"New Moisture Profiling Steam Shower - Result of 15 Years of R&D at Weyerhaeuser"

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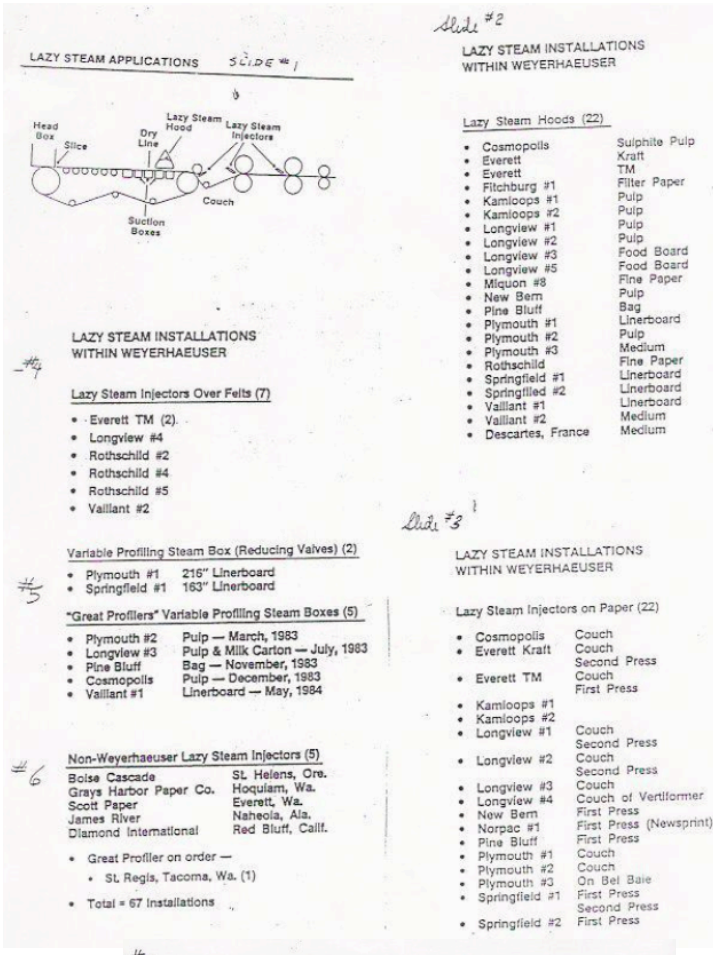
Introduction

Roger Wells graduated from the Pulp and Paper school at Syracuse University. He worked 21 years for the Diamond National Company in molded pulp mills on process and machinery development. He continued this work with Weyerhaeuser Research, accumulating about 30 patents of his own. Two years ago, he changed his working relationship to that of a consultant and licensee.

Please welcome, if you will, Roger Wells.

I have 30 minutes to cover 15 years of development and applying steaming technology within the Weyerhaeuser Company. This effort grew from one person to more than four people with our own laboratory working exclusively on steam applications. Some people have wondered how a company can justify this amount of development effort on a field as small as steam application to improve drainage. We are talking (slide 1) about what we call Lazy Steam Hoods and Lazy Steam Injectors and variations.

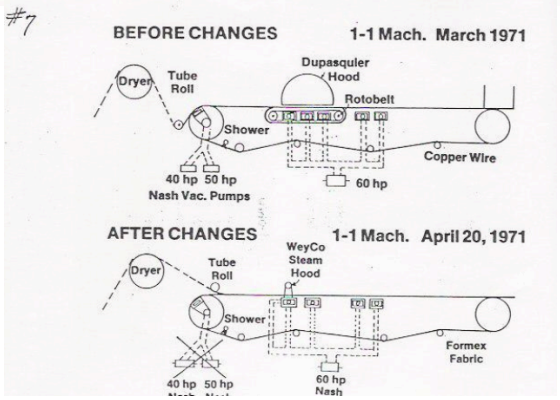
Here is a listing (slides 2-5) showing the installations that were a result of this effort. In reporting to senior management in 1976, the Weyerhaeuser vice president in charge of research claimed the value of this technology to Weyerhaeuser over a ten-year period to be 90 million dollars.



Weyerhaeuser chose to keep this development as proprietary knowledge up until two years ago when it was recognized that these principles were generally known and were being applied throughout the industry.

The list shows what was done, not how it was done. That is what this paper is all about.

Let's start in 1969, 15 years ago. When I Joined Weyerhaeuser in their R & D facility in Fitchburg, Massachusetts, they had a six-foot wide fourdrinier machine making filter paper at about 120 ft/min. Here are some sketches of the wet end of the machine (slide 7).



Inasmuch as filter paper can stand no compaction, there is no press section. The paper goes directly from the couch to drying cylinders. Whatever water is left in it must be dried out on drying cans. It runs dryer limited.

Before we made any changes as shown in the top sketch, the machine had a copper wire. The sheet went under a Dupasquier steam box that was over a rotobelt with three suction boxes under it. The suction box covers were fully drilled. As a result of experimental work in the laboratory, we made the following changes as shown in the bottom sketch.

