FINAL REPORT

Project Title: Commercial Demonstration of Wood Recovery, Recycling, and Value Adding Technologies

Covering Period: November 20, 2001 through May 31, 2004

Date of Report: July 15, 2004

Recipient: **Auburn Machinery, Inc.**
150 Summer Street – Lewiston, ME 04240

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Other Partners: Maine Technology Institute – Cluster Enhancement Grant Award, cash match contribution of $100,000
One Church Street – Gardiner, ME 04345

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Project Objective:

- Develop a fully operational Recovery and Value Adding (RVA) facility which will be the first full scale commercial demonstration of solid wood waste recovery technologies for the forest products industry
- Showcase the different recovery technologies and systems, which are available
- Demonstrate the types of solid waste wood material, which can be processed, the types of new products that can be produced. Gather preliminary raw data of the yield potential
- Develop and showcase merchandizing techniques for marketing recovered products

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Executive Summary

Discussion:

This commercial demonstration project demonstrated the technical feasibility of converting low-value, underutilized and waste stream solid wood fiber material into higher valued products. With a growing need to increase product/production yield and reduce waste in most sawmills, few recovery operations and practically no data existed to support the viability of recovery operations. Prior to our efforts, most all in the forest products industry believed that recovery was difficult, extremely labor intensive, not cost effective, and that recovered products had low value and were difficult to sell. This project provided an opportunity for many within the industry to see through demonstration that converting waste stream material into higher valued products does in fact offer a solution. Our work, supported by the U.S. Department of Energy, throughout the project aimed to demonstrate a reasonable approach to reducing the millions of recoverable solid wood fiber tons that are annually treated as and converted into low value chips, mulch and fuel. Consequently sawmills continue to suffer from reduced availability of forest resources, higher raw material costs, growing waste disposal problems, increased global competition, and more pressure to operate in an Environmentally Friendly manner. It is our belief (based upon the experience of this project) that the successful mainstreaming of the recovery concept would assist in alleviating this burden as well as provide for a realistically achievable economic benefit to those who would seriously pursue the concept and tap into the rapidly growing "GREEN" building marketplace.

Ultimately, with participation and aggressive pursuit of the recovery concept, the public would benefit in that:

- Landfill/disposal waste volume could be reduced adding greater life to existing municipal landfill sites thereby minimizing the need to prematurely license and open added facilities. Also, there would be a cost avoidance benefit associated to what would have been the added municipal (community) management costs involved with maintaining closed landfills.
- With greater quantities of recovered material being returned to and integrated into manufacturing and the marketplace, reduced demand upon virgin wood sources could help lead the way to promoting improved relations and environmental balance between producers and consumers further expanding the value of our natural resource without adding environmental burden.

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Summary of Objective Accomplishments

- **Develop a fully operational Recovery and Value Adding (RVA) facility which will be the first full scale commercial demonstration of solid wood waste recovery technologies for the forest products industry.**

A facility was developed and utilized to convert a wide range of under-utilized and waste wood material into a variety of recovered and value added products. Raw material (project feed stock) utilized included random size and shaped wood retrieved from sawmill chipper and grinder infeed conveyers, old graying and degrading lumber from outside mill storage yards, reject components from sawmills, pallet mills and turning mills, used pallets and shipping crates, deconstruction materials, used building materials coated with lead based paint, random material from landfills and so on. The recovered raw material went through the facility for re-sizing, defecting, nail removal, drying, ripping, planing, trimming, shaping, finishing and assembly procedures. Examples of the products manufactured from recovered stock included varieties of flooring, paneling, molding, picture and award frames, dowels, wine and gift boxes, supermarket checkout dividers and dimensional stock that could be used to manufacture furniture, cabinets, millwork and other conventional and custom wood products. Even the dry residual material (shavings and wood chips) was converted into firewood briquettes.

- **Showcase the different recovery technologies and systems, which are available.**

Throughout the project, recovery technology was demonstrated to a wide range of interested parties, including mill owners and managers, recycling facility and deconstruction project managers, machinery operators, EPA and DEP staff, US Forest Service technicians, governmental personnel, local and national politicians, architects, university research teams and so on. To achieve a very broad based demonstration program, a key technology component (the Yield Pro recovery unit) was made portable and transported throughout the U.S. East Coast and other locations in the country to a range of primary and secondary woodworking operations, recycling facilities, deconstruction projects and educational seminars for on site recovery and value adding demonstrations. The facility and portable system were made readily available for parties who had an interest in viewing the recovery and value adding process first hand.

