content overlaps the upper end of short fiber content for the Texas varieties. The few samples cleaned in saw type lint cleaning indicate that lint cleaning damaged upper half mean length slightly and did not decrease short fiber. The results from efforts to improve the amount of fiber removed by the gin stand indicates that there is a tradeoff between improved fiber removal and short fiber content of the tag cotton. The current effort is to get good long fiber removal to eliminate tails and tangles from the coated cottonseed product. Some work may be required later to optimize the tradeoff with short fiber as market uses for the tag fiber develop.

Fiber strength for the tag cotton was just below the Texas cottons which were all new high strength varieties. Some of the tag cotton samples were in the range of the older lower strength varieties, which may have been the actual origin of the cottonseed. Fiber elongation tended to be well above and distinctly different from that of the Texas varieties (Figure 2). The reason for this will require further study.

Fiber reflectance was much lower and yellowness about the same or slightly more for the tag cotton samples compared to the Texas cotton. This could be expected from reginning seeds and not using lint cleaning on the tag cotton. The few lint cleaned samples tended to show slightly improved fiber reflectance but retained a high degree of yellowness. The tag cotton cleaned up very well as far as fine trash appearance but the failure to improve reflectance may indicate that the tag cotton fiber is different from the original fiber ginned off the seeds for some reason.

AFIS fiber data for the tag cotton showed similar results to HVI data in comparison to the Texas varieties. Fiber length, L(w), showed a greater difference between the Texas varieties and tag cotton samples (Table 2) with a higher CV. Upper quartile length (Figure 3) overlapped the lower end of the Texas varieties and short fiber was higher. Lint cleaning tended to degrade all the length measurements for the tag cotton.

AFIS visible foreign matter was higher for the tag cotton than for the Texas varieties (Figure 4) but had a wider variation and was helped considerably on the few samples from lint cleaned lots. The tag cotton contained much more neps and seed coat neps than the Texas varieties. Neppiness is probably largely a result of the more rigorous treatment required to regin cottonseed.

AFIS fineness (Figure 5) and maturity ratio (Figure 6) for the tag cotton were both higher than for the Texas varieties. These measurements along with HVI micronaire seem to indicate that the tag cotton is a somewhat different population of the fiber than the bulk of the fiber ginned from the seeds. This may need more investigation.

Because there is a wide variation in the data and the process is still in the developmental stage the individual sample data for the tag cotton samples tested to date is included in tables as an appendix to this paper. The ginning equipment is still evolving and lint cleaning barely looked at, so the fiber properties are still somewhat indefinite. The current objective has been to get enough fiber cleaned off the cottonseed to give a good coated cottonseed product, but the potential volume of fiber is enough that further work to refine the fiber product based on its properties and potential uses is warranted.

## Conclusions

The fiber test data for the tag cotton indicates that it is comparable in many respects to ordinary lint but with some distinct differences. It has good upper end length properties but more short fiber. It has good fiber strength and very high fiber elongation properties. It is somewhat coarse with very high maturity. The volume of production resulting from the coated cottonseed development will introduce a new fiber into the market in a sizeable quantity. This fiber should be considered for its somewhat unique properties in uses that can tolerate the high neppiness but need high elongation and maturity. The potential quantity available warrants research studies to find a home for this unique new fiber.

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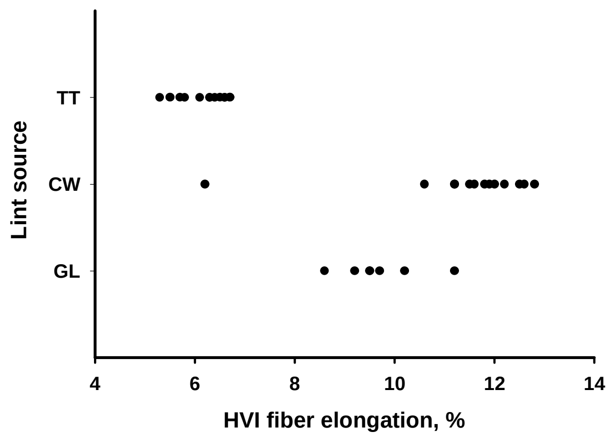


Figure 1. HVI fiber elongation, 5 for tag cotton from the two coated cottonseed plants with data for 15 varieties of 1997 crop Texas cotton for comparison. Lint sources are: TT Texas crop, CW first commercial plant, GL pilot plant in gin lab.

