Report on Consultation Work for Green River Panels., Songkhla September 2008

Raymond J. Roberts

Abstract. This report details work done to improve operations of the Green River Panels Particleboard Plant carried out over two weeks in September 2008. The major efforts were to improve the recovery of "A" grade board and primarily involved the optimisation of the blenders including the commissioning of the new chiller. The blenders had no manufacturing setups and were running in a manner that resulted in poorly blended flake which in the core resulted in lower MOR and resulted in the production of an unacceptable level of dust and glue spots in the surface. The report also details work to be carried out prior to the next visit and also sets priorities for future visits and plant improvements in both the short and longer terms.

1. Matters Arising from the last Visit

- Flake quality ex flakers, too much poor quality flake produced due to no system in place to change flaker knives at correct intervals.
- Flake classification; to much dust in surface and fine material in core due to sub-optimal screen configuration in PAL flake classifiers.
- Chip quality; too much dirt in chip as well as too much recoverable material being dropped out of the roller screens.
- Logyard stock control and quality; there is too much poor quality material i.e. too small with insufficient trimming of branches which will result in breakages and blockages of the chipper infeed conveyor.
- Blender optimisation; the blender was not commissioned with any formal setups nor was there any knowledge of blender setups in the company who provided the blenders nor at Green River Panels.
- Sander and sawing optimisation; as production increases this will become an increasing bottleneck resulting in too much work in progress stock.
- Master panel size; this needs to be increased to optimise productivity through the sanders and saws.

- Butt to butt sanding; boards at the infeed need to be sanded so that there is no lost sanding time which can never be recovered.
- Balancing calibrating sander; too much material is being sanded from the bottom of the board requiring extra surface flake to be spread. This is very expensive and can lead after laminating to serious bowing problems. I have a router test that will measure how much is removed by each sanding head both top and bottom and I will do the test on my next visit.
- Optimising saw infeed pusher; the pusher must work faster and after pushing must lift prior to retracting to enable another board to be fed to the pusher so that there is no lost time which currently causes slow sander throughput.
- Optimising saw outfeed bins; the sander/sawing line stops when one of the "A" grade bins is full and drops down in preparation for pack removal. The bins are currently configured for "A" grade, "B" grade and reject. They should be configured; two for "A" grade and one for "B" grade & reject which can be manually sorted and regraded. This means that when one "A" Grade bin is full boards can be directed to the other "A" grade bin while the first is lowered for removal of the pack. This means that the sander/sawing line does not stop which currently it does leading to unacceptable levels of downtime.
- QA data and reporting; this needs to be reviewed so that production get the information they need to control the plant and unnecessary testing does not take place, i.e. there is no need to test incoming resins, it is far more essential to test the get times of the core resin mix at the blender to determine whether or not sufficient catalyst is being added. Other tests required are MOR-A test i.e. glue bond durability, regular flake analysis ex the flakers, and more detailed flake testing ex the PAL screens. This will be one of the issues I deal with on my next visit.
- Grit analysis for improved LPM machinability; given the amount of dirt in the furnish it is essential if board from this factory is going to be laminated either by customers now or by the company itself in the future, that grit tests be carried out. Grit in the surface causes particleboard chipout and machinability problems which will result in loss of customers and many quality complaints.
- Use of plastic staples; this will save damage to sander belts that could happen if the currently being used thumb tacks end up in the sanders. Sander belts cost hundreds of dollars.

- Sander grading methods and standards; there was far too much board being downgraded to "B" grade due to an unnecessarily tight grading specification for dust and glue spots. The original standard was glue spots <2mm and only 3 per panel. This needs to be changed to Glue spots are allowable up to 10mm and 4 per panel and dust spots to 25mm up to 4 per panel. The amended grading standard stated <5mm in error it should be <25mm.

- Dust leaks and explosion hazards; more explosion vents are needed especially after the dry refiner and ultimately a firefly system plus gas deluge needs to be instituted.

- Improve dry refiner capacity; this is only running at 50% capacity i.e. 3 tonnes per hour instead of the design capacity of 7 tonnes per hour due to the induction fan not having sufficient capacity. This could lead to a buildup of material in the refiner getting too hot which could result in an explosion. The dry refiner needs to run at full capacity to enable sufficient surface to be generated when making thinner boards.