- **Demonstrate the types of solid waste wood material, which can be processed, the types of new products that can be produced. Gather preliminary raw data of the yield potential.**

As stated in objective one above, a wide range of pre-consumer and post consumer under-utilized and/or waste wood material was converted into a significant variety of RVA products. Much of the recovered material had an immediate potential to be absorbed into the mainstream woodworking industry for conversion to a much-expanded range of conventional and custom products. Preliminary yield data has been collected and compiled.

The physical conversion of raw material into saleable products proved to be a logistically viable endeavor as demonstrated through the quality products produce and in the positive feedback received from those pursuing

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RVA wood products manufactured. Through the hands-on field and facility work performed by the principal investigator and his core staff, the data generated and collected supported the premise that through implementing proper planning, processing and conversion techniques, vast amounts of (recoverable) under-utilized and waste wood material can effectively be converted into a wide range of valuable and environmentally friendly products for the rapidly growing global "Green" marketplace.

- **Develop and showcase merchandizing techniques for marketing recovered products.**

Throughout the project, merchandising material was developed and great effort taken to facilitate the selling of RVA products generated from the facility (*some of the promotional material was illustrated in earlier progress reports*). In an attempt to identify market potential and RVA program participants who could capitalize upon the market opportunities, sample products were exhibited in a range of venues including technology development program events, pallet recyclers meetings, building contractor trade shows, deconstruction educational seminars, military base disposal programs, and general wood product industry trade shows. Direct contact was made with numerous architects and designers who indicated their interest in generating environmentally friendly "Green Certified" projects. The concept of "Closed Loop Recovery" was developed by our team and educational material circulated promoting the concept to project developers, architects, interior decorators, designers and so on. Dialogue with architects working on new projects at California State University – Monterey Bay (Fort Ord campus) was pursued in an effort to entice them to include recovered wood products in their current and future projects. They have been encouraged by our team to procure and utilize the wood recovered (much of it old growth and verticle grain douglas-fir) from on campus military structures scheduled to be disposed of in the near future. Work was performed with the Fort Ord Re-use Authority to encourage them to require all new development projects on the sprawling Fort Ord complex include a given percentage of recovered wood products from wood recovered at the base, i.e., "Closed Loop Recovery".

To further demonstrate the results achieved from the DOE funded project, on November 12-14, 2003 recovered wood products generated from both this wood RVA project, as well as other products derived through the activities of this project, were exhibited at the US Green Building Council Expo in Pittsburg, PA. The principal investigator of this DOE project was invited to be a guest speaker at the conference respectfully presenting upon the subject of RVA products for the building industry (the industry reached a sales level of $130 billion dollars in 2002). Annually, this event serves as the premiere educational forum and trade show for "Green" minded architects, designers, interior decorators, project developers, media, government procurement, manufacturers and so on (attendence was soldout). **LEED (Leadership through Energy and Environmental Design)** program credits are required in order to "Green Certify" buildings. Recovered and recycled wood products generate a range of LEED credits. RVA products will prove to play a growing and key roll in getting future structures "Green Certified".

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PROJECT SUMMARY NARRATIVE

The Department of Energy supported project titled "Commercial Demonstration of Wood Recovery, and Value Adding Technologies", commenced in December, 2001. Initially, two pieces of equipment were identified and purchased (planer & recovery machine). Partial installation of the equipment was completed during the first month of the project's commencement. Simultaneously, an industry survey was generated and circulated in solicitation of feedback aimed at identifying existing and new market opportunities for products to be generated from recovered material throughout this project. The survey costs were covered by a cluster enhancement grant match that allowed the project to fundamentally roll forward prior to our having completely finalized the initial administrative requirements of the award.

Good progress was made during the first portion of the project. Sample products were produced (presented to industry marketing consultants for input after they had signed non-disclosure statements). And, based upon very positive feedback, Patent and Trademark opportunities were investigated through the University of Maine School of Law Patent Program. Based upon initial consultation, intellectual property protection was pursued. However, other than through having individuals/organizations sign non-disclosure documents, it was not anticipated that intellectual property rights would be defendable in a court of law if challenged. Although the material source was unique, the end product, in most all instances, did exist prior to the commencement of this project. Therefore, it was decided that pursuing market niche and first entrance would afford greater opportunity for success.



