PROCESSING OF BOARD ELEMENTS FOR PRODUCTION OF FURNITURE BODIES ACCORDING TO IFS TECHNOLOGY

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Abstract

The presented study carried out an analysis of a novel IFS Folding System technology connected with the manufacture of bodies of cabinet furniture taking into consideration their different variants. Major phases of the process of the IFS technology were described and illustrated in a synthetic manner and ways of realisation of individual technological operations were presented together with the utilised machines and equipment. Situations constituting new approaches in technologies employed to make furniture elements were identified. The authors indicated a new technology of cutting board elements which utilised a processing centre employing a group of working assemblies where cutting was carried out with the assistance of shank cutters. The study is recapitulated with a description of the effects of the IFS technology.

Key words: *IMA Folding System technology, carcasses of cabinet furniture, chipboard, woodworking machine, tools*

At present, production of the furniture sector in wood industry is based on the processing of wood-derived articles, primarily wood-based materials, such as chipboards and MDF boards. Large quantities of consumed wood-based materials result mainly from traditional technologies of cabinet furniture production requiring considerable amounts of raw materials.

The IFS technology is based on a system of incisions and an elastic glue line connecting individual sections which, after assembling, constitute a furniture construction, for example, a construction of a cabinet furniture carcass. Thanks to variations in the thickness of fibreboard elements employed in the IFS technology and the novel form of the construction maintaining overall dimensions and reduced weight, it is possible to achieve reduction of traditional wood-based materials necessary to manufacture a given piece of furniture. Other advantages include: decreased quantities of wastes of wood-based materials requiring expensive utilisation, reduced costs and forms of transport of individual furniture parts, simple assembly and reduction of furniture hardware to the minimum. Another significant advantage of the discussed technology is associated with the guaranteed durability and life-span of the obtained constructions (especially with regard to furniture used in 'difficult environments', e.g. kitchen furniture).

The performed analysis of the durability of furniture constructions used in difficult environment conditions confirms advantages resulting from the application of the elastic glue bond linking individual furniture walls. The introduction of such glue line from plastic material restricts significantly the occurrence of zones of rapid deterioration of the construction condition. Furthermore, increased construction durability also results from the fact that the IFS technology eliminates traditional methods of connection of board elements. Figure 1 presents examples of wear of a piece of kitchen furniture of traditional construction.

Figure 1 Wear of a piece of kitchen furniture of traditional construction

The IMA Folding System technology can be realised either on traditional or special machines utilising appropriately selected tools associated with machining parameters and method of controlling. The technological process associated with the IFS technology involves mainly typical operations realised in the course of processing of furniture elements. Below, the authors performed the analysis of individual operations carried out within the framework of the IFS technology. It should be emphasised that at the moment several variants of this technology are being realised and tested. The current study focuses on some selected, in the authors' opinion, most interesting technological operations.

1. The cutting of board elements into panels (strips) of definite width corresponding to the width (height) of the article currently under construction. The operation can be realised on traditional panel sawing machines (Fig. 2) or other machines. The newest processing centre for the cutting of fibreboard elements is equipped in 4 – 5 working units operating using shank cutters of small diameter. The centre is further equipped in mobile work tables with special suction nozzles (holding board elements) controlled electromagnetically. During cutting, the board elements are situated directly on the centre table without a base board element (Fig. 3).

Figure 2 Cutting of board elements into strips on a panel sawing machine

a

b

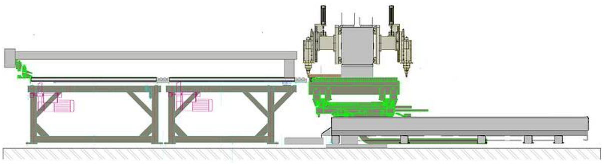
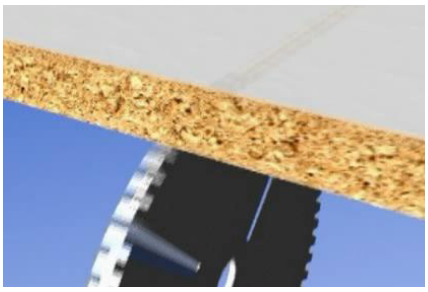