- Flaker mill optimisation; currently the interval between knife changes is too great resulting in the production of poor quality flake. Flake analysis ex the flakers needs to be undertaken to optimise when the knives need changing. This needs to be done straight after a knife change, then at 3, 6, & 9hrs after the knife change. At least 6 samples are needed.

- Improve surface quality of board; there is too much dust and glue spots. This will be rectified when the correct surface screens are put in the PAL flake classification system (0.4mm)

- Sub-optimal screen configuration in PAL flake classification system. The screens configuration at present is producing too much fine material in the core flake and too much dust in the surface flake. The fine material in the core needs to be redirected to the surface and the dust in the surface needs to be removed for burning in the heat plant or disposal by sale. See Table III for current and recommended screen configurations.

- Improve board physical properties; MOR is too low and IB's are unnecessarily high due to the higher than necessary resin loadings to improve MOR. This is primarily due to flake quality and poor blending efficiency however following blender horn optimisation that will be detailed below, there was a significant improvement in MOR's due to better blending efficiency.

2. Major priorities of this visit

- Optimising blender performance, with correct horn & paddle settings and use of outfeed flaps to improve dust & glue spots and properties. This is the subject of a separate operating procedure sent to Green River Panels previously.

- Flake quality improvement to optimise the PAL flake classification screens as is detailed in Table III below to reduce the amount of dust and grit in the surface and to re-balance the core to surface ratio by removing finer material from the core and directing it to the surface enabling the reduction of dust from the surface. This will improve bending strength properties such as MOR and reduce dust and glue spots and will lead to reduced resin loadings in both the surface and core.

- Implement effective QA measurement systems to ensure production personnel get the required information to optimally run the plant. This includes regular flake measurements from the screens and from the flakers. Gel tests of resin at core blender must be done to adjust hardener levels. Stop conducting unnecessary tests such as testing raw resin and rely on the data supplied by the resin manufacturers. There is also no need to measure MOE as MOR is the really important measure. Surface soundness testing needs to be implemented as a measure of how well surface is glued. This is very important once board is laminated and is a very good measure of how surface blender is performing. In addition plotting data is best way to present all results and is the easiest understood

- Improve flaker setups, based on when it is necessary to change knives based on testing flake quality from the flakers.

- Make recommendations to improve quality of logs to chipper, by implementing a minimum top end diameter of 5cm and ensuring all branches are trimmed flush with the log. All branch stubs should be less than 5cm. This will ensure fewer blockages in the chipper infeed conveyor as well as eliminating torn conveyor belts..

- To set up standard operating procedures based on:what is required by Production, this is now being undertaken by Mr Prabas. A list of priorities set out in Table IV. Set up a template for documented work instructions that: are simple to understand and can be used as training documents and can be developed into ISO 9001 system resulting in everybody operating to standard systems

3. Major results of the visit

3.1. Blending efficiency

The following major problems with the blenders were identified:

- Insufficient chilling capacity resulting in resin curing at the tips of the horns resulting in increased motor current and very poor blending.
- No setups for the blenders were provided for by the manufacturers. This resulted in;
- Incorrect setups with horn angles resulting in very poor blending efficiency leading to low MOR's and a high frequency of dust and glue spots.
- Outfeed flaps were stuck in position providing no control for flake retention.
- Injection nozzles were incorrectly set up and some were not even operational

What was achieved in terms of optimal horn and paddle positioning resulted in a reduction of dust and glue spots in the surface blender and improved bending strength as a result of optimisation of the core blender refer to Figure 1. It is important to commission the automatic control for the outfeed flaps which is especially important when the amount of flake that is blended is very low, however most of the effort of blending takes place in the injection and mixing zones as per Figure 1. If the motor current is too high or too low then the only horns to be adjusted are those in the mixing zone i.e. if current is too low then the angle of only one row of horns is to be zero and if the motor current is too high then the angle of only one row of horns is to be changed to plus five degrees.

