PLANT REJUVENATION

HOW WILLAMETTE INDUSTRIES GAVE LIFE TO A '60'S VINTAGE PARTICLEBOARD PLANT

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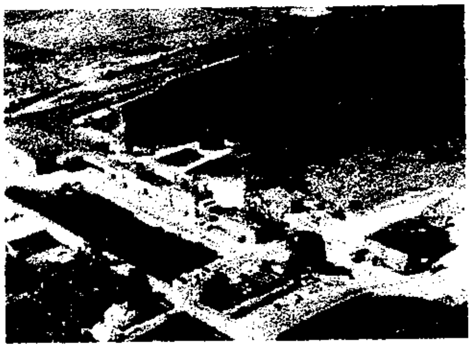
Introduction

The subject of this report is a particleboard mill in Eugene, Oregon originally started-up in 1962 as the Cascade Fiber Co. The mill later became part of Bohemia, Inc. and Willamette Industries, Inc. gained control of the facility in 1991 as part of their Bohemia acquisition. They were immediately faced with a dilemma. The mill is located just 50 miles south of Willamette's flagship, Duraflake mill. Duraflake was just completing a major modernization of its own, and this was a time of severe spotted owl-induced wood shortages, with a weak particleboard market to boot. Bohemia had up-graded the mill with a new press in the mid 1980's. It was operating profitably under excellent management and had a top-notch, safe, high performing workforce.



Cascade Fiber in the mid 1960's

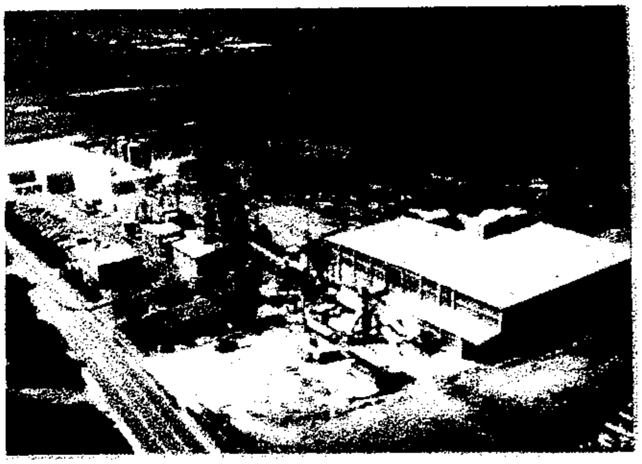
The first thing Willamette did was set some ground rules. If the plant was to continue to operate, certain "premises" would have to be established. First, the plant could not compete for raw material with Duraflake. It needed to expand the wood basket by developing new fiber resources. Second, it had to shift its focus to markets not at that time served by Willamette's other northwest mills. Third, it needed to transform itself in a cost effective way.

A plan was developed to convert the plant to MDF and run it with sawdust, chips, and recycled wood. The plan was accepted by the Board of Directors and the project was initiated in August of 1994.

The author was serving as Plant Manager of the Eugene Mill at the time of its conversion. He was involved in the conceptual development of the project, and managed the mill through the construction, start-up, and first year of MDF production.

Project Scope

A whole new refining and drying system was required, along with an MDF production line. The mill laid out well, and everything could be made to fit with a very high reutilization of existing structures and equipment. Since the mill was already a permitted major source, the environmental permitting was simplified, with good cooperation from local regulators.



The mill as it appeared prior to the MDF conversion project.

Much of the construction work occurred while the mill continued to produce particleboard. The mill then shut down for about seven months, and started up in February 1996 as Eugene MDF. The plant today occupies essentially the same foot print as the old mill, and all of the major structures are still in use.

Following is a partial list of the main members of the team that created the transformation of the plant in Eugene. Willamette's project manager, Barry Hutchins assembled an excellent group that included many others. Everyone worked very well together, and the project stayed on budget and very close to schedule.