Sample finger-jointed flooring/paneling with inlayed accent pieces all made from recovered primary and secondary industry offal



Sample Wine Box Covers made from recovered material



Sample Wine Boxes made from recovered material

Equipment arrival and installation continued throughout the first six months of the project with all but three units in place. Of the 114 industry surveys circulated, a 15+% response rate was achieved. We expressed concern to the University Of Maine Department Of Industrial Cooperation relative to the low response rate. They informed us that for this particular market, response's above 5% would be considered, in their experience, a success. A summary of these results follow in Table 1



Sample wall covering panel made from recovered low value waste wood



Wall panel made from recovered deconstruction material (notice nail-hole character markings which, based upon survey results, further increase the value of the end product)

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After having completed the industry survey, an additional survey was created and circulated to two specific groups. Forty-one organizations were targeted in Group one receiving a 68% response rate (table 2 summarizes the survey results). Group two was targeted to 16 key "Green Building" individuals in an effort to further develop market opportunities for the products made from recovered material, all responded (table 3 summarizes the results).

General Market Survey Highlights	
% of Survey Respondents	41 Organizations surveyed, 68% responded
57%	Responded that their customers have shown an interest in products made from certified or environmentally friendly wood
43%	Stated that they were not aware of where to locate recovered wood products
21%	Responded that they currently sell recovered wood material and or products
54%	Have an interest in selling any products made from recovered "Environmentally Friendly" wood material
20%	Of those interested in selling recovered wood material foresee a viable sales opportunity within the first year of promoting recovered wood products for sale
11%	Feel that recovered products marked with Made in "X" would substantially add to sales efforts

Most believed that the market success of recovered products will need to be consumer driven. Premium pricing should not be anticipated, some actually anticipate price breaks if purely promoted as produced with recovered or reclaimed material. Products will need to sell upon merit and quality of actual products produced. Focus upon character and charm of product. Afterwards, the social benefit of being Green or Environmentally Friendly products will make consumers feel good...

Table 2

Industry Survey Highlights	
% of Survey Respondents	114 Organizations surveyed, 15.79% responded
55.60%	State to sell products made from recovered material
61.11%	Feel they have some rudimentary form of recovery in place
50.00%	Have an interest in an RVA Program
33.33%	Have an interest in the establishment of a re-sale program
38.89%	Have a willingness to encourage sales that promote RVA
33.33%	Have a willingness to promote RVA products
33.33%	Have a willingness to change material handling system
16.67%	Utilize a time base ROI in their decision process
22.22%	Require a ROI of 24 months or less
33.33%	Identified obstacles to implementing an RVA program

An overriding theme for many of the respondents was that if someone came forward with market opportunities, they would more likely than not participate in an RVA program. Most of the reluctance seems to stem from not having time or whereabouts to pursue markets. Many admitted to the willingness to jump in after someone else lead the way.

Table 1

Green Market Survey Highlights	
% of Survey Respondents	16 Professionals surveyed, all responded
87.5%	Considered recovered wood products to have a higher social value than virgin wood
56.3%	Felt that recovered wood products had a higher economic value than virgin wood
93.8%	Responded that they currently sell recovered wood material and or products
54.0%	Believed that recovered wood had a higher environmental value than virgin wood
81.3%	Of those interested in selling recovered wood material foresee a viable sales opportunity within the first year of promoting recovered wood products for sale
11.0%	Feel that recovered products marked with Made in "X" would substantially add to sales efforts
81.3%	Had the opinion that consumers would welcome wood products if they knew they were made from recovered wood rather than virgin wood
61.5%	Believed that Architects perceive recovered wood products as being equal to those produced from virgin wood
42.1%	Felt that home buyers and builders perceived recovered wood products as being equal to those produced from virgin wood
68.8%	Have seen an increase in Government interest for certified and/or recovered wood
62.5%	Have seen an increase in Architectural interest for certified and/or recovered wood
37.5%	Have seen an increase in Business & Builder interest for certified and/or recovered wood
62.5%	Have seen an increase in customer interest for certified and/or recovered wood
37.5%	Currently use recovered or recycled wood products in building projects

Table 3

Results from the survey provided added encouragement that markets and consumer interest for recovered products were real and growing. Specific samples and promotional material was developed as well as circulated for further scrutiny and input. Examples of some products are presented upon the next page. All initial readings were positive.