We switched to the first formex fabric permanently used in the mill. We removed the rotobelt.. We removed the fifth suction box and switched its vacuum to the No. 4 suction box. We replaced the fully drilled suction box cover on the fourth suction box with a cover that had just two quarter-inch wide slots in it, two inches apart. We replaced the Dupasquier steam box with what we later called a Lazy Steam Injector. This is simply a drilled pipe designed to deliver non-turbulent steam from a throat one and one-half inches wide. This injector was positioned over the first slot.

By concentrating the vacuum on the No. 4 box and reducing its open area, we were able to achieve such a high velocity through it that the water was literally blown off the fibers. The furnish contained cotton linters, glass fibers, etc. and was hydrophobic anyway.

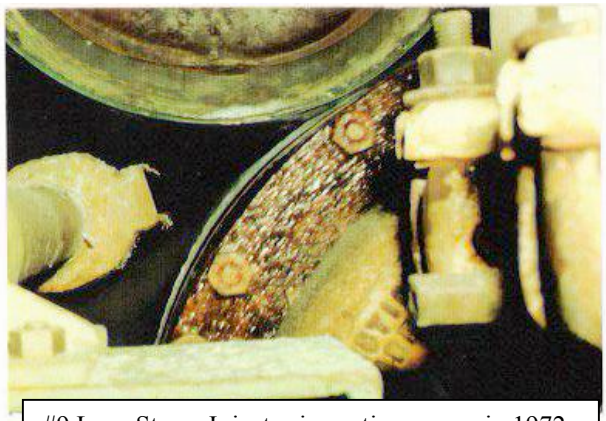
The condensate remaining in the sheet was pulled out as the sheet passed over the second slot.

We discovered that the knock-off showers were splattering up onto the couch roll and this water was being carried back into the sheet and the couch vacuum was not pulling it out. We therefore moved the take off roll to a higher position and pulled the sheet directly off the fourdrinier. This enabled us to knock off the couch vacuum pumps and save 90 hp.

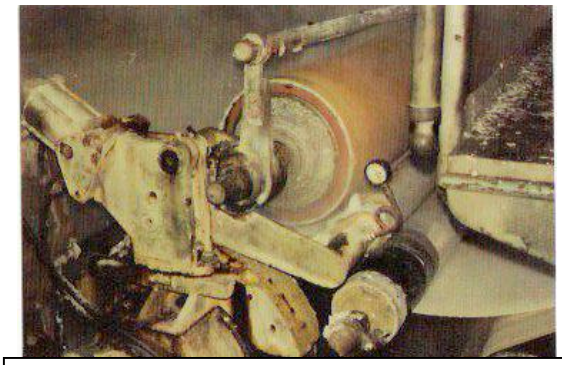
The net result of all of these changes was a 28% increase in production and some unhappy machine crews who had to move a little faster. What we learned here, we applied to felts later.

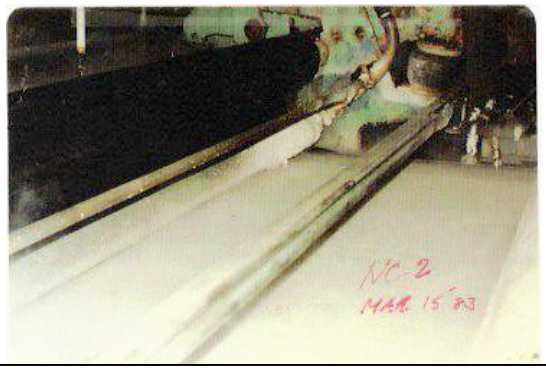
In response to interest of other Weyerhaeuser mills in applying steam to the fourdrinier, I visited several of them. At the Everett kraft mill, it was suggested that the Lazy Steam Injector would be an excellent way to get heat into a suction press nip (slide 9). This was tried and was very successful in increasing the speed of the machine. As shown on this slide (slide 10), they also used a steam injector to apply steam to the couch roll between the lumpbreaker and the take off roll.

Everett kraft now uses a Lazy Steam Hood on the fourdrinier and Injectors after the couch and at both suction presses. The sheet entering the dryer is about 170°F and up to 50% solids. They have an authorization request in for a Great Profiler.



#9 Lazy Steam Injector in suction press nip 1972

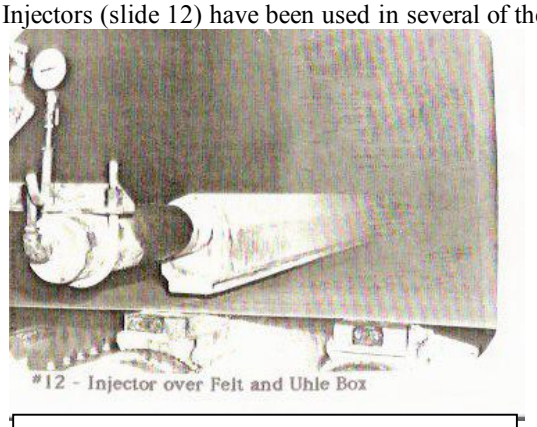




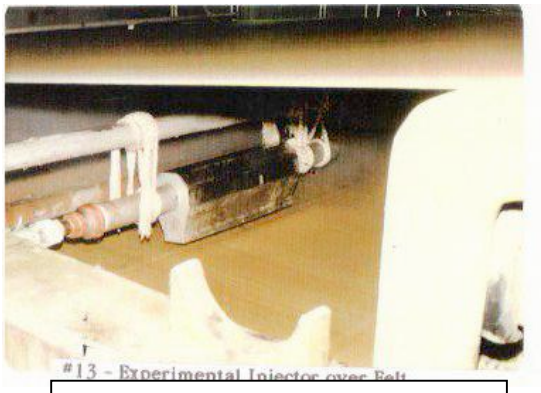
#10 / #11 Lazy Steam Injectors at the outgoing or ingoing nip of a couch-lumpbreaker

Another good spot for applying steam (slide 11) is the ingoing nip at the couch lumpbreaker as shown here on the Plymouth No. 2 machine making pulp.