Project Principles

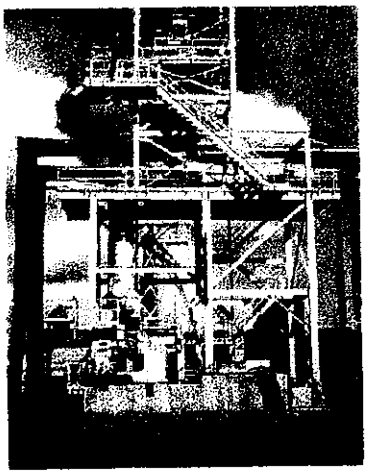
- General project management by Willamette Industries
- Engineering and construction support by CE/Western Engineering, Inc.
- Mechanical construction by O & S Contractors
- Electrical install by Olsson Electric
- Control programming by ABB
- Drive by IESCO

- Pneumatic systems by Western Pneumatics
- Process piping by Pacific Northern Industrial

The project team recognized that MDF technology was rapidly expanding and wanted to help push the envelope. Following is a partial list of the some of the key technology installed at Eugene.

Notable MDF Technology

- Raw material area designed for Recycled Urban Wood
- Single stage high energy refining
- Recirulating 2-stage, direct fired dryer, with W-ESP stack control
- Fiber heat and humidification
- Cross-belt sanding
- Centralized operator control



The AS/B 150 refiner tower under construction

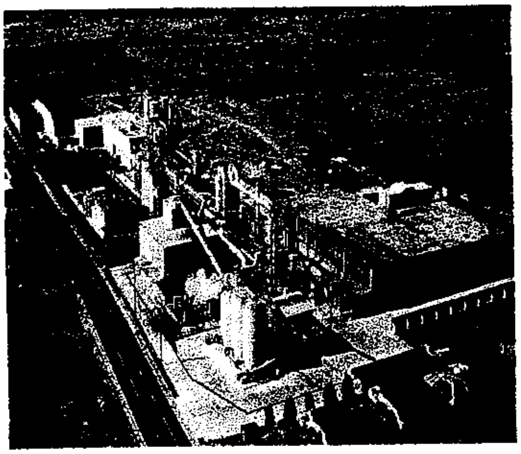
Although all, and more, of the new technologies listed had been tried before, Eugene may have been the first to incorporate all of these into one facility.

One of the prime assets at Eugene was its high quality workforce. Keeping them together and building a sense of ownership in the new facility was identified as crucial to the success of the project.

Willamette chose to use the six month conversion shut-down to install a new management philosophy at Eugene. The entire workforce was kept on payroll and provided with nearly 300 hours of classroom and field training. Both technical and soft "people skills" were taught, and the employees participated in the development of a new skill-based work system that provides compensation based on ability.

Plant Tour

The emphasis in the raw material area was on a versatile handling system that would perform well transporting sawdust, chips and recycled wood, and extensive cleaning equipment for the recycled urban wood. The only modifications to the truck dump and raw material storage area were a new disk screen to remove gross over-sized, and a storage slab for saw dust. Re-entry bins were refurbished, and conveyors were modified to connect with a new Acrowood screen, a rebuilt, used chip washer, and a Continental bucket elevator for filling three Ladig silos.



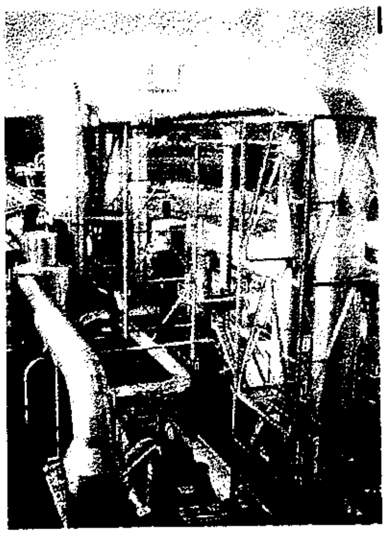
Eugene MDF shortly after start-up.

The refiner was probably the toughest early choice. Everyone was talking about 2-stage refining and all the manufacturers were building bigger machines with enormous horsepower potential. The team settled on the single-stage high-intensity concept, with an AS-150 model refiner from Andritz-Sprout/Bauer. This is a big, heavy machine, with bearings and mechanical seals on both ends of the rotating assembly, a 66" rotor disk with shaft mounted ribbon feeder, and equipped with an 8000 hp motor.