River Panels/Green River Images/Surfblender.eps

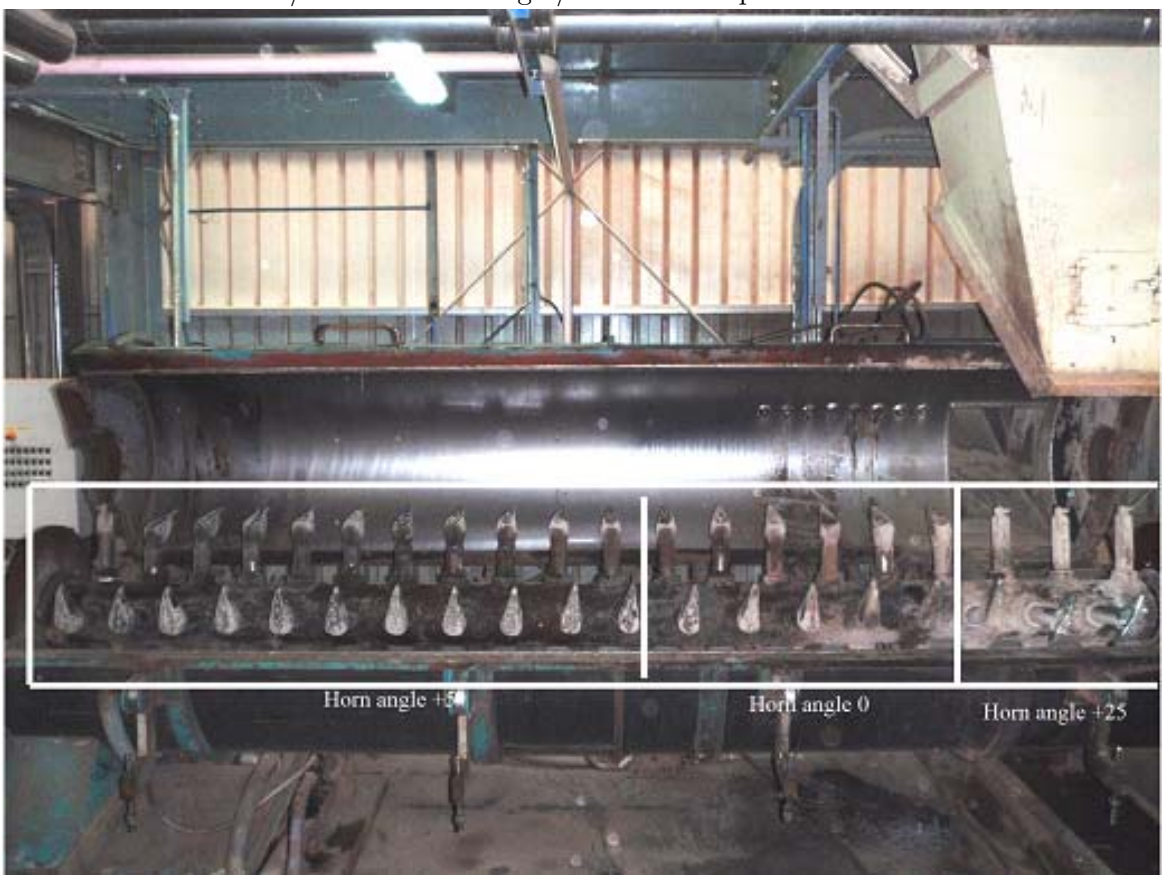

Figure 1. Horn angle positions for both blenders

3.2. Visual grading standards

The original grading standards are set out in Table I. These standards were much tighter than those in use in Australia and New Zealand which are perfectly adequate for the production of laminated panels using particleboard so the standards proposed here will therefore also be suitable for the production of low pressure melamine panels or other laminating with foils or veneers etc.even thought they are still considerably tighter than those in Australia and New Zealand.

Table I. New grading standards

Item	Original standard	New standard A grade	New standard B grade
Glue spots	<=2mm <=3 per panel	<=10mm <=4 per panel QC little finger	Allowable if smooth
Dust spots	<=2mm <=3 per panel	<=25mm <= per panel QC thumb	Allowable if smooth
Big chip	None	None	Up to 15mm
Warp	No standard	1.5mm/m	1.5mm/m

3.3. Flake classification

There is currently too much dust (and I have no doubt grit) in the surface flake which is causing dust and glue spots as well as too much fine material in the core flake that should be in the surface flake. Table III sets out my recommendations as to how to configure the PAL screens to optimise the flake quality for the blenders. Table II shows the existing screen configurations. It will be important that I am on site to optimise the screens which will have to be done during the production of thick boards as it may be necessary to make minor changes to the screen configuration during production to achieve full flake optimisation. Flake from the flakers must be tested 0, 3, 6 & 9 hours after knife changing to enable optimum knife changing regime to be implemented. The amount of fine material <1.0mm is the key variable to be checked.