Injectors (slide 12) have been used in several of the mills over felts as shown in the Rothschild mill.



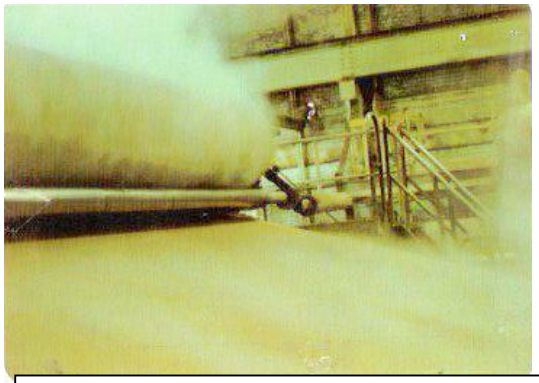
#12 Lazy Steam application to Press Fabric in 1977

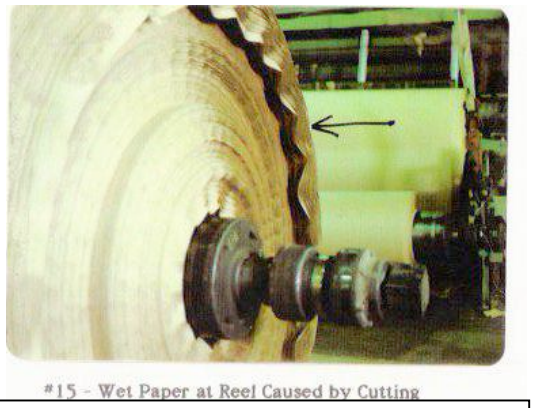


#13 Trial unit over uhle box

We had a two-foot long injector (slide 13) made up for a two-week study in the laboratory of the Albany Felt Company. We use this trial Injector quite often for testing the suitability of putting steam in other locations.

These injectors are quite easy to install (slide 14). Here is an installation at the couch roll of the Bel Baie machine making corrugating medium on Plymouth's No. 3 machine.





#14 / #15 - Lazy Steam Injector at Bel Baie couch and result at reel when turned off

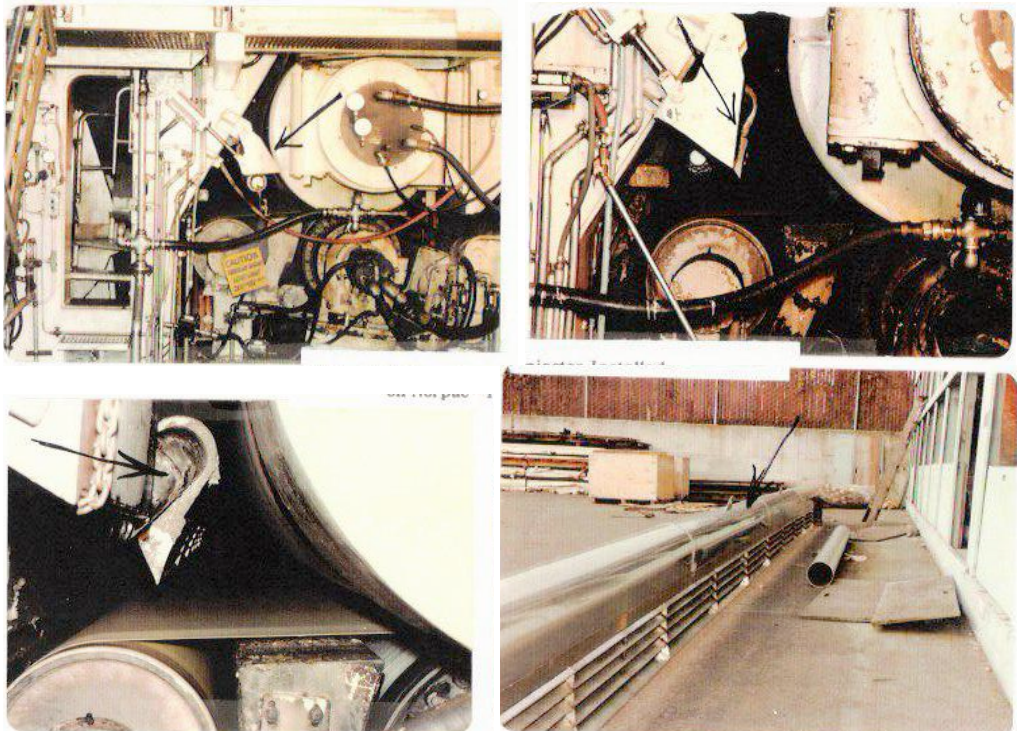
There was a question of how much good it was doing. The machine superintendent said, "Let's see! Shut it off!". They shut it off abruptly (slide 15) and this is what happened at the reel

The sheet suddenly widened out four inches from being too wet.