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Novelty boxes designed for product fit, presentation & consumer reuse



Training & Set-up of Dry Kiln Operation

The dry kiln unit was delayed and not received until July 28, 2002 which did have an impact on our ability to experiment with varying species for product assembly, quality, and market penetration due to our need for providing moisture consistency. Additionally, the City of Lewiston made us aware (in mid-June) of a zoning change (we nor the property owner who have both been operating this location for well over 15 years were never notified of the change until we requested an excavation permit in preparation for the kiln's arrival). The zoning change would have precluded us from placing the portable kiln and raw material for temporary storage outside the building and/or upon our premises. We aggressively pursued conditional rezoning with the City's Planning board (finally had a planning board meeting on July 23, 2002) and won unanimous support for our request. We received a final response to the affirmative on the evening of July 30, 2002 from the City Council. Training and hook-up of the kiln was completed in mid-September and light production for the overall project was well underway.

A small (recovered) flooring project was undertaken to demonstrate the viability of collecting offal material (in this case oak trim ends destined for disposal) and show how recovery, (through systematically preparing and finger jointing pieces together into room [or near to room length]) would provide a high quality product that could further appeal to installers of this material through its quick and ease of installation. In this particular demonstration, one live joint was allowed for mobility of the finished product, building access, and handling. The installation process went extremely well in that only one end needed to be trimmed. Doing such created a natural looking random pattern and with only one joint per strip for the installer to contend with. This made for quick installation producing minimal waste. The pictures that follow identify the demonstration process from

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material collection through processing and installation. Unfortunately, weather hampered this first installation. Since length of the finished product required access through a specific entrance opening (in this case a second floor window within a fenced in area), late season production followed by early & heavy snowfall required waiting until access for product delivery was accessible. With this said, installation did go extremely well.



Collection of Secondary Industry Offal Samples



Restacking of trimmed Offal Samples



Set-up for Finger Joint Processing of Offal Samples



Finger Joint Processing of Offal Samples



Finger-Jointed Blanks ready for pressing together



Finger-Jointed Blanks after having been pressed



Full-length view of Systematic and Custom Length Flooring



Room length product passed through window opening



Receiving material and setting aside for installation



Marking for alignment and installation



Installation of systematically designed flooring concept



View of flooring after installation

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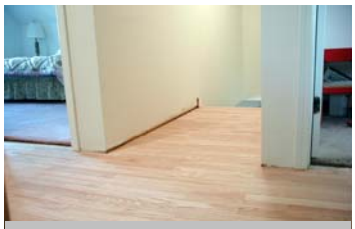
Processing techniques continued to be experimented and explored as we expanded upon our knowledge and skills base through lessons learned.



Additional view of installed flooring



Additional view of installed flooring

A weeklong demonstration of the mobile/portable production facility partially funded under this project and other Maine State agencies was completed in September 2002 at varied mills in multiple states from Wisconsin across and northward back to Maine. Doing such afforded us the ability to showcase actual recovery opportunities (the process of) and technology supported by this project to multiple individuals and entities across a good cross section of the Country.



Inside view of portable processing unit



Portable Unit at a mill site prior to a live demonstration



On-site live demonstration with portable unit



Outside view of portable processing unit



View of offal stockpile located at a domonstrtation site visited



Set-up of Portable Demonstration Unit



Mill workers receiving recovery demonstration and instruction

As climate conditions began to deteriorate in late fall, added warehouse storage was pursued to allow flexibility and convenience of product availability and to ensure proper shelter for collected raw material prior to snowfall/inclement weather settling in. During this period, and as part of a multi-step product conversion opportunity, additional processes were experimented upon. One project entailed receiving used pallet components and demonstrating its conversion into solid wood wall covering (paneling). This particular project also entailed the first operation of the Kiln duly required for the stabilization of raw material providing moisture consistency (12%). The paneling was presented for utilization by the newly elected President of the National Wood Pallet & Container Association. The processing, design, and subsequent installation was

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intended for decorative display demonstration purposes at the administrative facility. The understanding was that once installed it would be made available to interested parties for demonstration as to how low valued wood (in this instance, used pallet deck boards) could be converted into much higher valued & aesthetically pleasing finished wood products. Although the focus of this particular project centered upon gaining experience and a working understanding of the conversion process involved for this particular material, the quality and character of the finished product provided for great testament to the opportunities and benefits that recovery and value adding could provide in the near future. In addition to product conversion, we solicited input from the installer respective to opinion of product. At first, the installer was negative to the idea. However, as the installation took shape, the attitude shifted to very positive. This particular installer could not believe how well the material installed and looked upon completion.