Table II. Existing Screen configurations for the PAL flake screening system

Deck	Screen 1 (mm)	Screen 2 (mm)
Oversize	4 of 3x40 & 4 of 10.5x10.5	All 3x40
Core accepts	All 0.7x2.1	All 0.7x2.1
Surface accepts	8 of 0.237 & 8 of 0.192	6 of 0.237 & 8 of 0.192 & 2 of 0.11

Table III. Recommended Screen configurations for the PAL flake screening system

Deck	**Both Screens (mm)**	**Comments**
Oversize	8 of 3x40	Remove all square screens
Core accepts	2.1, 1.5 & 1.3	To be optimised by Dr Ray
Surface accepts	all 0.4	This will remove dust and grit

3.4. Setting up standard operating instructions

Detailed work instructions are to be written according to Table IV by Mr Prabas. It is essential that this is achieved in order that all production personnel are operating to a standard set of instructions, and have a documented system to use during training. Should the company wish to pursue ISO 9001 certification (for which I am a fully qualified external auditor from P. E. Batalas in London) a fully documented system is fundamental. The QA department must be responsible for the maintenance of the documented system and must communicate with production during the writing up of Work Instructions.

River Panels/Green River Images/sop.eps

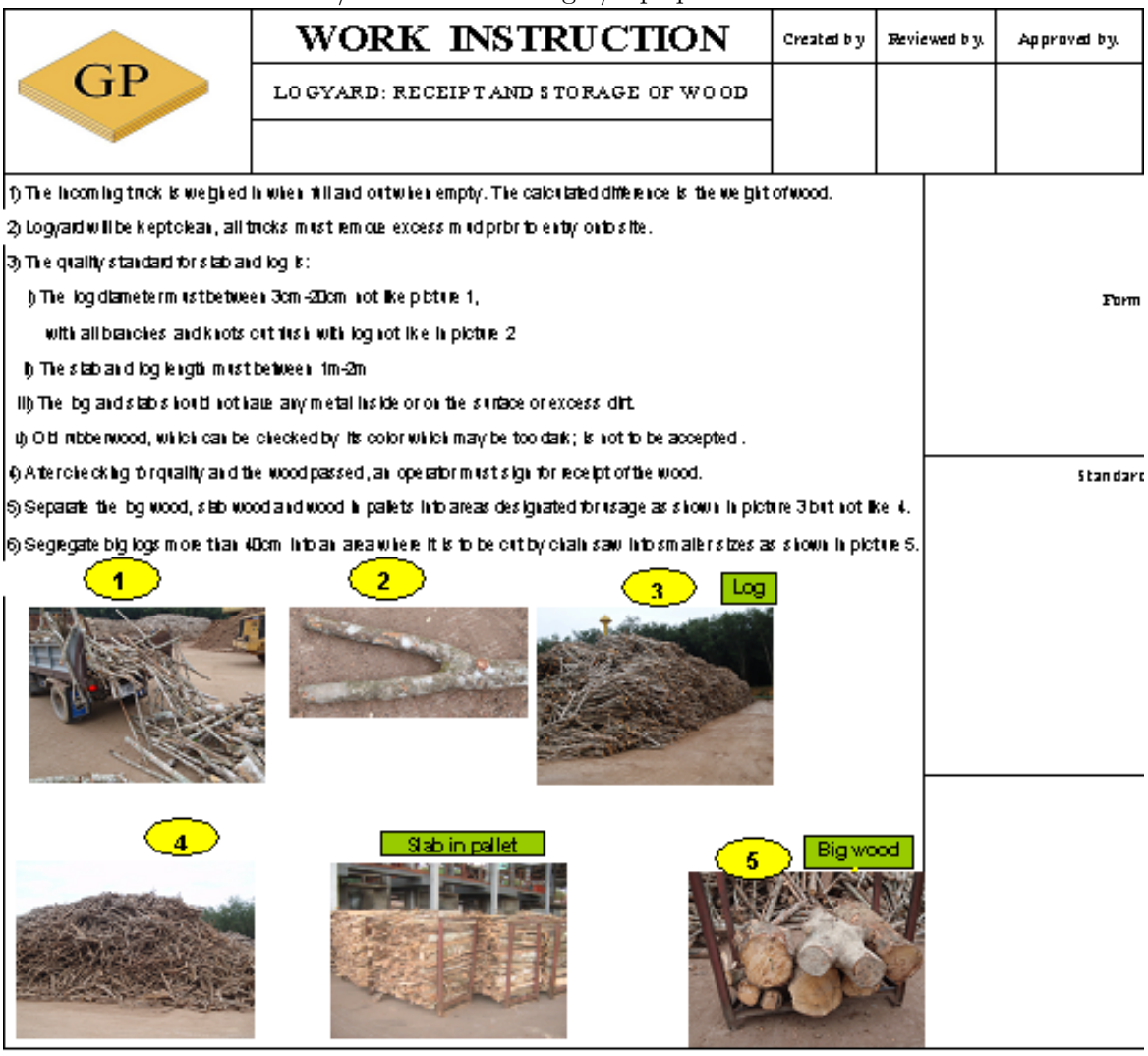

Figure 2. An example of a modified sop that can be used as a template for future sop's.

Table IV. Priority listing of work instructions

Section	**Work Instruction**	**Relation to existing documents**
Logyard	Logyard maintenance and stock control	Combine Logyard & Logyard 2
Logyard	Chipper operation	Combine chipper WI 1,2,4 & 3
Logyard	Changing chipper knives	Combine Chip 1 & Chip 2
Production	Flake preparation	Combine F1 to F4
Production	Removal and replacement of knife ring	Combine flaker 1 & flaker 2
Production	Removal and replacement of knives	Combine flaker install & flaker install 2 and knife jig
Production	Sharpening of flaker knives	Grinding knife
Production	Drier operations	WI Energy plant.old
Production	Determination of flake moisture content Includes charting of data	None existing
Production	Hardener and Urea preparation	None existing
Production	Resin recipes	None existing
Production	Gel time of blender resin	None existing
Production	Calibration of flow meters	None existing
Production	Calibration of weight belts	None existing
Production	Forming station box checks	None existing
Production	Blender setups	As per Dr Ray's examples
Production	Setups for each thickness	None existing