This Injector stayed installed only about four months and then was taken off the machine. The added drying capacity was not needed and in that position, the Injector got dirty on start-ups.

It is a valid application. Some of you with Bel Baie's may want to try it.

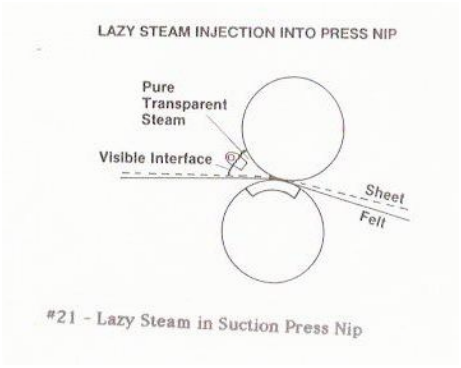
We also have applied a Steam Injector with an eight-inch wide face to the first press roll of the Norpac No. 1 newsprint machine (slides 16-19). Though it is non-profiling, it enabled the machine to establish a worlds speed record. The mill will not run without it.



Lazy Steam Injector with retraction mechanism installed on Norpac #1 in 1980

We found that steam injection in press sections invariably saved steam. On linerboard, they would give an additional 50 fpm over that obtained by Lazy Steam Hoods on the Fourdrinier.

If you have a good Lazy Steam Injector (slide 21) in a suction press nip, you will have pure, transparent, superheated steam completely filling the nip. You will often note an interface where the pure steam is interfacing with air and condensing in a wavy layer as shown on this slide.



#21 - Lazy Steam in Suction Press Nip

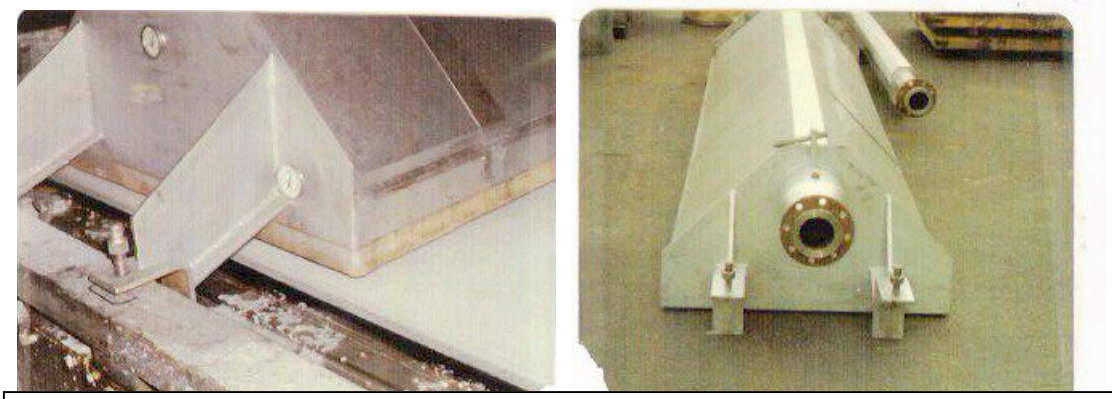
As part of a licensing agreement with Weyerhaeuser, Lazy Steam Injectors have been supplied to Boise Cascade, James River, Diamond International, Scott Paper and Grays Harbor Paper Company.

(Slide 22) This is Grays Harbors' steam injector. It has a little dogleg on the discharge to make it fit where they want to use it.

Weyerhaeuser does not have a profiling steam injector at this time but expects to before long. However, if you add an injector in a press section, you can afford to cut back steam in a profiler on the fourdrinier and make it work better.

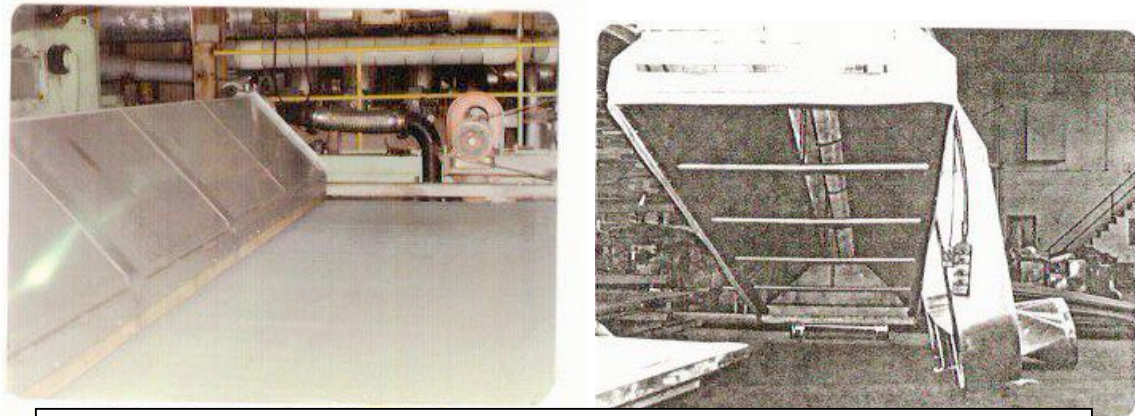
On this history of steam applications in Weyerhaeuser, let's back up to 1971 again in Fitchburg.