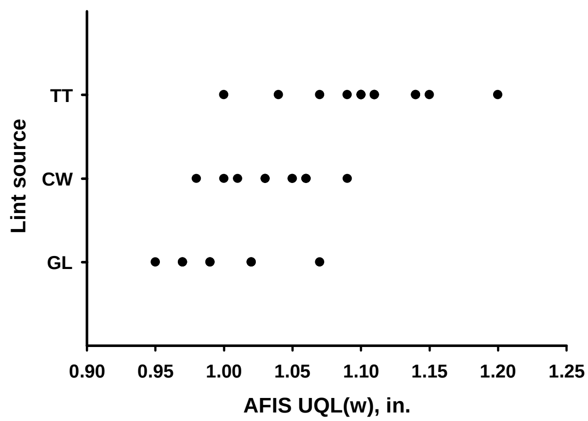


Figure 2. AFIS upper quartile length, UQL(w), for tag cotton from two coated cottonseed plants with data for 15 varieties of 1997 crop Texas cotton for comparison. Lint sources are: TT Texas crop, CW first commercial plant, GL pilot plant in gin lab.

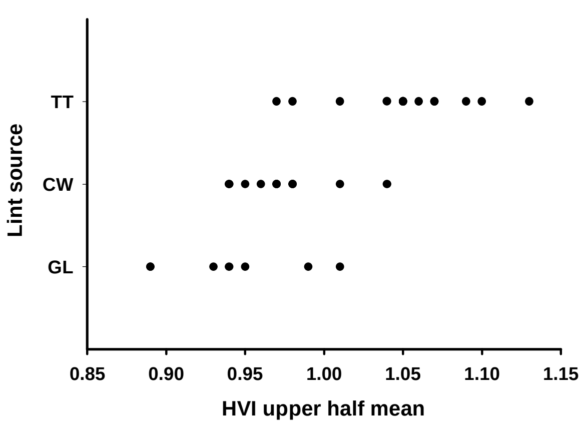


Figure 3. HVI upper half mean length for tag cotton from the two coated cottonseed plants with data for 15 varieties of 1997 crop Texas cotton for comparison. Lint sources are: TT Texas crop, CW first commercial plant, GL pilot plant in gin lab.

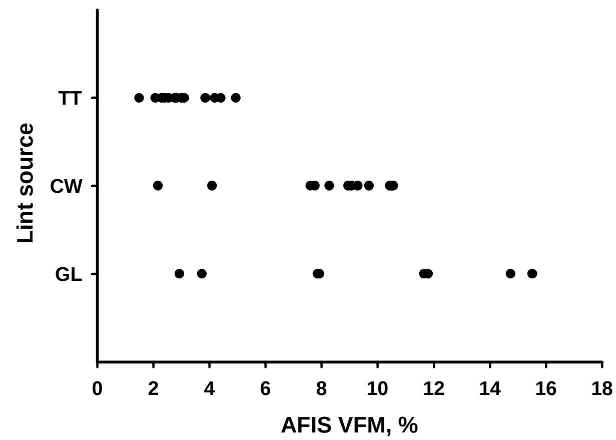


Figure 4. AFIS visible foreign matter, %, for tag cotton from two coated cottonseed plants with data for 15 varieties of 1997 crop Texas cotton for comparison. Lint sources are: TT Texas crop, CW first commercial plant, GL pilot plant in gin lab.

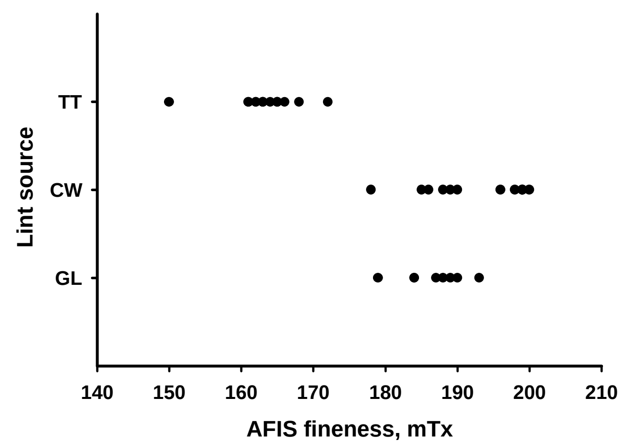


Figure 5. AFIS fineness, mTx, for tag cotton from two coated cottonseed plants with data for 15 varieties of 1997 crop Texas cotton for comparison. Lint sources are: TT Texas crop, CW first commercial plant, GL pilot plant in gin lab.