Starting this big motor proved to be another major challenge. Because the plant operated off a shared electrical substation, the permissible voltage drop is limited to 5%. With various electrical starting techniques either being inadequate or too expensive, FAC was hired to build a mechanical starter. They supplied a system using hydraulic motors to drive rubber tires against the main shaft to bring the motor and refiner assembly up to near-full rpm before energizing.

Because the existing boiler was very small, the dryer had to be designed around a direct fired, sander dust fueled, heat source. Complications created by uncertainty with chipwashing and high energy refining were a concern for dryer sizing. Secondary particulate control of the dryer exhaust was also required.

With John Westphal, of Westec America's help, a 300' long x 64" diameter, low temperature, primary stage dryer with twin high efficiency cyclones was designed. It is heated with a 45 million Btu/h sander dust-fired Coen burner, complimented (or complicated) with 40,000 cfm of recycled dryer exhaust. The cyclones exhaust through two GeoEnergy wet electrostatic precipitators, with a combined capacity of 100,000 cfm for secondary particulate, and some VOC control. By partially recycling the exhaust, the size of the wet ESP's were reduced, and the thermal efficiency of the dryer was improved.



The 2-stage Westec flash tube dryer.

Fiber from the primary dryer transfers into a steam-heated second stage unit for final moisture control. It discharges across a Thayer weigh scale, and into a 20 unit Convey-Keystone metering bin. Fresh fiber from the secondary dryer combines with reject and trim fiber from the line in the single fiber bin. It is then conveyed with heat and humidity- tempered air to the forming line. All of the fiber handling air systems were designed by CE/Western Engineering and built and installed by Western Pneumatics.

The forming machine has quite a story. It was originally installed at Willamette Industries' plant in Malvern, Arkansas in 1981 when that facility was converted from particleboard to MDF. Retired a few years ago, the machine was completely rebuilt and it is now functioning very well.

Sunds supplied the precompresser, a 2000 pli multi-nip machine. All line conveyers were designed by CE/Western Engineering and built locally by Lebanon Machine. Everything was made to fit into the existing production building.

The press itself was relatively new. It was installed in 1985 after the plant was down for a year after the old, original press failed catastrophically. To increase daylight for the caulless loader and taller MDF mats, it was reduced from 15 to 13 openings, and new simultaneous closing was installed. Another hydraulic pump was also added to increase closing speeds.

The old merry-go-round, caul-type loader was replaced with a high speed Sunds caulless loader. This meant having to dig a pit for it indoors, with the press already in place. The loader installation went well, but its hydraulic unit had to be shoe-horned in under the new control center.

All of the equipment downstream of the press was either rebuilt, or existing and left alone. The Globe vertical cooler and in-line panel saw were originally installed in 1987 as part of Bohemia's rebuild. The fans were stripped off the cooler to make it passive, and another press load of capacity was added with a shop-built star wheel cooler. The saw was also extensively reworked, and christened with the new name of "Moss Saw" in honor of a senior plant millwright who retired when the particleboard plant shut down. To meet the higher quality sanding requirements of MDF, the '70's vintage 6-head Kimwood as complemented with a new cross-belt unit, also from Kimwood. The sander area was left pretty much intact, though the grade bins and graders stations were moved to accommodate the cross-belt. A fair amount of rework was needed in the silos area to deal with the different handling characteristic of MDF sander dust and, particularly, saw trim. This plant recycles all available sander dust and trim back into the board.

The pre-existing warehouse and shipping facilities are adequate for the new facility and product. No changes were made there.

The concept of single-operator, central control of the entire process; wood yard through the in-line saws, has worked out very well. From one location, one person can monitor everything. Of course when the fur begins to fly, four operators can work together to bring things back under control.