Production	Regular inspection/cleaning of forming line	None existing

3.5. Measurement systems and the role of the QA department

It must be appreciated that the role of the QA department is to supply production with the information required to run the plant. It serves no other function and should be responsible to the plant manager. Any testing that is not useful for production should be discontinued immediately. In this class I include the too frequent testing of raw resins from the suppliers. This should be done on an infrequent basis and only to verify the supplier's data which should be used. I will assist the company to set up meaningful specification limits for resins on my next visit. The testing of MOE is not required as MOR is the most widely used and useful test. The testing of surface soundness needs to be instituted immediately as this tests how effectively the surface is bonded and also tests the amount of precure that exists after sanding. This is an essential test if the board is going to be used for laminating as it determines whether there is any soft surface that could lead to machinability problems after laminating. Other tests that should be included are grit tests using a laboratory furnace such as the one shown in Figure 3 to determine the level of grit in the surface which is the largest cause of machinability problems in particleboard. The level should be below 0.1% and in fact even better below 0.05%.

Another fundamentally important test is to scan the through-panel density of the panel using an x-ray tube based density profiler as shown in Figure 4. This is an extremely important test and is used to ensure that there is no precure on the sanded board as well as testing the integrity and density of the core of the panel. It produces an output as shown in Figure 5. It automatically calculates core and surface densities, automatically calibrates itself, measures thickness of the sample, and only takes one minute per sample which is very fast and multiple samples can also be run. The output is in text file format which can be used by other programs. It is a self contained package that plugs into a Windows based computer with a serial interface.I have identified a source of the equipment and should have a quote by the time I return to Green River Panels. I have commissioned similar equipment in Australia and can attest to the quality of the equipment and it's importance to the particleboard operation.