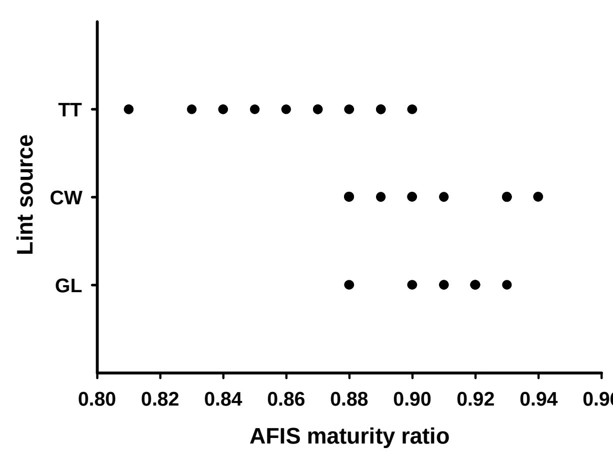


Figure 6. AFIS maturity ratio for tag cotton from two coated cottonseed plants with data for 15 varieties of 1997 crop Texas cotton for comparison. Lint sources are: TT Texas crop, CW first commercial plant, GL pilot plant in gin lab.

Table 1. Average HVI fiber quality data for tag cotton that was removed from cottonseed to facilitate the coating process in the pilot plant and first commercial plant. With average values computed from data for 15 upland varieties from "Texas Cotton Quality Evaluation, Crop of 1997" by International Textile Center, Texas Tech University, as a basis for evaluation.

| Cotton source | MIC rdg | UHM in. | UI ratio | STR g/tex | ELO % | Rd | +b | SFC % |
|---|---|---|---|---|---|---|---|---|
| Pilot plant | 5.2 | 0.94 | 78.0 | 26.0 | 9.70 | 63.1 | 10.8 | 19.9 |
| First com. | 5.5 | 0.98 | 76.5 | 25.3 | 11.08 | 58.2 | 10.1 | 21.6 |
| Texas crop | 4.1 | 1.05 | 81.8 | 28.8 | 6.18 | 76.4 | 9.4 | 14.3 |

Table 2a. Average AFIS length, short fiber and visible foreign matter for tag cotton that was removed from cottonseed to facilitate the coating process for EASI*flo*[tm] seed. With average values for 15 upland varieties reported in "Texas Cotton Quality Evaluation, Crop of 1997" by International Textile Center, Texas Tech University, included as a basis for evaluation.

| Cotton source | Neps /gm | L(w) in. | L(w) CV% | UQL (w)in | SFC (w)% | VFM % |
|---|---|---|---|---|---|---|
| Pilot plant | 1113 | 0.77 | 42.3 | 1.00 | 22.6 | 9.52 |
| First com. | 871 | 0.79 | 44.2 | 1.04 | 23.7 | 9.31 |
| Texas crop | 311 | 0.91 | 32.8 | 1.10 | 11.1 | 3.04 |

Table 2b. Average AFIS seed coat Nep, fineness, IFC, and maturity ratio for tag cotton that was removed from cottonseed to facilitate the coating process for EASI*flo*[tm] seed. With average values for 15 upland varieties reported in "Texas Cotton Quality Evaluation, Crop of 1997" by International Textile Center, Texas Tech University, included as a basis for evaluation.

| Cotton source | SCN size | SCN no/g | Fine mTx | IFC % | Mat ratio |
|---|---|---|---|---|---|
| Pilot plant | 903 | 212 | 187 | 4.95 | 0.91 |
| First com. | 980 | 161 | 194 | 4.46 | 0.92 |
| Texas crop | -- | 22. | 163 | -.- | 0.86 |

## **Appendix**

Table A1. HVI micronaire, length, strength, and uniformity, data for samples from tag cotton that was removed from cottonseed to facilitate the coating process.