Used Pallet deck boards received for recovery and conversion



Removing embedded nails



Stickering Material for Kiln



Material placed into kiln for achieving moisture consistency



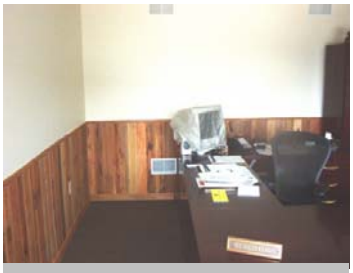
Pallet Deck board Paneling as prepared for shipment



Pallet Deck board Paneling as prepared for shipment



Pallet Deck board Paneling as prepared for shipment



View of paneling after installation



View of paneling after installation

Great effort was placed upon identifying further opportunities for demonstrating the technology that was now in place and functioning as anticipated. Additionally, focus was spent upon identifying new product opportunities to build added market exposure/concept acceptance. By this point in time, employees had gained tremendous exposure and experience capitalizing upon what was learned and developed during the ramp up process. Three specific organizations were targeted for in-depth demonstration upon recovery technology and improved yield opportunities for their low value material. These organizations agreed to have material delivered for recovery demonstration upon their offal, waste, or old and stagnate inventories. One organization was primarily

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interested in identifying improved yield potential. The second was interested in a new product potential. And a third, (detailed further in the report) was interested in identifying yield improvement opportunities as well as the possibility for added economic gain associated with a new product concept for conversion of weathered short material into a unique product.

The first organization was a hardwood mill who delivered material for processing and identifying yield potential (this material was destined for a chipper prior to this demonstration)… It chose to identify yield potential from its waste bound material to estimate production possibilities for converting its low-grade material into high end flooring.

3 5/8" Strip Yield Study

Processing Criteria:

1. Sort out pack to widths ranging from 3 ½" to 9" by ½" increments.
2. Track piece count, linear foot and board foot count of sorted boards.
3. Rip 3 5/8" width strips from each piece.
4. Track yield of useable 3 5/8"strips, 4' and longer
5. Track yield of offal material, 4' and longer and 1" and wider
6. Track piece count, linear foot and board foot count of ripped boards.
7. Calculate yield results



Side view of delivered material for yield demonstration



End view of delivered material for yield demonstration

Note: The following issues identify variables impacting the results of this yield study.

1. The material, as received, had a lot of twisted and swept boards. These conditions made it difficult to establish a straight edge on many pieces and resulted in a lower yield of 3 5/8" stock than would be expected from flatter and straighter material.

2. Since the majority of the 93 pieces of 3.5" to 4" wide stock did not yield a useable 3 5/8" x 4' strip, most of this material fell into the Useable Edging 3" + category

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3. Any offal material under 1" x 4' was not documented, and effects the yield results accordingly.



Presorting view of material

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4. 1” x 1” x 4’ stock could be converted into pointed stakes and estimated to be worth +/- $500.00 / mbf.

5. If no other value added opportunity exists for the 1” x 1”+ x 4’ strips, they could be included in the pointed stake value adding category.



Ripping Stock for Component Yield



Ripped Stock Ready for Yield Tally

YIELD RESULTS

PC COUNT	WIDTH INCHES	BD FT RCVD	BD FT @3 5/8"	% YIELD 3 5/8"	BD FT Usable edging	% YIELD Usable edging
93	3.5	201.0	43.0	21.42	137.40	68.36
7	4	18.7	14.2	75.90	2.70	14.30
4	4.5	8.8	7.1	80.56	0.00	0.00
25	5	77.1	45.3	58.78	25.90	33.65
84	5.5	286.7	170.4	59.43	82.20	26.68
17	6	55.8	33.2	59.60	14.29	25.64
10	6.5	41.2	23.0	55.77	14.80	35.86
7	7	22.5	11.6	51.79	10.00	44.43
5	7.5	23.1	3.9	16.98	15.46	66.85
7	8	33.7	21.3	63.20	11.90	35.35
4	8.5	19.5	8.2	75.40	4.73	24.30
5	9	30.0	12.1	74.00	6.90	22.93
268		**818.1**	**393.3**	**50.80**	**326.28**	**40.30**

Of the total piece count received (268), 207 pieces yielded the sought after dimension for further processing into flooring blanks. Of the 818.10 board feet received, a total of 719.68 board feet were deemed salvageable (393.3 @ 3.625” target, and 326.26 for other value added opportunities). Keeping in mind that this material was slated for the chipper and stated differently, a 48% reduction in waste was achieved if considering the target width

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product of 3.625” in and of itself. If consideration is applied to the total salvageable quantity, an 87.9% reduction is waste was achieved.