Control room

A rejuvenated Eugene MDF is now running very well. Uptime is calculated on a "total available hours" basis, and is showing signs of meeting its 92% goal. Designed around 60 mmsf capacity, the plant routinely makes over 200 msf/day and should be able to hit 70 mmsf/yr, or more than 120,000 cubic meters annually. The wood mix is now running regularly over 30% recycled wood, and occasionally over 50%.

Plant emissions are close to predicted levels with the exception of NOx, which is higher than expected. This is being addressed through decreased combustion of sanderdust by putting it back into the board. And, very gratifyingly, no major errors in design layout or engineering occurred. The plant seems well posed for the next 30 years.

Plant Rejuvenation

Now, the focus will move on from Eugene to the process of turning an old plant into a new one. Although renewal and capital upgrade is an on-going process at virtually all facilities, comprehensive planning for the long-term is sometimes lacking.

What needs to be pointed out is that retooling of older facilities in a comprehensive way can be more cost effective than simple, piece-meal change-outs of unit operations.

Today in North America there are presently 69 particleboard and 24 MDF plants operating. The table below shows of these 90-odd facilities, well over half were built before 1975, and 16 of the particleboard mills are more than 30 years old.

North American Plants are Aging

[illegible]	[illegible]	[illegible]
Total	69	24
Built before 1985	55	13
Built before 1975	45	10
Built before 1965	16	0

If you talk to the major equipment manufactures of multi-daylight presses, milling equipment, saws, dryers, etc. they tell you, and plant experience supports this, that the life expectancy of these critical component is about 30 years. This presents the operator of an older facility with three options of either (1) closing the plant, (2) changing out equipment as it wears out, or (3) taking a comprehensive approach to give the plant a new lease on life.

So which of these options should the operator of an old mill choose? This is not a casual question, but one that demands a careful assessment of the ramifications of all three options.

To do this, you must first take a very close look at the condition of what you have. Factor in the demands of future conditions of doing business, and then weigh that against your companies' future strategic positioning objectives.

Lets look at an example. Take the mill described below (Options Study); an early vintage MDF plant making 100 million ft2/yr. with a recently upgraded forming line, and a press showing its age. This plant has a relatively high wood usage, normal resin consumption, and a cost structure that makes it marginally viable under today's market conditions. It is also facing what all mills in the United States must contend with in the next few years; soon- to-be-mandated MACT controls of its hazardous air pollutant emissions.

Options Study

- 100 mmsf MDF plant
- 8' wide forming line, good condition
- Press limited, old, poor condition
- Impending HAPs controls
- Wood usage = 1.66 bdt/msf @ $60/bdt (48#, .120" sanding)
  = $99/msf
- Resin usage, 10% = $85/msf
- Total manufacturing cost = $336/msf + $15/msf SG&A
- Sales average = $350/msf

The ramifications of choosing the first option, "doing nothing," are not very bright. Although we can hope for improved market condition, Peter Drake and other prognosticators are not too optimistic about MDF prices for the next five years. The operators of our hypothetical plant can either continue to struggle for awhile until either regulations or a catastrophic failure shuts the mill down, or perhaps more practically, pull the plug now.

The second choice is to accept that HAPs controls are a cost of doing business, and plan to make that minimal "incremental improvement". This means our operators still needs to keep their fingers crossed that the press will last. This choice does nothing to improve mill operations. Rather, it adds additional complexity to the facility and increases manufacturing costs significantly. So, your already unprofitable operation becomes even less competitive, particularly against Canadian mills not mandated to address HAP's.

By looking at the challenges in a more comprehensive way, a scenario might be developed that addresses both the press problem and the HAP's issue at the same time.

This approach is outlined below in the Comprehensive Plan. By going with continuous press technology, you can expect substantial reduction in both board density and sanding allowance that translates directly into real unit savings of wood and resin. This new press is sized to not simply match the capacity of the old one, but take advantage of the fiber that is currently being produced, (and so essentially comes free) and stretch it into an additional 20 million feet per year of production.

