

Development of Mechanisms for Removing Excess Laminated Paper

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Abstract - This paper presents an overview of the new cost-effective edge trimming processes which were developed in spacewood furnishers and other existing edge trimming processes which are widely used on short cycle lamination press (pre-lamination press). The development and implementation of new edge trimming methods for removing excess paper are expected to result in significant cost saving, improved product quality, reduction in scratches and time saving.

Index terms - MDF Board, melamine impregnated paper, short cycle laminating line, short cycle lamination press machine, trimming.

I. INTRODUCTION

The short cycle laminating line is mainly used for laminating melamine paper on core board such as MDF or Particle Board to make modern decorative furniture board.

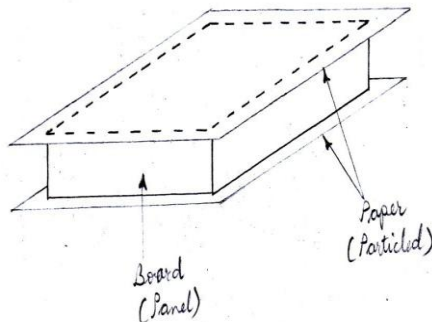


Figure 1. Paper laminated on board

The working principle of short cycle hot press machine is to supply heat and pressure to the stainless steel plate which heats the surface of melamine paper and melt the melamine, become solid with certain texture by the stainless steel plate, leaving a required laminated surface on board. The interaction of wood with melamine during hot pressing is required for the development of bonding strength between melamine paper and board [4].

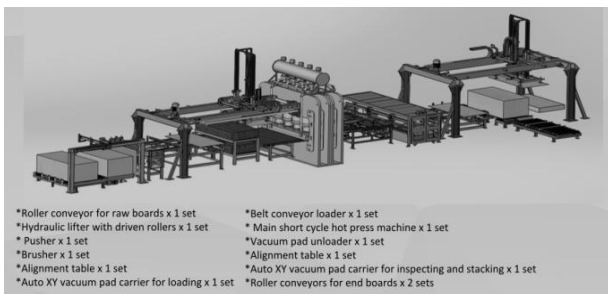


Figure 2. Short cycle laminating line

II. WOODEN BOARDS (USED IN SCL)

Board materials such as MDF and particleboard are made from pieces of wood compressed together at high pressure. Water-repellent sheets are also made for use in place where humidity may be high.

• Particle Board

The board is composed of small wooden fibers. It has no ornamental quality, so is covered. There are various thicknesses of board. Uses include: floor sheathing, furniture making.

• Medium Density Fiberboard (MDF)

It is greatly versatile, contained outstandingly pressed wooden strands stuck together. This strategy for assembling implies that cut edges are neater than those on different materials. It can give an unbending auxiliary part, or can be complicatedly molded to frame a beautiful surface prepared for paint. It is accessible in different thicknesses. Fundamental disadvantage is that it radiates a fine clean when cut, which must not be breathed in. Wear a cover when MDF is being cut. Uses include: Cabinets, bureau entryways, enclosing, racking.

Dampness safe MDF is a form of MDF that can oppose moisture. It is frequently green. Uses include: Areas inclined to dampness: e.g., kitchen or washroom.

• Fiber Board

It is a lightweight variant of MDF. The joints between sheets can be taped and the sheets painted. Uses include: Underlay for ground surface, or as another option to drywall on a roof.

• Moisture-repellent particleboard

It is more water-repellent than typical particle board. It is frequently shaded green. Uses include: Flooring.

Particleboards are produced using little particles of wood (sawdust) while MDF (Medium thickness fiber

board) is produced using wood strands. MDF is a more grounded and furthermore a costlier material when contrasted with particleboards.

III. EXISTING EDGE TRIMMING PROCESSES

The edge trimming process removes excess laminated melamine paper from the laminate edges and disposes the excess material. It is necessary to remove the excess edges of melamine paper, as melamine paper is abrasive that can produce scratches on other boards when it breaks into small particles.

ARRI (Automation & Robotics Research Institute at the University of Texas at Arlington) evaluated four edge-trimming methods for excess cover film on glass: spinning saw, laser, hot wire, and hot knife. These methods can be used for trimming the melamine paper laminated on board [1].

A. Spinning Saw Trimming

ARRI made a system of spinning saw trimming which consists of a motor with slitting saw blade fixed to a robot arm. For finding the glass edge, an optical sensor is used. It is mounted on the robot arm, below the saw blade.

ARRI considered offline sensing for finding the glass edge, out of offline sensing and online sensing as online sensing is complicated. In the offline sensing, edge sensing is done before edge trimming. The sensor moves with the help of a robotic arm across the glass edge from one end to other. The edge-trimming path is determined by sensor location. The off-line edge method of sensing was used to calculate the cutting path and to find the glass edge.