It is also important that the QA Manager becomes a very visual presence in the control room and to be of assistance if needed. This is a support role and must continuously demonstrate the need for such a position by being supportive and useful to Production.

River Panels/Green River Images/furnace.eps

Figure 3. A laboratory furnace used to determine the amount of grit in surface flake

River Panels/Green River Images/Proscan.eps

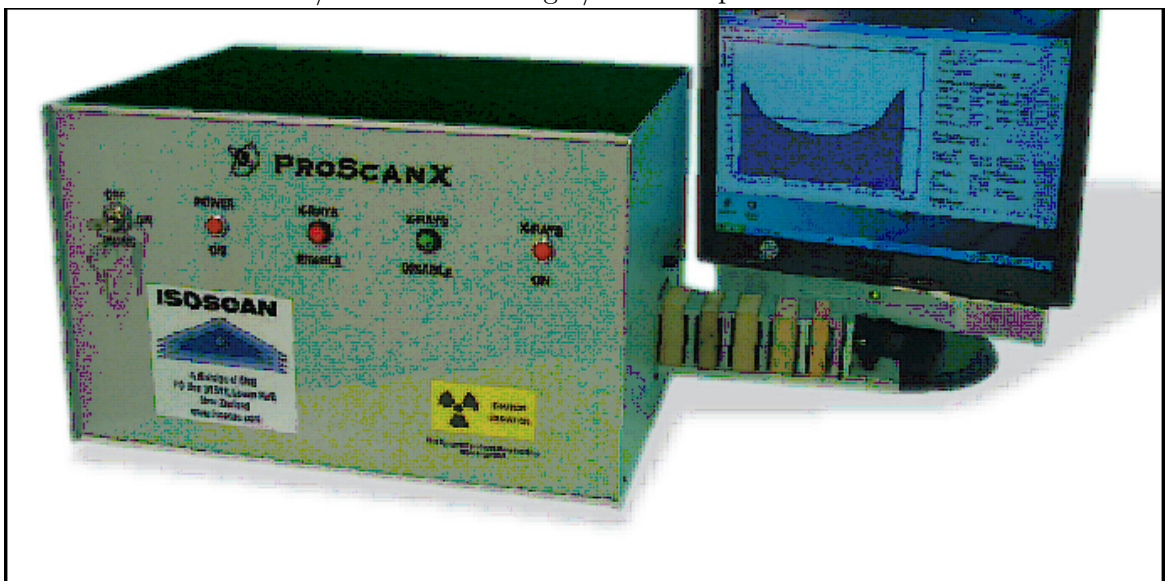

Figure 4. An X-ray sourced density scanner used to determine through panel density