Figure 3 A modern centre for cutting board elements (Cutting-Centre IMA)
a – general view, b – schematic diagram

2. Formatting of the obtained strips into specific lengths resulting from the overall dimensions of the given piece of furniture under construction together with appropriate technological allowances. The operation can be performed during the phase of board formatting or at the workstation of the transverse cutting along the IFS technological line.
3. Milling of transverse grooves in the bottom part of the board panel (Fig. 4) at distances matching the modules, dimensions of individual segments of the part under construction. The operation can be carried out on the IFS technological line or, for example, in the processing centre equipped in appropriate control systems.

a b



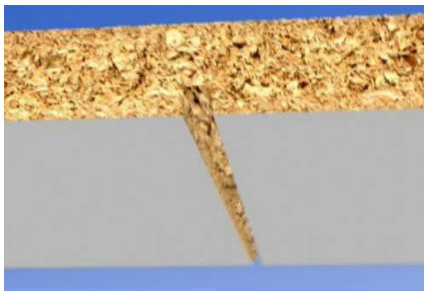


Figure 4 Milling of transverse grooves in the bottom part of the board panel
a – setting of the milling cutter during processing, b – finished groove

4. Hole drilling through boards from the top side of the panel at the height of the groove milled earlier – in the middle part of the groove length (Fig. 5). The hole allows the administration of glue to the area of the groove. The drilling operation – employing typical spiral bits equipped in a centring point and a spur as well as sintered carbide tips – can be carried out on the IFS technological line or in the processing centre utilising, e.g. the drilling option or milling with the head edge of the shank cutter.

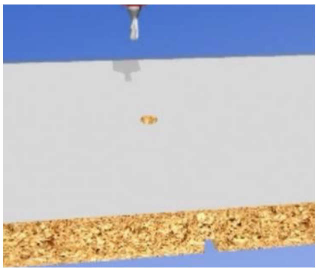


Figure 5 Drilling of the hole through the board panel allowing glue administration to the groove area

5. Application of the fast-hardening glue filling precisely the prepared groove. The glue administration (Fig. 6) takes place through a hole drilled earlier. This operation can be performed on a workstation prepared especially for this purpose or on the IFS technological line (Fig. 7). Figure 8 shows a finished panel with glued grooves placed with the glued area facing outside.

a b c

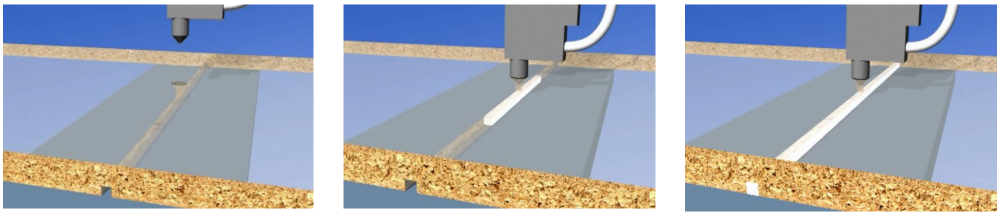


Figure 6 Process of glue administration into the groove area
a – before gluing, b – in the course of gluing, c – groove filled with glue

Figure 7 Workstation together with a device for glue application into groove area, on the IFS line; a – workstation with a divice for glue application, b – glue nozzle