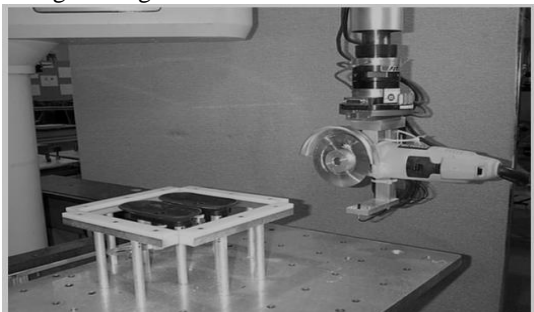


Figure 3. Spinning saw setup for module trimming [1]

b) Laser Trimming

In laser trimming, laser is used to trim the excess laminated paper. Fig. 4 shows a sample of ethylene vinyl acetate (EVA) trimmed sheet. The trimmed edges are slightly rough and have an acceptable appearance. Compared to a hot knife, the laser cutting system is approximately 100 times the cost.

But the disadvantage of laser trimming is that it damages the workpiece because of an edge sensing error resulting in positioning the laser beam.

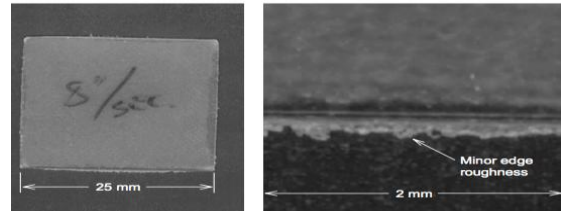


Figure 4. Top view of a sheet. The photo on right is a close up of the bottom edge of the sheet in the left photo [1]

c) Hot Wire Trimming

A hot wire trimming system is shown in Fig. 5. For trial, an optical edge sensor, a robotic arm, and module vacuum stage was used.

In the beginning of test, the hot wire could cut the edges properly. When the wire proceeds along the module edge, the material reduce the temperature of wire so the remaining wire overheats and the cutting action of wire is reduced. Due to this the wire begins to yield and then breaks. At lower speeds the cutting action of the hot wire is very effective. Larger wires are better than small wires to sustain greater resistance to yield. The larger diameter wire requires force to move the wire through the material. So it is not feasible and does not meet requirements.

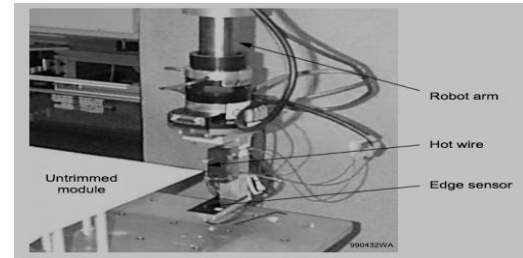


Figure 5. Hot wire setup for module trimming [1]

d) Hot Knife Trimming

A hot knife trimming system was designed and assembled at ARRI. For trial, an optical edge sensor, a robotic arm, and module vacuum stage was used.

In the trial, it was found that hot knife trimming was better than hot wire due to the higher thermal capacity of the graphite blade. At higher cutting speeds, the cut finish deteriorated because the hot knife power supply could not maintain the blade temperature.

To measure the blade temperature a thermocouple was used. The blade starts to deform at the temperatures above 450°C.

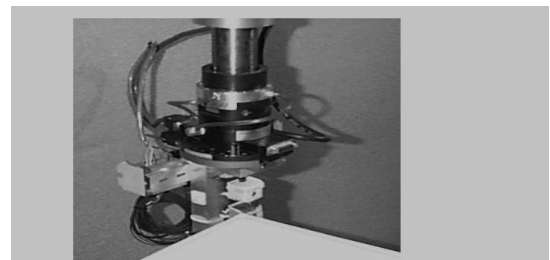


Fig 6. Hot knife setup with graphite blade and untrimmed module [1]

Due to low cost of this system and ability to produce good quality trimmed edges at speeds that meet the requirements, the hot knife was selected as the best method for the edge trimming process.

IV. REVIEW OF LITERATURE

Van Ho, Nicholas Maskal, and Andrew Rathod design an automatic wood trimming machine. In which the team of three engineering students designed and made an automated wooden plank edge trimming machine that includes anti-jamming and continuous loading characteristics [2].

S. N. Gandhare et al (2016) designed the multi sided 2R trimming mechanism to eliminate the manual trimming of banding strip of wooden panel [5].

Carmen Regalado, D. Earl Kline, Philip A. Araman, confer about physically operated edging and trimming framework utilized in factories don't reached the highest acquirable value from the board being handled, furthermore, that huge increments in esteem can be normal through enhancing hardwood edger and trimmer framework [6].

Vassil Jivkov, University of forestry Sofia, conferred about furniture joint, twisting quality, edge banding in wooden board making operation. To enhance the buckling quality under the compression test of end corner joint from 16-18 mm board [7].

Jingxin Wang, William A. Goff, Lawrence E. Osborn, Gregory W. Cook, enquire on two separate events to assess number edging, trimming and evaluating practice crosswise over West Virginia. Estimation for wind down, clear wood, and imperfections were gone up against 60 bits of timber before edging and trimming at each saw process [8].