We tried over suction boxes on the Fourdrinier what we called a Lazy Steam Hood (slide 24). This is the basic design that ended up over the Fourdriniers of 22 of Weyerhaeuser's machines making pulp, linerboard and corrugating medium. It replaced many Dupasquier and homemade boxes (slide 25).



#24 / #25 – Non-profiling Lazy Steam Hoods for uniform steam application

The steam enters at the top through a drilled pipe, is baffled in such a ways that it is completely non-turbulent, and just flows evenly down onto the sheet. Being non-turbulent, we call it "lazy" (slide 26). It has a felt skirt around the bottom of it that holds the steam in, but permits pulp to pass through in case of a flood on the wire.



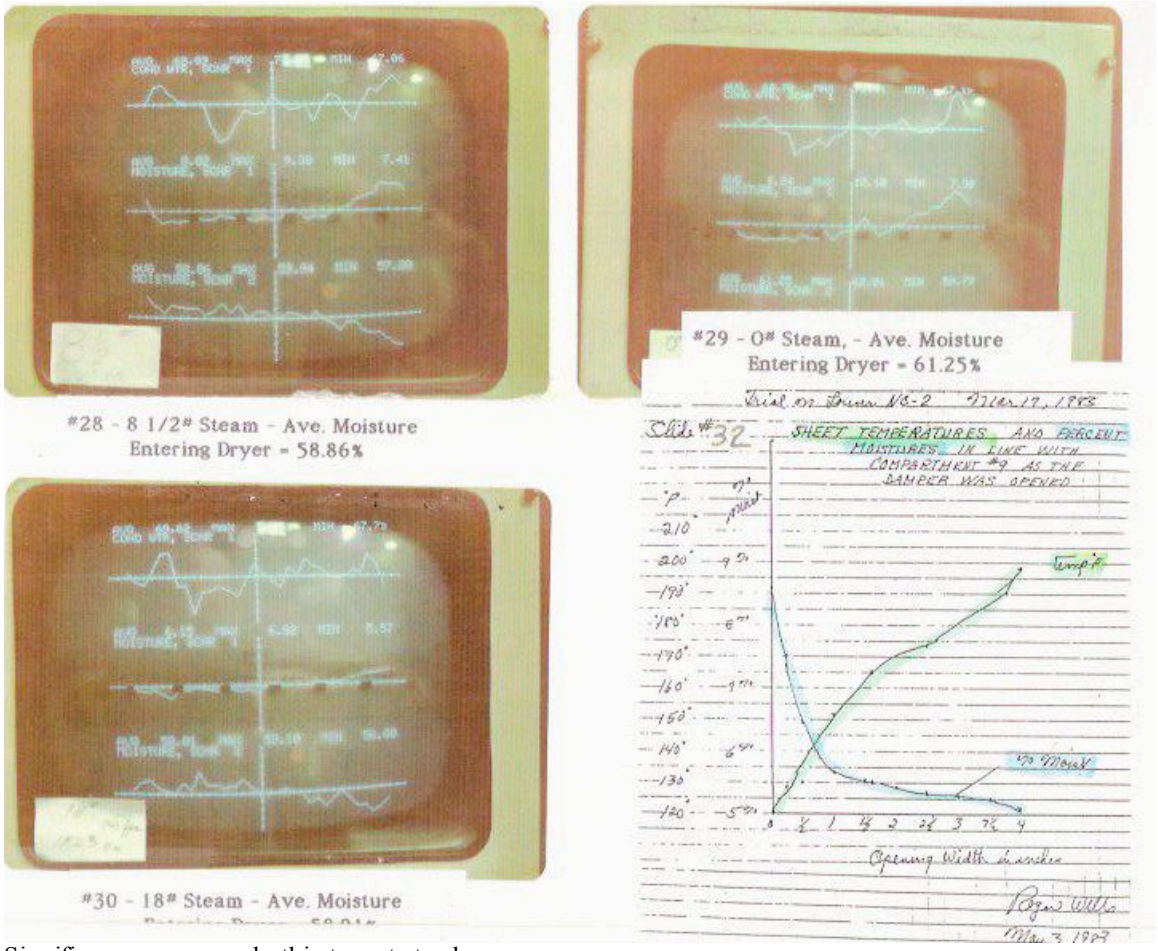
#26 / #27 – Non-profiling Lazy Steam Hoods are very simple in design

(Slide 27) Another slide shows the inside of the steam hood. It is just plenum.

The success with steam in Fitchburg became known to other Weyerhaeuser mills and in 1972; we were called upon to provide Lazy Steam Hoods to Plymouth No. 1 and No. 3 machines. The effectiveness of this Lazy Steam on 69 lb linerboard is shown on the next three slides (slide 28). Watch the bottom line. It is the moisture profile entering the dryers.

We ran a trial on this 216" linerboard machine. At 10:20 in the morning, they were using 8-1/2 lbs steam pressure in the Lazy Steam Hood. You will note on the bottom line the moisture profile of the sheet entering the dryers. The average moisture is 58.85%. We abruptly turned the steam hood off (slide 29) the moisture entering the dryer increased to 61.25% - we then opened the hood up to 18 psi (slide 30) and you

can see that the average moisture dropped to 58.01%. This is a reduction in water entering the dryer of 12-1/2%.