| Sample source | MIC rdg | UHM in. | UI ratio | STR g/tex | ELO % | Gin, version |
|---|---|---|---|---|---|---|
| Pilot plant | 4.2 | 0.99 | 80.1 | 27.5 | 9.5 | 90 saw, A |
| Pilot plant | 6.2 | 0.95 | 78.3 | 23.6 | 9.7 | 90 saw, B |
| Pilot plant | 5.3 | 0.94 | 77.1 | 27.0 | 9.2 | 90 saw, B |
| Pilot plant | 5.5 | 1.01 | 77.1 | 24.6 | 8.6 | 110 saw, B |
| Pilot plant | 5.2 | 0.89 | 76.7 | 26.3 | 9.5 | 110 saw, C +LC |
| Pilot plant | 5.1 | 0.93 | 78.9 | 26.6 | 11.2 | 110 saw, C +LC |
| Pilot plant | 5.3 | 0.89 | 77.5 | 26.6 | 10.2 | 110 saw, C +LC |
| First com'l | 5.1 | 0.96 | 76.2 | 27.1 | 6.2 | 110 saw, B |
| First com'l | 5.0 | 1.04 | 77.2 | 25.9 | 10.6 | 110 saw, C |
| First com'l | 5.3 | 0.97 | 74.9 | 22.9 | 12.8 | 110 saw, C |
| First com'l | 5.0 | 0.98 | 76.3 | 24.8 | 12.5 | 110 saw, C |
| First com'l | 4.8 | 1.01 | 75.1 | 24.9 | 11.5 | 110 saw, B |
| First com'l | 5.7 | 0.98 | 77.1 | 27.1 | 11.2 | 110 saw, B |
| First com'l | 6.0 | 0.98 | 78.2 | 26.7 | 11.8 | 110 saw, B |
| First com'l | 5.6 | 0.97 | 77.5 | 25.6 | 11.6 | 110 saw, B |
| First com'l | 5.8 | 0.97 | 76.6 | 25.3 | 11.2 | 110 saw, C |
| First com'l | 5.8 | 0.95 | 76.2 | 23.3 | 11.9 | 110 saw, C |
| First com'l | 5.9 | 0.94 | 76.1 | 24.6 | 12.0 | 110 saw, C |

Table A2. HVI color, foreign matter, and short fiber data for samples from tag cotton that was removed from cottonseed to facilitate the coating process.

| Sample source | Rd | +b | Color GRD | AREA % | SFC % | Gin, version |
|---|---|---|---|---|---|---|
| Pilot plant | 70.4 | 9.4 | 42-1 | 0.20 | 21.1 | 90 saw, A |
| Pilot plant | 56.7 | 11.6 | . | . | 14.1 | 90 saw, B |
| Pilot plant | 63.2 | 9.3 | . | . | 16.0 | 90 saw, B |
| Pilot plant | 60.0 | 10.9 | 53-4 | 1.30 | 13.7 | 110 saw, B |
| Pilot plant | 61.8 | 11.9 | 54-1 | 0.80 | 27.3 | 110 saw, C +LC |
| Pilot plant | 66.7 | 11.0 | 43-1 | 0.60 | 19.3 | 110 saw, C +LC |
| Pilot plant | 63.0 | 11.7 | 43-4 | 0.90 | 27.6 | 110 saw, C +LC |
| First com'l | 60.5 | 12.0 | 54-1 | 0.07 | 22.4 | 110 saw, B |
| First com'l | 57.8 | 9.2 | 63-2 | 5.00 | 17.1 | 110 saw, C |
| First com'l | 56.1 | 10.3 | 63-4 | 4.80 | 26.9 | 110 saw, C |
| First com'l | 58.7 | 10.5 | 63-3 | 3.40 | 25.7 | 110 saw, C |
| First com'l | 59.9 | 9.4 | 63-1 | 2.30 | 22.4 | 110 saw, B |
| First com'l | 58.9 | 8.8 | 62-2 | 4.40 | 19.4 | 110 saw, B |
| First com'l | 60.1 | 9.4 | 63-1 | 3.40 | 17.4 | 110 saw, B |
| First com'l | 60.4 | 8.9 | 62-1 | 3.80 | 18.6 | 110 saw, B |
| First com'l | 56.2 | 11.0 | 63-3 | 2.90 | 23.6 | 110 saw, C |
| First com'l | 55.6 | 10.9 | 63-3 | 3.30 | 24.5 | 110 saw, C |
| First com'l | 56.4 | 11.2 | 63-3 | 2.90 | 24.0 | 110 saw, C |

Table A3. AFIS Nep, length and short fiber data for lint samples from tag cotton that was removed from cottonseed to facilitate the coating process for EASI*flo*[tm] seed.