Martin A. Hubbe, considers both well-built up and rising methodologies to change the furthest surfaces of cellulosic strands or films, regarding chemical composition as well as regarding results such as friction and adhesion [10].

V. NEW EDGE TRIMMER METHODS DEVELOPED

The above trimming methods are used for laminated glass trimming which can also be used for removing excess melamine paper which is laminated on wooden board. In order to reduce the cost of trimming equipment and time, the new edge trimming processes for melamine impregnated paper are developed. These are simple to use and manufacture.

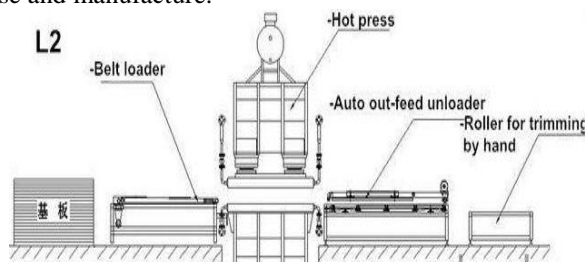


Figure 7. Block diagram of SCL press

The first mechanism consists of a long wooden board (panel) acting as a tool, a spring and 2 links as shown in Fig. 8. The longboard is fixed horizontally to the link2. The link1 and link2 are pivoted to each other. Link1 is mounted on the alignment table (unloader). The spring is fixed in between the two links. The function of the spring is to support the board and return the board to its initial position after removing the excess melamine impregnated paper. This mechanism is mounted on alignment table.

After pressing in SCL press, the melamine laminated board comes on alignment table to align itself. After aligning of board, the automatic vacuum pad carrier lifts the board from alignment table. This mechanism is fixed on alignment table around all four sides. When the board gets lifted, long wooden board removes the excess melamine paper from the board easily.

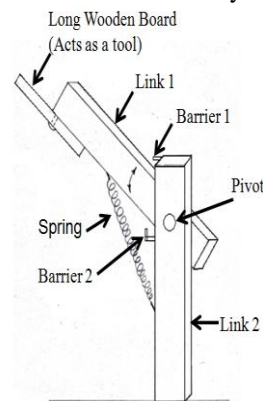


Figure 8. New developed mechanism (a)

Another solution for removing the excess melamine laminated paper is discussed below:

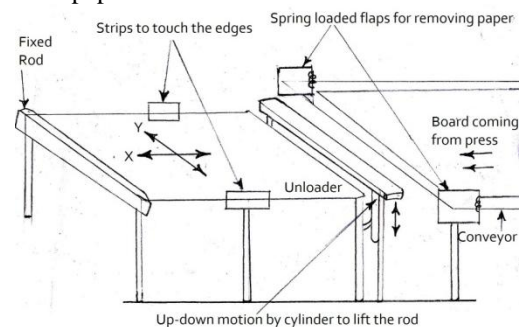


Figure 9. Another method of removing paper (b)

A mechanism has been made as shown in Fig. 9. When the melamine laminated board come out from short cycle lamination press through conveyor, the edges of board forces the spring loaded flaps to open with it resulting in removal of extra portion of paper from those 2 sides. When the board reaches the unloader through conveyor, it strikes the fixed metal rod (M.S.) attached at end which removes the paper from that side. Then the conveyor is reversed in X direction and at the same time the pneumatic cylinder lifts up the metal rod to which the board strikes and the paper gets removed from that side. In this way, the excess paper is removed from all 4 sides.

This mechanism doesn't require operators for its operation, as the program is directly fed to the machine and is automatic.

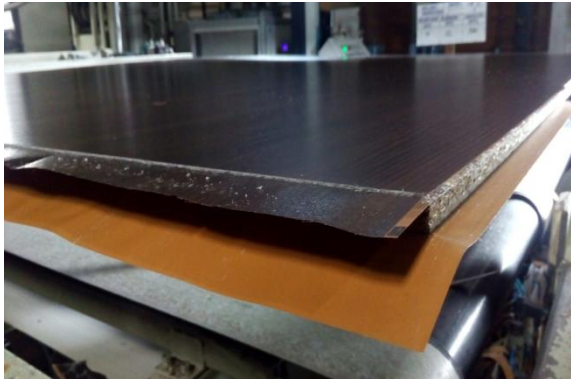


Figure 10. Melamine paper laminated on board

VI. CONCLUSION

Development in working system is most important in any case to reduce the system cost, reduce defects, increase production and save time. All the existing laminated glass trimming processes such as spinning saw, laser, hot wire and hot knife trimming are CNC based, requires power and operating codes. These processes can also be used for melamine impregnated paper trimming. Apart from these, two new excess paper edge removing methods are developed which gives the same results and reduce the cycle time.

These two mechanisms discussed above are only used for removing excess melamine impregnated paper effectively and are easy to implement and cost effective.

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