Significance - you can do this to wet streaks.

Let's get up to date again on this history of steam applications in Weyerhaeuser.

By 1974, research has moved from Fitchburg to Seattle while the Technology Center is being built near Corporate Headquarters. The steam applications group has grown to two engineers and three technicians.

In 1978, we developed a compartmented variable moisture profiling steam box to go over the fourdrinier. The steam was introduced through air operated valves to small steam injectors in each compartment. This was installed on Springfield's No. 1 machine making linerboard. A second one of essentially the same design was installed on Plymouth's 216" machine making linerboard in 1981. These are of a very practical, effective, maintenance-free design that I will report on if I have time at the end of this presentation.

However, 18 months ago, we came up with a design that we like even better. We call it the "Great Profiler." It is the real purpose of this presentation.

Weyerhaeuser has Lazy Steam Hoods on the Fourdriniers of most of their machines. These essentially are plenums filled with non-turbulent steam that flows evenly down on to the sheet. An ever-present challenge to the steam applications section was to find some way to convert these existing Lazy Steam Hoods to profiling steam hoods.

The results of several years of cerebral turmoil caused us to think of lazy steam as you would think of hot air and handle it the way you would hot air. In your home, you take hot air from a duct by opening a register or a damper or a louver; call it what you like. Therefore, what we have done is to provide a conversion kit of a louver that can be added to bottoms of the existing Lazy Steam Hoods. The louver

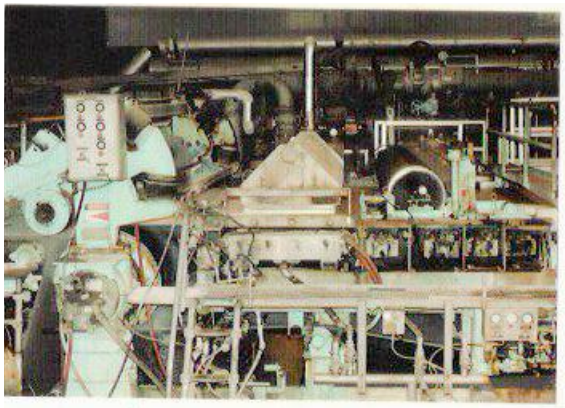
section has compartments six inches wide with a damper in each compartment that can be operated by a pull rod from the front end of the steam hood.

In March of last year (slide 31), the first Weyerhaeuser machine equipped with this profiling arrangement was Plymouth's No. 2 machine making pulp.

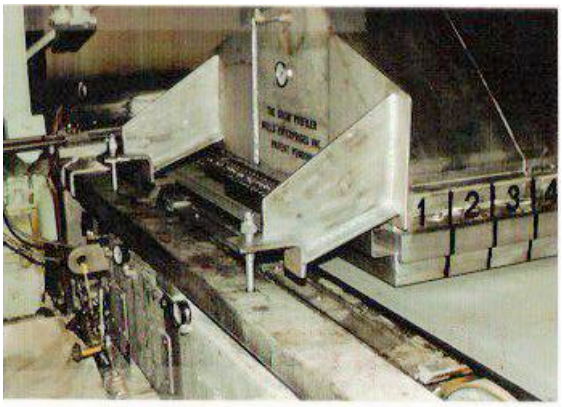
The Lazy Steam Hood was raised five inches and the louver section installed underneath.

The results were very dramatic. The moisture profile at the reel was leveled from a 2-1/2% total spread to less than 1%. Having this kind of control of their moisture profile made it possible for them to even out their basis weight profile. It enabled them to fully load their presses. It saved a lot of steam. By removing steam from over-dry streaks, all profiling steam hoods automatically save steam.

In a test, when the profile was very flat at 6%, one compartment, No. 9, was completely shut off (slide 32). Immediately, a very sharply defined wet streak showed up on the Measurex. This reading was 8.6%, which was an average of several scans. A single scan showed the moisture to be 10.0%. Inasmuch as this was causing the roll to be rejected, we promptly began opening the compartment in half-inch increments. Finally, at full open, the moisture at the reel was only 4.5%. This change from full closed to full open was over 5% at the reel. At the same time, we measured the surface temperature of the sheet as it came out from under the Profiler. The uniform increase in sheet temperature shows that the flow of steam is directly proportional to the opening of the damper. However, as practically everyone knows, the first pound of steam applied to a cold sheet has the greatest effect. Low levels of steam input are very energy efficient. High steam inputs are less efficient, but often are justified if they give added production on dryer limited machines.