a b

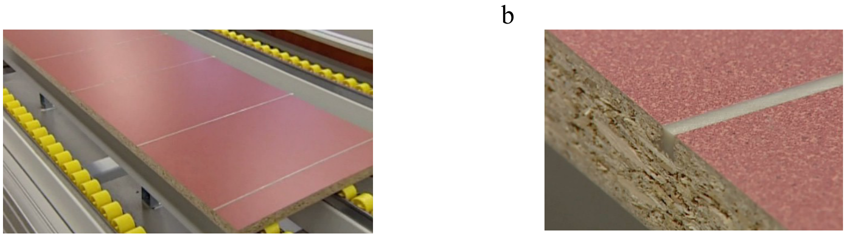


Figure 8 Panel with glued grooves; a – general view, b – single groove

6. Milling of a transverse V-shaped groove at the place of hardened glue line, on the side of the board with invisible glue bond (Fig. 9a). The depth of the performed groove leaves only a thin glue bond layer in the place of milling (Fig. 9b, c). The shape of the groove allows angle assembly of the board. The milling operation can be carried out on the IFS technological line or in the BIMA 410V processing centre (IMA Company) specially equipped and adjusted to the IFS technology. CNC control makes it possible to split the cycle of making the groove into stages which optimises the processing quality of external (veneered/finished) groove edges (Fig. 10a, b).

a b c

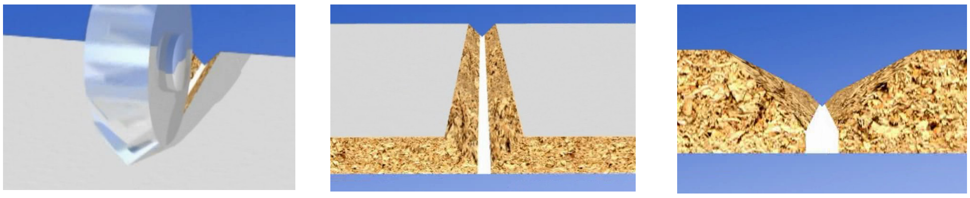


Figure 9 Milling of a transverse V-shaped groove
a – working situation, b – obtained groove, c - thin layer of glue bond at the place of milling

a b

Figure 10 Milling of a V-shaped groove in a processing centre
a – milling from one side, b – return milling

The initial groove milling and glue application can also take place in a different techno-logical variant in which the entire process is realised in the processing centre. In such IFS technological configuration, all initial operations are performed from the same side of the panel. First, using a milling cutter with a special profile, deep grooves are made practically speaking to the laminate boundary (Fig. 11). This is followed by the application of polyure-thane glue filling the bottom part of the groove. The centre is equipped in a special device for glue administration (Fig. 12). Next, narrow surfaces are veneered outside the processing centre but afterwards the element returns to the centre where grooves with hardened glue are milled (as shown on Fig. 10) to get the V shape (Fig. 13). After turning the board over, the laminate is cut along the length of grooves (Fig. 16) in order to allow the assembly of the construction.

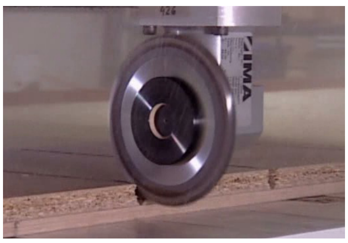


Figure 11 Execution of deep grooves

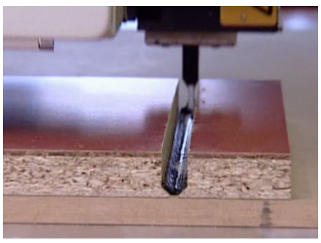


Fig 12 Application of glue to the bottom part of the groove

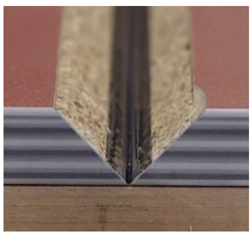


Fig 13 V–shaped groove

a b

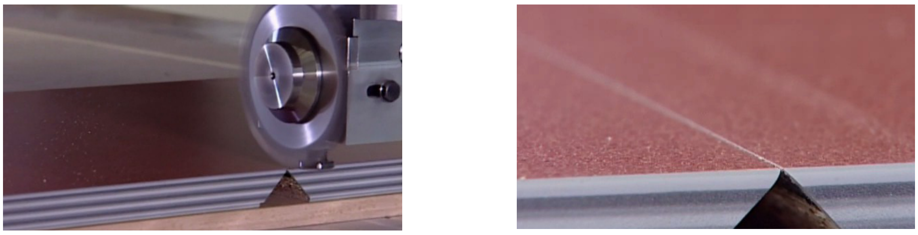


Figure 14 Laminate cutting along the length of the groove
a - cutting process, b - executed cut

