Report on visit to Benalla, July 2007

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Abstract.

This is a report on a visit to the Benalla facility of D & R Henderson Pty. Ltd. The visit was to analyse laminating performance however mention was made of the serious machinability issues being encountered with laminated particleboard from the factory. There are serious quality deficiencies in the quality of the paper being received from Windsor which would be affecting fully absorbed costs of the factory. The quality of the paper from Windsor does not match either imported paper or paper sourced from another Australian manufacturer.

1. Treated paper issues

The laminating operation at the Benalla plant of D & R Henderson is based around a high performance Dieffenbacher 16 x 6 foot press capable of very fast press cycles with time to full pressure being <1s. With treated paper sourced from CHH Mt Gambier (75gsm) and Vasatech SDN BHD Malaysia (77gsm), the press achieved heat cycles as fast as 13s at 215°C with no porosity, with paper related defects being 0.8%. In fact 6 month old paper from CHH Mt Gambier was pressed at 15s heat cycle time again with no porosity with the author in attendance whereas fresh paper from Windsor pressed on the same board had serious porosity issues.

Current paper used which is sourced from D & R Henderson's Windsor facility, regularly results in high levels of porosity which requires extended cycle times on average 20 - 23s, and on occasions exceeding 30s. These combined with reduced temperatures and pressures are required to achieve acceptable levels of recovery yet defects still can exceed 5%, ten times that of the imported paper. Porosity appears greatest in the middle of the board due to excessive resin coatweights in the centre of the paper caused by the four foot mark from the treating rollers. This also causes boards sticking to the top platen unless cycle times are significantly extended.

Extending press cycles is a very costly 'solution' and it seems counter intuitive to have the performance of a $7 million laminating press which would be one of the most capapble in Australia being dictated to by the very poor quality of treated paper from a paper treater that would be worth at best 10% of the value of the Benalla press. The porosity is caused by migration of MF resin into the insufficiently cured core of the paper during pressing. The Windsor 'solution' is based on slowing

the curing down at lower temperatures and pressures and extended cycles to attempt to get the resin to flow laterally to fill up the voids prior to resin cure. The correct solution is what has been achieved by the author elsewhere where full saturation of the first stage UF resin has been achieved minimising the MF resin coat resulting in much faster cycle times and no porosity. The author has researched the issue of paper treating including solving porosity in great detail [1] & [2]. The correct way to run such a high speed press is to run at as high a temperature as possible, which is 5°C below the point at which precure occurs. With the right kind of paper with a high speed press this can considerable exceed 200°C. Specific pressures must also be kept at a maximum.

Trials should be done on Windsor paper to see how fast it runs to determine the variability of performance of the paper. It is also recommended that paper by sourced from CHH and Vasatech to determine how much the overall cycle times could be reduced.

1.1. Packaging of treated paper from Windsor

The presentation of the treated pallets of paper from Windsor is significantly worse than that of the Malaysian or CHH paper when delivered and significantly worse than other pallets of treated paper seen by the author. There are significant amounts of curling on the edges of the paper as well as on the ends. This creates major problems during paper lay-up as the paper folds against the curl, creases, then cracks and more often than not tears leaving large areas of cracked or missing paper and paper chips. Curling of the paper also increases the difficulty of correctly aligning the paper on lay-up and can lead to greater instances of missing paper.

The actual stacking of the paper is also very poor, with stacking variation in the cross direction being up to 20mm and in the machine direction being over 25mm. Given current overtrim is 12mm, significant amounts of missing paper lay-up occurs. There is no reason why edges of pallets of treated paper should not be absolutely square which is in fact the industry standard and is exactly how the CHH Mt Gambier and Vasatech paper was delivered. Other faults seen in the pallets from Windsor are creases in the pallets which can result in cracks and paper chips during lay-up. Poor paper stacking also means that the overtrim must take stacking variation into account. The press is capable of laying up to <5mm i.e. overtrim should be no more than 5mm. However this would only be successful with stacking to the equivalent of Malaysian paper, which appears way beyond the capacity of the Windsor operation. Poor stacking also increases the chances of paper chips being laid

up in the press. It is recommended that Windsor use heavy duty angle brackets that have heavy duty cable grounded to the machine to get rid of static. This will enhance stacking.

It was also noted that the length of the treated paper sheets varied by as much as 75mm in pallet no. 090701, while not being typical certainly indicates problems with the guillotine.

1.2. Resin coat weight

The resin weight noted on the treated paper summaries that accompany the pallets show around 60gsm. Yet on measuring the total paper plus resin weight can be up to 200gsm. Given the paper weight is 75gsm, the added resin weight is in fact 125 gsm. I am assuming that the figure of 60gsm resin addition is MF only however I would be very interested to see how this is an actual figure calculated for each pallet as one would have to know the amount of UF added in the fist stage and without breaking the web, this is impossible to determine and there is no way that the web would be broken for each pallet of paper. Given equivalent papers have coatweights between 90 & 95gsm, there is a real potential to cut down on the use of resin and in so doing reduce press cycle times.