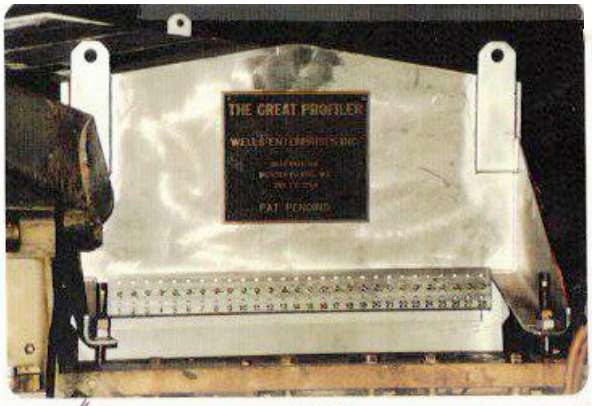


#33 "Great Profiler" Plymouth #2



#34 "Great Profiler" Longview #3

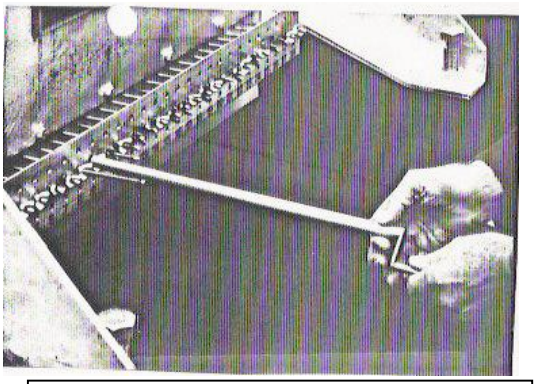
Because this profiling arrangement was so successful (slide 33), it was added four months later to Longview's 216" No. 3 machine making milk carton stock and pulp. Here is an end view (slide 34). This enabled them to raise the moisture entering the size press from 0.9% to 1.5% and gave them an increase in production that gave them a payback of three weeks.



#35 "Great Profiler" Pine Bluff #36 Pine Bluff - Inlet end

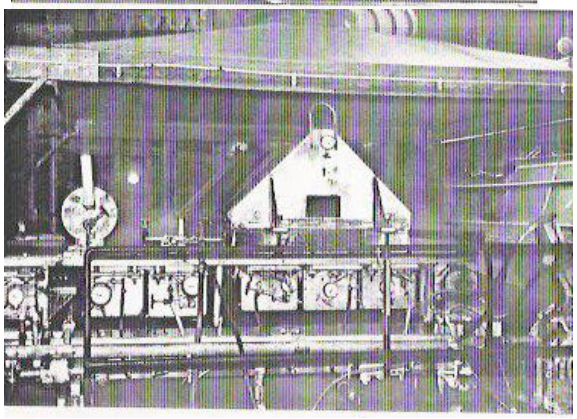
Success breeds success. Weyerhaeuser's Pine Bluff mill installed a "Great Profiler" early in November (slide 35). Rather than take their Lazy Steam Hood off their machine and install a louver section under it, Pine Bluff chose to have built a new plenum with louver attached. This was fabricated in Everett and shipped to Pine Bluff. This slide shows the steam inlet end of the Great Profiler before it was shipped to Pine Bluff. For installation, all that Pine Bluff had to do was raise their single steam supply inlet to match the inlet of the "Great Profiler" (slide 36).

This slide is another view. (Slide 37) This slide shows the method of adjusting the dampers that control the steam flow from each compartment. The dampers are spring-loaded to close and are opened by turning nuts on threaded quarter inch rods. A typical adjustment to make a noticeable change is five turns or 1/4" change in control rod position. Slide #38 shows the compartments from underneath.



#37 – Manual adjustment of Great Profiler with crank handle

#38 View from below of compartment walls of Great Profiler extending to the bottom of the box.

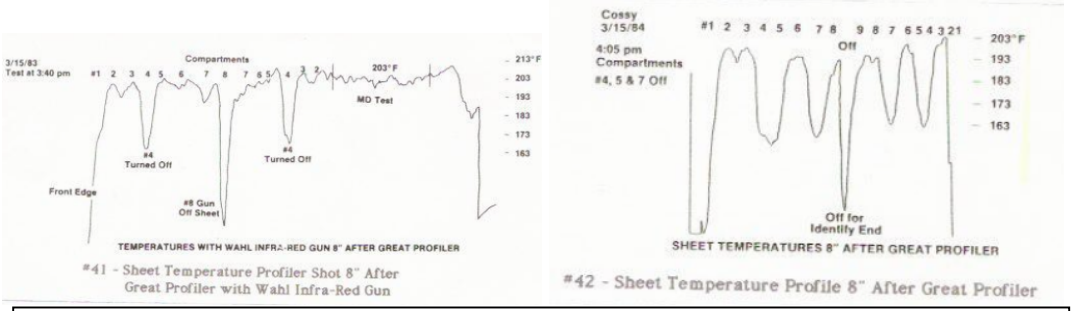


#41 Great Profiler at Cosmopolis

This slide shows the change in moisture profile of 50# bag as the profiler was turned on. The profiler showed a 30% improvement in two-sigma spread.

However, Pine Bluff found it more to their advantage to use most of this moisture profiling capability to correct their basis weight profile that was a serious problem. The installed cost of the complete "Great Profiler" in Pine Bluff was very reasonable. It was installed during a felt change.

Weyerhaeuser's Cosmopolis mill ordered a "Great Profiler" on November 15 of last year. It was installed on December 15 also during a felt change (slide 41). Following are some slides showing temperature profiles of the top of the sheet 8" after this Great Profiler.