7. Execution in the panel with V-shaped grooves and elastic bond of necessary operations associated with its purpose and construction assembly. Depending on the function of the construction, drilling and hardware mounting operations are usually carried out. These operations can be performed either on the IFS line or on separate workstations employing different machines and equipment. Figure 15 shows operations carried out on the IFS technological line: hole drilling for dowels and guides as well as mounting of dowels and guides. The construction of working units is designed in such a way as to allow different variants of drilling.

a b c

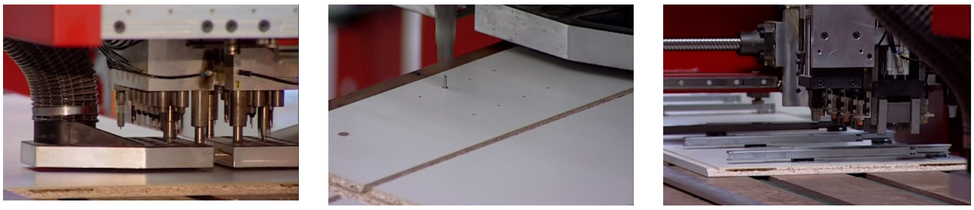


Figure 15 Execution of operations associated with the purpose and construction assembly
a - hole drilling for dowels and guides, b - dowel mounting, c - guide mounting

8. Construction assembly. The assembly can be carried out either by gluing together the corner elements, and then the construction cannot be disassembled or employing appropriate hardware (tubular or other) mounted in special seats.

<u>Assembly carried out by gluing together corner elements</u>

Initial stages of the assembly are presented in Fig. 16a and b, where the construction is assembled following the application of glue into the groove in the back wall.
Figure 17 shows the device and the process of gluing of corner elements on the IFS line.

a b

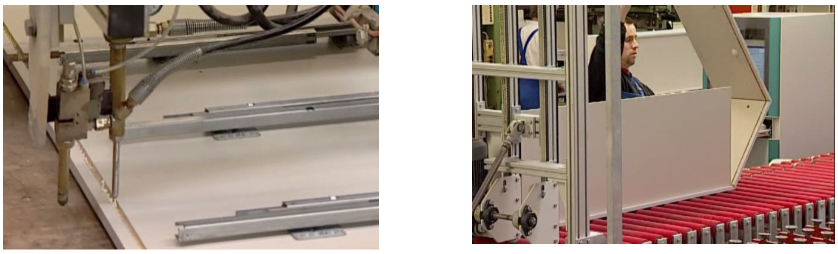


Figure 16 Initial stage of the final assembly
a - glue application into the groove in the back wall, b - construction assembly

a b c

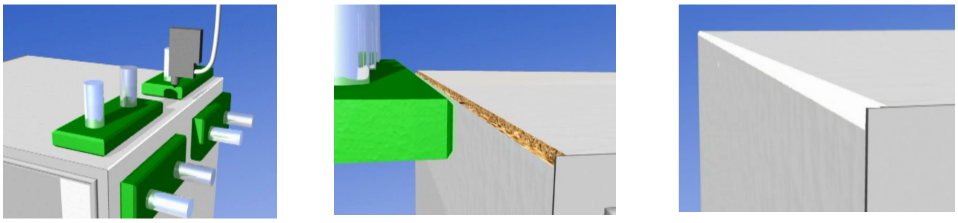


Figure 17 Gluing together corner elements closing the construction
a – device with gluing nozzle, b – prepared groove, c – glued corner elements

Assembly carried out employing special tubular hardware

Seats for tubular hardware in the walls of the V-shaped groove are made using a shank cutter in the processing centre (Fig. 18). The method of mounting of tube fittings with the assistance of a special device on the IFS technological line is shown in Fig. 19. The tube fittings are pressed to the seat surface which was earlier covered with glue. The finished panel ready for assembly is presented in Fig. 20, while Fig. 21 shows the finished body after assembly.