| Lab test date | Nep size | Neps /gm | L(w) in. | L(w) CV % | UQL (w)in | SFC (w)% | Gin, version |
|---|---|---|---|---|---|---|---|
| Pilot plant | 799 | 1267 | 0.75 | 49.4 | 1.02 | 29.1 | 90 saw, A |
| Pilot plant | - | 853 | 0.78 | 40.9 | 0.99 | 20.4 | 90 saw, B |
| Pilot plant | - | 799 | 0.80 | 39.6 | 1.02 | 18.8 | 90 saw, B |
| Pilot plant | 809 | 1057 | 0.83 | 40.3 | 1.07 | 17.9 | 110 saw, B |
| Pilot plant | 817 | 1379 | 0.74 | 44.6 | 0.99 | 26.4 | 110 saw, B |
| Pilot plant | 807 | 1298 | 0.75 | 42.4 | 0.97 | 23.9 | 110 saw, C +LC |
| Pilot plant | 794 | 954 | 0.77 | 38.5 | 0.97 | 19.3 | 110 saw, C +LC |
| Pilot plant | 805 | 1300 | 0.73 | 42.6 | 0.95 | 25.0 | 110 saw, C +LC |
| First com'l | 799 | 1051 | 0.73 | 46.2 | 0.98 | 29.0 | 110 saw, B |
| First com'l | 817 | 583 | 0.80 | 43.0 | 1.06 | 22.0 | 110 saw, B |
| First com'l | 809 | 583 | 0.81 | 41.6 | 1.05 | 20.7 | 110 saw, B |
| First com'l | 813 | 528 | 0.81 | 41.3 | 1.06 | 19.8 | 110 saw, B |
| First com'l | 793 | 879 | 0.86 | 39.3 | 1.09 | 16.3 | 110 saw, C |
| First com'l | 820 | 941 | 0.79 | 43.9 | 1.05 | 23.8 | 110 saw, C |
| First com'l | 816 | 1057 | 0.78 | 46.0 | 1.03 | 24.7 | 110 saw, C |
| First com'l | 819 | 1211 | 0.75 | 47.7 | 1.03 | 27.5 | 110 saw, C |
| First com'l | 826 | 1100 | 0.78 | 46.8 | 1.06 | 25.7 | 110 saw, C |
| First com'l | 820 | 965 | 0.75 | 48.4 | 1.01 | 28.7 | 110 saw, C |

Table A4. AFIS VFM, SCN, fineness, IFC, and maturity ratio data for lint samples from tag cotton that was removed from cottonseed to facilitate the coating process for EASI*flo*[tm] seed.

| Lab test date | VFM % | SCN size | SCN no/g | Fine mTx | IFC % | Mat ratio | Gin, version |
|---|---|---|---|---|---|---|---|
| Pilot plant | 2.93 | 957 | 160 | 179 | 6.00 | 0.88 | 90 saw, A |
| Pilot plant | 15.52 | 853 | 143 | 189 | 5.30 | 0.90 | 90 saw, B |
| Pilot plant | 11.80 | 799 | 106 | 188 | 4.60 | 0.93 | 90 saw, B |
| Pilot plant | 11.66 | 931 | 247 | 184 | 5.60 | 0.91 | 110 saw, B |
| Pilot plant | 14.74 | 915 | 377 | 193 | 4.40 | 0.91 | 110 saw, B |
| Pilot plant | 7.85 | 919 | 260 | 187 | 4.40 | 0.92 | 110 saw, C +LC |
| Pilot plant | 3.73 | 961 | 109 | 184 | 5.10 | 0.92 | 110 saw, C +LC |
| Pilot plant | 7.92 | 891 | 298 | 190 | 4.20 | 0.92 | 110 saw, C +LC |
| First com'l | 7.60 | 973 | 170 | 190 | 5.00 | 0.88 | 110 saw, B |
| First com'l | 8.95 | 990 | 101 | 198 | 4.00 | 0.93 | 110 saw, B |
| First com'l | 9.06 | 993 | 103 | 199 | 4.10 | 0.94 | 110 saw, B |
| First com'l | 9.29 | 1031 | 85 | 199 | 4.20 | 0.93 | 110 saw, B |
| First com'l | 7.76 | 964 | 87 | 178 | 6.70 | 0.88 | 110 saw, C |
| First com'l | 10.56 | 990 | 167 | 188 | 5.10 | 0.91 | 110 saw, C |
| First com'l | 8.27 | 988 | 173 | 189 | 5.00 | 0.90 | 110 saw, C |
| First com'l | 10.49 | 941 | 286 | 199 | 4.10 | 0.93 | 110 saw, C |
| First com'l | 9.69 | 966 | 249 | 196 | 3.80 | 0.93 | 110 saw, C |
| First com'l | 10.43 | 973 | 199 | 200 | 3.10 | 0.93 | 110 saw, C |