Comprehensive Plan

- Add HAP's controls
- Replace press with 26m Continuous

Results:

- Reduce wood usage to 1.41 bdt/msf (45#, .040" sanding) =

  $84.60/msf
- Reduce resin costs to $72.84/msf
- Increase production by 20 mmsf from 25,000 bdt of "free wood"

The financial impact of this choice is shown below. On the cost side, to deal with HAPs we will incinerate the press emissions with an RTO. Our hypothetical example has real estate available parallel to the existing production line, allowing us to install the new press and RTO while the old plant continues to run. When that equipment is all checked out and ready to go, the plant will shut down for about four weeks to move the line, and install connecting conveyors. Eighteen million dollars is a realistic cost estimate for the project.

Financial Impact

Cost: $18 million

- Install press, oil heater, and RTO
- Relocate production line

Margin Improvement: $6.6 million/yr.

- Resin & wood cost reduction = $28.60 on 120 mmsf
  = $3.4 million/yr.
- Extra sales come free, except for raw materials:

  $320/msf mfg cost
  -$158/msf raw material cost
  $162/msf margin improvement on increased production
  x 20 million ft^2 production increase
  $3.2 million increased profit

PAYBACK:

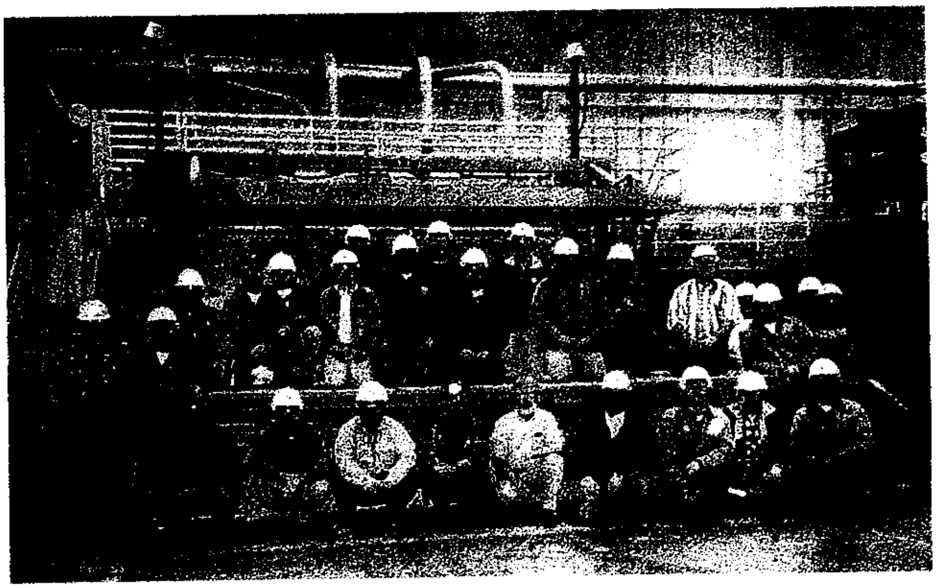
$$\frac{\text{\$18 million cost}}{\text{\$6.6 million savings and increased margin}} = 2.7 \text{ years}$$

The margin improvement from reduced unit raw material costs, and increased productivity, provide revenues over current costs sufficient to pay off the project in less than three years. The reduction in reduced board density and sanding allowance allows for a 20 million ft. increase in production. With no change in the resin dosage rate, resin consumption costs drop by $3.4 million per year on a $/msf basis. Since all current fixed and operating costs remain unchanged, the only real cost of the added production is the value of the raw materials. The extra 20 mmsf of production improves the margin of sales price over manufacturing cost by $3.2 million a year.

Conclusion

The above example shows that by carefully considering all options, a company with business goals aligned toward remaining competitive in the MDF business can receive an attractive pay back on a modernization project. Not only can this approach return a marginal facility to profitability, it positions and equips it to operate competitively for the long term.

The point is be proactive. Deal with the problems of aging plants on your terms, and be creative in your thinking. So, for mills that resemble Willamette's old mill in Eugene, and want to stay in business for years to come, put a good team together and do some comprehensive planning.



The Eugene MDF project team.