A detailed examination of coat weight variation was made with two pallets of paper. Fifty-four samples were obtained six were obtained cross direction (CD) and nine were obtained machine direction (MD).

Pallet 70702 had an average weight of 208.4gsm whereas the pallet 90702 had an average weight of 196.6gsm i.e. over 12gsm difference. This suggests that these two pallet would not have performed the same way on the press with the former requiring more curing time.

Looking at variation within each pallet:

Pallet 70702 had the following significant *($p < 0.001$)* cross direction coat weight variation (measured in gsm):

1	2	3	4	5	6
206.1	206.8	210.8	216.3	210.8	199.5

The lowest coat weight measured in this pallet was 198.2gsm and the highest was 218.5gsm i.e. *over 20gsm difference in resin loading in one sheet of treated paper.*

Pallet 70702 had no significant machine direction coat weight variation

Pallet 90702 had the following significant *($p < 0.001$)* cross direction coat weight variation (measured in gsm):

1	2	3	4	5	6
190.8	194.1	202.4	203.2	199.6	189.8

There was no significant coat weight variation in the machine direction.

The lowest coat weight measured in this pallet was 185.6gsm and the highest was 213.4gsm i.e. *nearly 30gsm difference in resin loading in one sheet of treated paper*. This is totally unacceptable and if the treater was producing ten million square metres of paper per year and the average variation in coat weight was 20gsm this equates to an overuse of over 150 tonnes of MF resin per year. At an estimated cost of $1,000 per wet tonne the total additional cost of this is over *$100,000 per year*.

Note that there was significantly more resin in the middle of the sheets of treated paper no doubt caused by treating four foot and six foot paper. However the application rollers on the treater need replacing now along with new bearings and bearing blocks and should have been replaced much earlier. This excessive resin coat in the middle of the paper would also mean that this paper would have to be cured longer otherwise the board sticks to the top caul plate in the centre of the board which happens frequently on what would be considered reasonable heat cycles of <25s. Roller tolerances on treaters must be measured in tolerances of microns as eccentricity or variations in diameter of one micron result in a 1gsm coat weight variation in resin application.

A treater that the author has worked upon has the following cross direction coat weight variation on 75gsm paper. Note the comparisons of coat weights with the Windsor paper. A 5gsm variation across the panel should be expected.

1	2	3	4	5	6
172.1	169.2	168.2	168.3	168.5	169.2

Two months later the results were:

1	2	3	4	5	6
170.5	170.0	169.75	168.75	169.38	169.62

The absolute difference in coatweight in a 16 x 6 foot sheet of paper from this treater was 9 gsm which is one-third of that from Windsor. This will result in papers that press considerably faster and cost considerably less. The average coatweight is nearly 30gsm lighter than that of Windsor at that is entirely saved on applied resin. A resin saving of this magnitude is over $250,000 per annum. On this basis alone and the fact that the imported paper is not much more expensive than the Windsor paper albeit with a full 3% saving on defects, it begs the question why continue to buy treated paper from Windsor.

1.3. B stage cure

B stage cure measures were regularly taken at Benalla however the results were very high, about 90%, yet the paper did not feel that dry. Benalla use clips attached to the samples of paper being analysed to stop the samples sticking in the oven and include the weights of these when measuring and calculating coat weights. It was demonstrated to the Quality Officer that the differences are relative and if the weights of the clips are not taken from the paper weights, then the B stage cure measure is *overstated* by over 15%. It should be checked whether Windsor do the same thing. For the Dieffenbacher laminating press to work to it's full capacity, it is essential that the actual B stage cure of the paper be over 75 - 80%. This will result in faster press cycles but also will significantly reduce blocking. However it is imperative to ensure that there is adequate impregnation of the UF resin in the first stage [2].

2. Laminating

The performance of this laminating press is absolutely dominated by the quality of the treated paper. However there are a number of issues that could significantly improve the operation and reduce defects. It was noted that when the lay-up arm drags the paper from the pallet it creates a sharp angle on the paper which if significantly curled on the end which is often the case, the paper cracks and as it is drawn across the mesh to the centre line either below or on top of the board, it rips. This could be eliminated if the top of the paper pallet was raised so it is above the infeed line so that the paper can be picked and dragged without excessive bending and cracking. This would effectively reduce the amount of lift of the paper by the paper arm. This would involve repositioning of proximity switches at no cost. In addition if the separating air nozzles were aligned such that the air was blown parallel

to the paper rather than at an upward angle of over 30° i.e. blowing directly onto the paper causing it to flex this would also reduce paper cracking during lay-up. Overall the paper layup facility is superb.