River Panels/Green River Images/output.eps

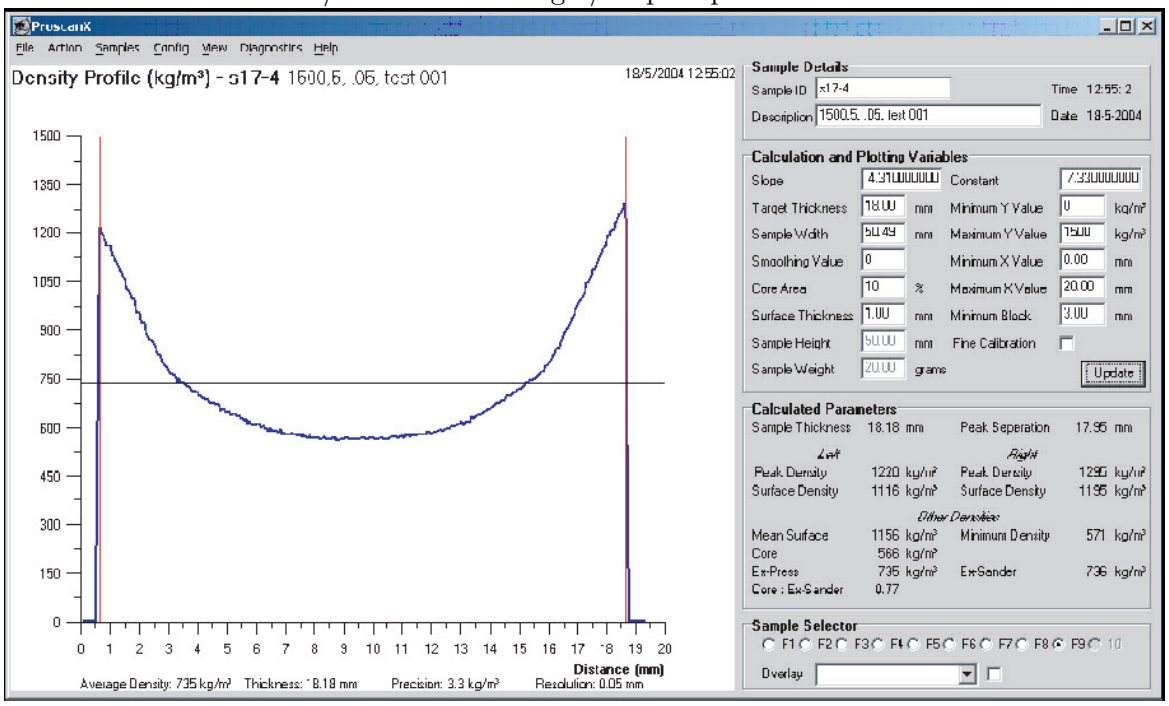

Figure 5. A density scan produced using a density scanner

3.6. Operating limits

It is essential that operators are given limits within which they can change the process. Any changes outside these limits must be authorised by a more senior person such as production manager or plant manager. It must be noted that the QA manager should have no authority to approve changes to operating conditions.

Figure 6 shows operators and supervisors limits at a large particleboard plant in Australia. The implementation of such limits is very important because variation between operators is a significant cause of operational and quality problems at all panels plants (in fact any manufacturing operation) that does not specify correct limits.

River Panels/Green River Images/limits.eps

Item	T2 Operator's Limits	T2 Production Supervisor's Limits
Board Weight	Run to Set up target	Run to Set up target
Ex- Press Thickness	± 0.3 mm	± 0.5mm
Density	Refer to QP1QA00001	Refer to QP1QA00001
Flake Ratios	Run to Set up ratio	Run to Set up ratio
Flow Meter Zeroes Resin A Ratio Other Ratios Moisture Hardener Mix	Run to = 1% Run to Set up ratio Run to Set up ratio Run to Set up ratio Refer to QW1PC04001	As for Operator Run to Set up ratio Run to Set up ratio Run to Set up ratio Refer to QW1PC04001
Core Gel Time	± 5 secs	± 20 secs
Press Timers Press Pressures Press Temperature Stops Time Cycle Time	Run to Set up targets ± 20 Bar Run to set up target As per setup	Run to Set up targets + 50 Bar Run to Set up target ± 8 secs As Thermocouple indicates

Figure 6. Limits of operators and supervisors at a large Australian particleboard plant.

3.7. Projects to be completed by the end of the next and future visits

- There is a need to improve the performance of the ID fan on the outfeed of the dry refiner to increase it's capacity to the design capacity of 7 tonnes per hour up from the current 3 tonnes per hour. This is also important to reduce operating temperatures in the refiner by more effectively clearing material through the outfeed. The dry refiner is the biggest source of fire and explosion in particleboard plants, so this is fundamentally important to be done as soon as possible.
- Redesign blender horns to improve cooling of the tips of the horns.
- Chipper infeed chutes to be redesigned to reduce snagging of smaller logs.

- Blender nozzles need to be optimised.
- Log quality standards must be instituted, minimum small diameter 5cm to stop tangling and damage to infeed conveyor belts and branches must be completely removed with knots flush with log.
- Optimise PAL screens as described above
- Investigate optimisation of the size of master panels.
- Institute butt to butt ribbon sanding of boards to improve productivity
- Measure the amount of board removed at each sanding head to enable even spreading of surface material.
- Optimise saw infeed systems as described above.
- Optimise saw outfeed bins
- Need to institute check grading of B grade packs by production personnel
- Need to improve log infeed dirt removal
- Need to simplify information systems to and from QA & production
- Need to introduce in-line mixers for blenders, especially important with E1 and E0 resins
- Institute box checks to ensure correct formation at the spreaders
- Improve chipper utilization through better log infeed system