The second organization’s project involved their sending the demonstration facility low grade birch for conversion with the following criteria:

- Product to be used for wall covering (finished length approximately 40”)
- Species to be utilized is Birch
- Raw material length ranged between 48” and 144”
- Width was variable
- Thickness was 4/4
- Raw material to be delivered to demonstration facility @ a 6% to 8% moisture content
- Finished product dimensions were made as 1 ¼” N (narrow), 3 ¼” M (medium) and 5 ¼” W (wide) and 3/8” in thickness
- Wall pattern produced was: N-M-W-M-N-M-W-M-N per panel produced
- The back was allowed to be rough (un-planed) as long as the panel was uniform in thickness



An overview of Recovery and the conversion process



Side view of raw material delivered



Pre-sorted view of raw material



View of sample material produced identifying the required and varied widths of 1 ¼”, 3 ¼”, & 5 ¼” as well as a decorative wine box

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The third organization involved a vertically integrated softwood lumber company. Two product runs were completed along with the development of a unique wall paneling project during this demonstration. A sample installation of this new paneling received excellent review. Promotional material was developed and provided to the lumber company for display at its seven retail outlet stores. In addition to the promotional items being displayed, the organization planned and presented the new product at its contractor's invitational tradeshow. The product was very well received by attendees.

To further promote total utilization through value adding, captured wood sawdust and shavings/chips were processed and converted into 2.5" diameter by 4" long mini fire briquettes. The process utilized did not involve the use of any additives for adhesion. The captured material was compressed with a Pipetta Unit utilizing hydraulic press action thereby creating a friction-based formation of the briquette. Samples were distributed for feedback. Initial results identified good potential, those who experimented with the briquettes stated that they produced a good supply of heat and that the aesthetic properties (for those seeking such) were better than initially anticipated.

Following are the yield and detail results as well as an overall photo journal of this demonstration.

Sample Panel Processing Field Test
Yield/Cost Analysis

Description

Convert packs of 4", 5" and 6" wide, mixed grade, rough dry short 4/4 pine boards into 3/8" thick finished panels with widths including 1 ¼", 2 ¼", 3 ¼", 4 ¼" and 5 ¼", in order to determine processing logistics, costs and yield.

Processing

Ripping: A chain fed straight line ripsaw was used to rip the rough boards to generate straight and flat rough panel blank stock and to defect problem materials. To maximize yield, narrower panel blanks were produced from cupped, waned, split and swept stock, as well as boards with loose or missing knots. The 6" wide pile was processed first to generate all of the useable 5 ½" wide blanks possible. Problematic boards were placed in stacks according to their useable width to be ripped later.

Resawing: A horizontal band resaw was used to split the 4/4 rough blanks into two pieces of 7/16" thick stock.

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Note: Since many of the rough boards measured +/- 7/8" thick, many of the 3/8" thick finished panels were rejected due to erratic / scant finish surfaces after molding. A 5/16" thick finished product would likely increase the yield for the program.

Molding: Each group of rough sized blanks was molded into finished Akcent panels. The back side was left rough to save material and to accentuate the "Recovered Wood" nature of this product.

Note: Some of the panels rejected due to problems along their edges were put aside to re-run into narrower panels.

Trimming: A single blade up-cut saw was utilized to trim both ends and to cut the finished panel material to proper and require length.

Note:

1. All of the cutting to finished length was performed on a pneumatic chop saw. A double end trim saw would reduce the time for cutting by over 50%.

2. To increase yield, many 36" long finished panels were produced from panels that would not make a useable 40" long unit.

3. To increase yield, a given number of 12" and longer useable trim ends will be kept to sell as extender panels for producing 48" high panels.

Comments

This initial run was performed as a test. Material and equipment that was moved and/or handled more than usually required for the purpose of this test would not be duplicated in an ongoing production process.