The pressing operation is superb and given the correct paper quality it could be operated with much faster press cycles given it has high specific pressures and very fast closing speeds and high platen temperatures which should be run 5°C below the point at which pre-cure occurs as well as. This will achieve very fast cycle times however will also expose poor quality treated paper. Paper with significant levels of porosity caused by the migration of MF resin into the core of the paper ([2] will need to be pressed at much lower temperatures with reduced press temperatures to enable the MF resin to plasticize and fill up the voids. This could increase cycle times by up to 20 seconds and will not fully alleviate the problem as was seen by the author with the one pallet of paper (070702) originally being pressed at 22s being extended by 5 second increments to 40s and still not eliminating the porosity. One cannot and should not operate such a press in this manner. Another pallet 070703 produced adequate results at 25s, so the cycle was reduced to 20s with poor results, increased to 22s again with poor results. The original cycle time of 25s was then run again with poor results i.e. in the space of 15 minutes the quality of the paper varied such that it could not run on the original cycle time. The variability between paper pallets is unacceptable however such variability within a pallet is untenable.

Once the paper quality issue is fixed there are however a number of ways to further improve the performance of the press. The press has the capacity to achieve heat cycles of <12s however there are two main issues regarding the outfeed that could be limiting factors. Firstly when the press is producing two eight foot boards, the grading operator grades each one separately whereas when a sixteen foot board is produced, they grade this as one board. Therefore it should be encouraged to grade the two eight foot boards at the same time. This would require some rearrangement of the outfeed bins but could be achieved as follows, where A is A grade board, B is B grade, C is C grade and CB is coverboard:

Bin no.	1	2	*Centreline*	3	4	5
Outfeed side	*C*	*A*	*Centreline*	*A*	*B*	*A*
Press side	*CB*	*A*	*Centreline*	*A*	*Spare*	*A*

The other issue is the speed of the paper trimmers. When two eight foot boards are produced, the trimmer cuts in one direction only, returns to the idle position then trims the second board. It should be possible to trim going both ways i.e. at present when the trimmer returns to the idle position, it lifts up to get the knives away from the board. Therefore another set of knives could be attached and the trimmer lifted enough to activate this new set of knives and trim on the return stroke. This would save seconds per cycle and enable much faster overall cycle times to be achieved, and with a press such as the Dieffenbacher that could reduce the hours run.

2.1. Defects

Current defects are running at 3.83% due to paper related faults where the paper originates from Windsor and substrate faults are 3.27%. As stated above the Malaysian paper related defects were 0.8%. Any decent paper should give paper related defects <1.0%. This is the industry norm. Anything more than this is unacceptable. Given the fact the difference in price between the imported Malaysian paper and the Windsor paper is only about $\$0.05/m^2$ the reduction in defects that would result from using imported paper would many times offset the higher cost of the treated paper.

2.2. Recommended testing regime

- Porosity checks should be done on every ten packs and every time the cycle changes.
- Steam resistance tests should be carried out once per day.
- Acid cure tests should be done on the same frequency as Steam resistance.
- Pressing parameters should be correlated to treated paper pallets.
- Full coat weight variation studies should be done at least once per two weeks.
- B stage cure tests should be done on each pallet of treated paper.
- The 'Roberts' flexibility test should be carried out on each pallet of paper.

2.3. Pallet presentation measures

- Adequacy of the packaging and any obvious damage should be noted on each pallet.

- After removing packaging, the height of the pallet should be measured on each corner and in the middle of every side.
- After removing packaging a estimation of the number of free paper chips should be made.
- An indication of the blockiness or freeness should be obtained by flicking the pallet akin to flicking through a book.
- Measure number of major creases (if any) along each side.
- Stacking variation should be measured MD and CD.

2.4. Operational measures

It is recommended that paper related defects be fully categorised into the following;

- Torn paper lay-up
- Missing paper
- Pressed paper chips
- Double paper lay-up
- Cracked paper

2.5. Key treatment parameters

The key treatment parameters are solids content of the 1st stage UF resin, volatiles ex the first stage, accurate coat-weights of both UF and MF resin, oven profiles in the 2nd stage including fan speeds, cooling roll temperature. These are only a guide and the author would have to do a detailed study on the Windsor treater to fully evaluate the operation.

3. Machinability of Particleboard

It was stated that machinability of particleboard is a similarly serious issue to the company as is the performance of the laminating press. The author has considerable experience in solving machinability issues, and has recently completed a very successful project in Gympie. The author would be willing to assist the company on this issue as well.

4. Conclusion

I recommend that an extended trial of imported paper be run at Benalla in order to optimise the performance of the LPM press and to reduce defects by >3%. In the meanwhile it is recommended that the treating operation at Windsor be looked at in order to improve the performance of the product and to significantly reduce costs. Unless the paper from Windsor can match the imported paper or other paper that has been used, I recommend it no longer be sourced.

References

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