#41 - Sheet Temperature Profiler Shot 8" After Great Profiler with Wahl Infra-Red Gun

#42 - Sheet Temperature Profile 8" After Great Profiler

#41 #42 - CD Temperature profiles downstream of closed compartments of Great Profiler on pulp machine at Cosmopolis

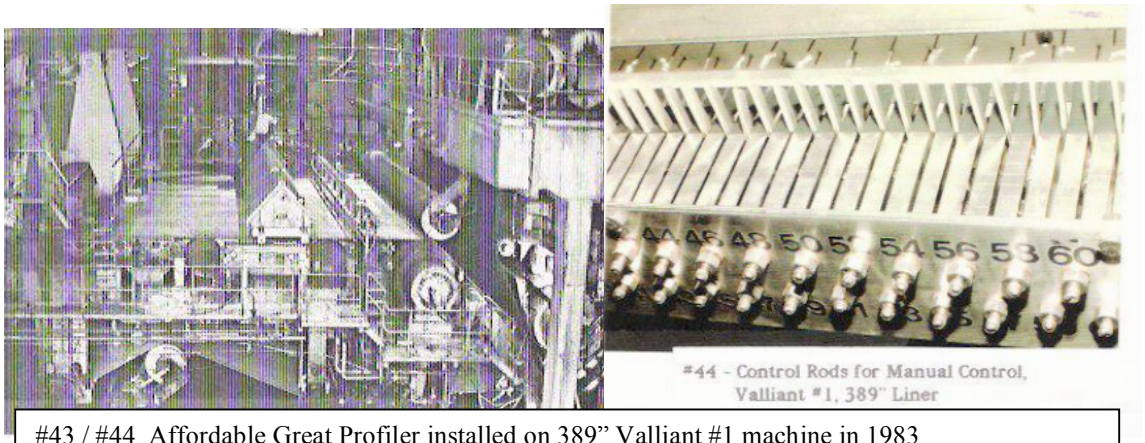
As shown in this slide, a Wahl infrared gun scans the sheet from the front edge into compartment No. 8 which is four feet in from the front edge. The compartments were all opened the same amount except compartment No. 4 which was closed. You will note that the temperature following compartment No. 4 dropped from 200°F to 163°F which was the incoming stock temperature. At compartment No. 8, the temperature scan was reversed and that same temperature drop at compartment No. 4 was noted.

(Slide 42) In this slide, the test was the same but compartments No. 4, 5 and 7 were shut off with all of the other compartments open the same amount. You will note the wider cold streak at 4, 5 and 7, but the sheet after the No. 6 compartment has the temperature right back up to 193°F. Again, the gun scanned back from compartment 9 to the front of the sheet and the curve was the same.

These curves show the remarkable capability of the louver to sharply define steam application. This really should be expected for the non-turbulent steam is just above the full area of the compartment waiting for the damper to be opened and let it flow down onto the sheet.

(Slide 43) In early May we installed a Great Profiler on Weyerhaeuser's 389" linerboard machine in Valliant.

(Slide 44) The control rods for this are in two rows with fingers extending up through the slots to show the position of the rods and thus the amount the dampers are open.



#43 / #44 Affordable Great Profiler installed on 389" Valliant #1 machine in 1983

You will note that the Great Profiler is manually operated from the catwalk along the front side of the machine.

Weyerhaeuser is well along on a way to operate these dampers by remote control. This will be an all electric means that will require running only seven wires from the control room to the Profiler rather than an umbilical cord of air lines that would be required if we used pneumatically operated valves. We have no valves in the profiler as such. We have dampers that require a two-inch lineal adjustment.

Once we have the remote electrical control, I have been assured it is not a big problem to run the profiler automatically from existing computers if the mills want to do it.

Weyerhaeuser has applied for patents on the Great Profiler. In October of last year, Weyerhaeuser licensed an outside firm to provide the Great Profiler to the pulp and paper industry. St. Regis has a Great Profiler on order for their 264" linerboard machine in Tacoma. What they will get is the same combination of plenum and louver as was installed in Pine Bluff. Inasmuch as this will replace an existing steam box, the steam line and valve are in place and the installation cost will be minimal.

To summarize, these features make Weyerhaeuser happy with the Great Profiler.
- It has a capability to provide very accurate streak control with non-turbulent, lazy steam.
- It is very simple to operate. Having no valves, it has minimal maintenance problems.
- It can use the total steam input for streak control
- It can use any steam available. Having no temperature sensitive parts, it loves superheated steam.
- It does not require a steam relief line or safety valves.
- It does not require lift cylinders.
- The only installation expense should be providing it with a steam supply.
- It can be built quickly and is comparatively inexpensive.
- Remote control or automatic control can be added on if desired.

Many more steam applications have been made in the past 15 years that I have not had time to tell about. We have drip-less steam showers on calendar stacks still being used in Fitchburg. We used a steam shower at the reel to correct a severe curl problem. We have a patented design of a steam box and added suction box which will deliver stock off a washer at 200°F and over 25% solids. We have a patented design of a variable profiling steam box that utilizes the principle of varying the area of the sheet exposed to steam. We have a portable Lazy Steam generator that we use quite often to flood superheated steam via an 8" diameter flexible hose into any spot on a paper machine where one questions the value of applying steam.

I'd be glad to discuss any of these subjects with anyone wishing to do so after this meeting. If anyone wants a copy of this paper, please let me know and I will send you one. I also have pictures, reports and a working remote-controlled model with me.

I'll be happy to answer any questions.