Yield

Since the rough material consisted of +/- 48" random length boards, and since the test run was focused upon producing a short wall paneling product, the yield is calculated on a before and after linear, edge to edge, wall covering basis.

Raw Material:

Four quarter rough dry pine mixed grade boards

4" wide boards	300 pieces x 3 ½"wide = 1,050" or 88' (rounded) of running wall covering
5" wide boards	240 pieces x 4 ½"wide = 1,080" or 90' (rounded) of running wall covering
6" wide boards	210 pieces x 5 ½"wide = 1,155" or 96' (rounded) of running wall covering

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Finished Panel Results:

Width	40" Pieces.	36" Pieces.	Running (inches)	Running (feet rounded)	% of Total
1 ¼"	97	12	136	11	2.5%
2 ¼"	124	40	369	31	7.2%
3 ¼"	432	36	1,521	127	29.3%
4 ¼"	350	24	1,590	133	30.7%
5 ¼"	289	19	1,570	131	30.3%
	1,292	131	5,186	433	100.00%

Yield Results:

Rough stock = 274' linear feet of running wall covering
Finished stock = 433' linear feet of running wall covering

Yield of linear wall covering area increased by 58%

Economic Analysis of Sample Run

Retail Price for 1,336 Square Feet 40" material @ $2.45/Sq Ft	$3,273.20	
Retail Price for 106 Square Feet 36" material @ $2.45/Sq Ft	$259.70	
Market Value of Material Produced	**$3,532.90**	
Less Pickup and Delivery Allowance of 4%	($141.32)	
Less Cost of Mfg @ $1.131/Sq Ft for material processed ready for delivery	($1,630.90)	
Less cost of Raw Material provided for study (1.220 board feet) @ $175/MBF	($213.50)	
Cost of Goods Produced:	**($1,985.72)**	
Gross Profit Potential	**$1,547.18**	**43.79%** GPM
This sampling:		
Net Gross profit value	$1,547.18	
Less value of material before process	($213.50)	
Economic gain in value	**$1,333.68**	
Economic yield improvement	**624.67%**	

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Sample view of raw material received from organization before breakdown process began



Sample of material stickered and set aside for next kiln process



Ripping material on Gang Ripsaw to desired widths

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View of 5 ¾" and 4 ¾" material after having been ripped



View of 3 ¾" and 2 ¾" material after having been ripped



Trimming and defecting material to length

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Resawing material with horizontal bandsaw producing 2 for 1 pieces



Planing & paneling profile process



End view of profiled paneling after having been planed

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View of material post planed and prepared for added/custom face profiling



View of custom face profiled material and sample installation



Additional view of custom face profile



Other custom face profile samples created to display pattern flexibility

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Artist rendition of custom face profiled paneling in multiple settings

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View of Pipetta unit utilized to process captured sawdust and shavings/chips into 2.5" diameter by 4" long fire briquettes. The process utilizes compression and friction, no additives or adhesive materials are used in making the briquettes.







Closer view of briquettes being produced and collected as well as a copy of a promotional photo for demonstration

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Conclusion

As presented, the commercial demonstration project demonstrated the technical feasibility of converting low-value, underutilized and waste stream solid wood fiber material into higher valued products. Numerous opportunities to showcase the different technologies, systems, processes and higher valued output were undertaken throughout this project. The physical conversion of waste stream bound material into saleable products proved to be logistically viable. The quality of products produced were highly regarded and well received by a diverse group of organizations and marketing personnel to include its end-users.

It is our conclusion, based upon the lessons learned through this project, that organizations within the industry who are able to take advantage of the recovery opportunities presented in conjunction with pursuing the rapidly growing "Green" building market as an outlet for the products produced will be in a better position than others who do or will not. The fundamental benefits associated to improved yield and the economic value of recovery over disposal via traditional means helps to address the ongoing issues of:

- Reduced availability of forest resources
- Higher raw material costs
- Growing waste disposal problems
- Increased global competition
- Pressures to operate in an environmentally friendly manner

Caution should be taken in the method of promoting/merchandising recovered material. There are those, who if presented with where the material originally came from (raw material source), would expect to pay less at face value due to the perception that recycled material is worth less and as such should be discounted. Respective to merchandising, promotion, and market opportunities, it is our experience that focus and attention needs to be placed upon the quality and character of the products produced. In many instances, the quality and natural character of recovered material promotes a higher price than virgin material due to its uniqueness.

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