

Eastern Washington Straw Residue as a Viable Fiber Source

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Possible Users

- Boise Paper Solutions- Wallula, WA
- Potlatch- Lewiston, ID
- Inland Empire-Millwood, WA
- Ponderay Newsprint-Usk, WA
- Keyes Fiber-Wenatchee, WA
- Michelsen Packaging-Yakima, WA
- Columbia River Pulp-Wallula, WA
- 100% Recycled Mills (2)-Western WA

Review of Tasks

- Phase 1- Wheat Straw for Newsprint
- Phase 2-Seed alfalfa for White Paper
- Phase 3- Wheat, alfalfa, and grass for molded pulp
- Phase 4- Liquor utilization for soil amendment
- Phase 5- Feasibility Study

Review of Tasks

- Phase 1- papermachine run Feb 15
- Phase 2- Bleaching research complete
 - 100% non wood run with alfalfa and wheat
- Phase 3-All straws have been pulped
 - Wheat straw pulp has been evaluated
- Phase 4-Liquor has been generated and field applied.
 - Preliminary info looks very good
 - Possible lignosulfanate substitution for road application
- Phase 5- Logistically can supply straw to western WA mills within 150 miles for brown grade substitution
 - Economics look very promising for replacing OCC in 100% mills

2004 Commercial Runs

- Keyes Fiber-Wenatchee WA
 - Manufactured thousands of Berry baskets using wheat straw as a fiber source
 - 50 & 100% substitution
- Western WA 100% OCC Brown Paper Mill
 - Two commercial runs on papermachine
 - First trial 2 tons with 25% substitution making tube and core stock
 - Second run with 35% substitution making partitionboard

Pulping for Paper Grades

- Medium/Liner- Single Stage
- TMP replacement-Alkaline/Peroxide
 - Semi-bleached
- Printing Papers-
Pretreatment/Alkaline/Peroxide
 - Bleached Grades

| Sample | Tear Index (Nm*m2/g) | Brightness | Tensile Index (Nm/g) | Yield (%) | Cook Time | NaOH/KOH % | H2O2 % | Per Acetic |
|--------|-------------------------|------------|-------------------------|--------------|--------------|---------------|-----------|---------------|
| #2 | 4.7 | 31.1 | 22.2 | 71.84 | 60 | 10--0 | 0 | |
| #6 | 4.6 | 48.8 | 31.1 | 67.19 | 60 | 10--0 | 10 | |
| #7 | 6.4 | 47.0 | 35.6 | 65.44 | 90 | 10--0 | 10 | |
| #10 | 4.4 | 44.9 | 25.9 | 59.75 | 60 | 10--0 | 5 | 0.5 |
| #12 | 5.0 | 53.9 | 31.7 | 61.92 | 60 | 10--0 | 10 | 0.5 |
| #13 | 4.8 | 51.0 | 22.5 | 68.78 | 60 | 10--0 | 5 | 1 |
| #15 | 5.2 | 52.0 | 24.4 | 62.69 | 60 | 10--0 | 10 | 1 |

Commercial Trial 1

| | Basis Wt (gsm) | caliper (mm) | bulk (cc/g) | SSC (md) | burst (kpa) | Muetek |
|----------------|-----------------------|---------------------|--------------------|-----------------|--------------------|-----------------|
| control | 643 | 0.787 | 1.55 | 14.86 | 1008 | 6.60/7.1 |
| wheat | 630 | 0.773 | 1.59 | 14.62 | 990 | 3.0/3.6 |

Molded Pulp Products

- Equivalent Strength
- Improved Drain Time from 1.2 seconds to 0.3 seconds

Strength Results

1-100% WS 2-50/50 Blend

| | Average Tensile (gm/cm) | | | Burst |
|---------|-------------------------|--------|-------|-------|
| | Load | Elong | TEA | psi |
| Control | 9793.45 | 0.8314 | 47.82 | 68.9 |
| 1 | 10017.57 | 0.9939 | 63.14 | 64.39 |
| 2 | 10137.11 | 0.9650 | 61.14 | 56.8 |

Bleaching Conditions

- Peracetic Acid
- Peroxide
- Oxygen
- All conditions are totally chlorine free, eliminating other environmental and permitting issues

| Sample | Tear Index (Nm*m2/g) | Brightness | Tensile Index (Nm/g) | Yield (%) | Cook Time | NaOH/KOH % | H2O2 % | Per Acetic |
|--------|-------------------------|------------|-------------------------|--------------|--------------|---------------|-----------|---------------|
| #10 | 4.4 | 44.9 | 25.9 | 59.75 | 60 | 10--0 | 5 | 0.5 |
| #11 | 4.6 | 51.0 | 19.8 | 70.19 | 60 | 0--10 | 5 | 0.5 |
| #12 | 5.0 | 53.9 | 31.7 | 61.92 | 60 | 10--0 | 10 | 0.5 |
| #13 | 4.8 | 51.0 | 22.5 | 68.78 | 60 | 10--0 | 5 | 1 |
| #14 | 5.3 | 51.2 | 22.5 | 70.61 | 60 | 0--10 | 5 | 1 |
| #15 | 5.2 | 52.0 | 24.4 | 62.69 | 60 | 10--0 | 10 | 1 |

| Sample | Tear Index (Nm*m2/g) | Brightness | Tensile Index (Nm/g) | Yield (%) | Cook Time | NaOH/KOH % | H2O2 % | Per Acetic |
|--------|-------------------------|------------|-------------------------|--------------|--------------|---------------|-----------|---------------|
| #3 | 4.1 | 31.8 | 24.6 | 77.86 | 60 | 5--5 | 0 | 0 |
| #4 | 4.4 | 52.3 | 23.9 | 69.22 | 60 | 5--5 | 5 | 0 |

Straw Comparisons

| | | Wheat Straw | Seed Alfalfa |
|-------------------|---------------------------|-------------|--------------|
| Basis Wt | gsm | 67.1 | 62.5 |
| Brightness | ISO | 37 | 42.5 |
| Tensile | nm/g | 71.1 | 77.1 |
| Tear | mn*m²/g | 4.7 | 5.7 |
| Burst | kN/m | 3.7 | 4.3 |

Conclusions

- Great steps forward have been made in 2004
- Research is pointing towards working with mills in finer process details
- Liquor utilization is still an issue, but with further opportunities
- Logistics and transportation are not an issue, even to western WA mills