a b

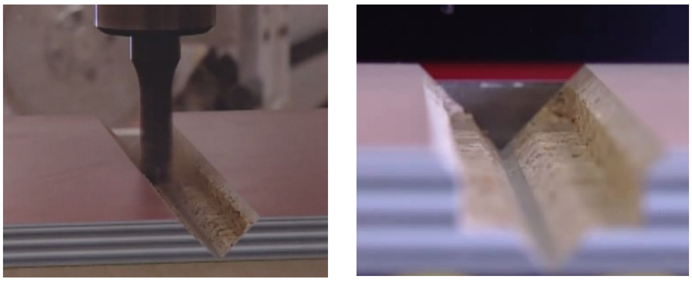


Figure 18 Making seats for tube fittings
a – seat milling, b – finished seat

a b c

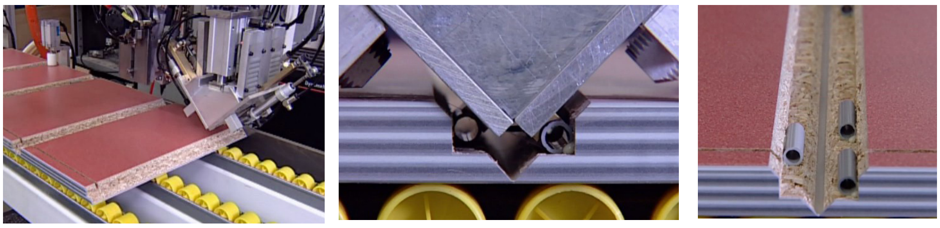


Figure 19 Mounting of tube fittings
a – workstation on the IFS line, b – device for mounting, c – fittings in seats

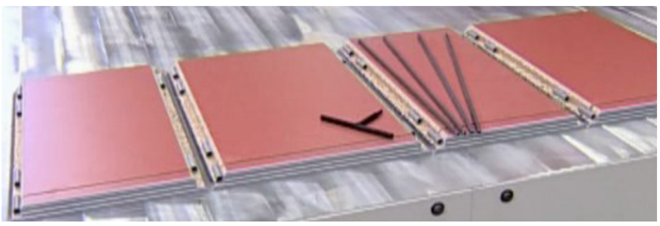


Figure 20 Panel prepared for final assembly

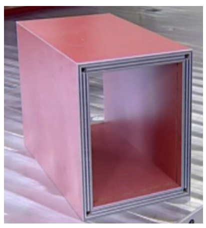


Figure 21 Finished body

IFS technologies occur in different variants depending on the way of execution and method of connection of corner elements as well as the method of the employed construction assembly.

In the latest body panels for individual assembly, very simple locking hardware was employed showing considerable versatility and possibilities of the IFS technology.

The construction of bodies manufactured using the IFS technology are characterised by considerable durability, stiffness and dimensional-shape accuracy as confirmed by many investigations and measurements.

RECAPITULATION

After the performed analyses and productivity improvements of the IFS technology, its versatility, elasticity and usefulness lie in:

- Obtaining a novel product in the form of improved section furniture construction with an elastic bond which replaces perfectly traditional constructions applied so far,
- Obtaining guaranteed construction durability, especially with regard to furniture utilised in difficult environments, e.g. kitchen or office furniture,
- Opening up of new possibilities regarding the design of the manufactured products by wider application of varying spatial forms,
- Reducing material consumption thanks to the optimisation of the cutting of board elements and to possibilities of the application of thinner boards,
- Reducing environmental nuisance thanks to decreasing quantities of the applied wood-based materials and, consequently, cutting the amount of emissions of harmful compounds formed during their production,
- Reducing costs of final products by: cutting the amounts of wastes of wood-based materials requiring expensive utilisation,
- Improvement of the construction safety thanks to improved effectiveness of connections, ease of relocation and greater functional durability.

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