

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

Publication number:

0 637 488 A1

(12)

EUROPEAN PATENT APPLICATION

(21)

Application number: **94202057.9**

(51)

Int. Cl.⁶: **B27N 3/14**

(22)

Date of filing: **15.07.94**

(30)

Priority: **06.08.93 IT MI931786**

(43)

Date of publication of application:
08.02.95 Bulletin 95/06

(84)

Designated Contracting States:
**AT BE CH DE DK ES FR GB GR IE IT LI LU MC
NL PT SE**

(71)

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Method for manufacturing panels and panels obtained thereby.

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Method for manufacturing panels by compressing fragments of bonded sheet material, such as thermoplastic resin coated cardboard, in a press at a temperature not lower than the softening point of the thermoplastic resin, comprising the addition of additives in the form of inert fillers or in the form of thermoplastic or thermosetting resins to modify the mechanical properties of the panel obtained and the addition of a layer of fine wood shavings on the outer face to improve its surface.

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This invention refers to a method for manufacturing panels in sheet form and the product obtained thereby.

There are known panels composed of incoherent materials of various kinds, impregnated with suitable binders and then moulded in a press.

A typical example of application of this technique consists of panels composed of fragments of wood of suitable particle size, impregnated with thermosetting resin. This material is cold-preformed into the shape of a slab which is subsequently compressed into its final configuration in a heated mould, where the binder is polymerized.

Panels of this kind have extensive empty spaces inside them, due to the fact that the quantity of binding resin must be maintained within permissible limits from the economic and technological point of view. In certain applications their consequent poor mechanical strength and high hygroscopicity is not appreciated.

Likewise, there are known panels obtained by milling and subsequently hot-pressing scraps and rejects of multilayered materials; the methods used for obtaining such panels are described in patents DE-A 2.258.169 and DE-B 1.151.374.

Due to the intrinsic properties of the raw material used, these panels have an uneven surface which prevents them from being given an aesthetically perfect finish either by painting, or by applying a paper coating.

The scope of this invention is to obtain panels composed internally of scraps of multilayered materials and externally of fine particle-sized wood shavings. Said panels are consequently characterized by a low degree of hygroscopicity, limited swelling in water, good thermal and acoustic insulation, deriving from the first component material, and an excellent finish and even surface deriving from the second component material.

The method for manufacturing panels according to the invention is characterized by the fact that fine particle-sized wood shavings, suitably mixed with resins, are distributed on the outside of a mass of fragments of sheet material composed of thermoplastic resin coated cardboard, the composition thus obtained being compressed in a mould at a temperature higher than the softening point of the thermoplastic material and higher than the polymerizing temperature of the resin used, and subsequently cooled.

The invention also refers to the panel obtained by such method.

During the course of this description, the term multilayered material, or bonded sheet material, refers to a composite material comprising a layer of cardboard and at least one layer of thermoplastic material on one of its outer surfaces.

Further layers may also be present, such as for example a sheet of aluminium foil.

The use of these multilayered materials as the basic ingredient for preparation of the panels, offers the advantage of perfectly even distribution of the plastic material on each of the fragments and, consequently, within the mass of the panel itself, resulting in optimal adherence between the component fragments and a singularly compact structure of the panel thus obtained.

A further essential advantage of the invention lies in the fact that scraps of multilayered material are widely available and exceptionally low in cost, in that they can be obtained from material discarded from the manufacture of boxes which use this material as a constituent.

The cost of disposing of these scraps weighs heavily on the industries which make up these boxes, and so the cost of acquiring the scraps from which the fragments are made may even be zero, or compensated with the cost of conventional disposal.

The plastic layer of the bonded sheet material referred to herein consists of a sheet of polyethylene, even though the presence of other thermoplastic materials is not excluded.

To carry out the procedure according to the invention, the sheet material is broken up into fragments, preferably having minimum dimensions of not less than 2 mm and maximum dimensions of around 40 mm, of the most diverse shapes, from substantially circular to elongated in the form of fibres.

According to the experiments conducted by the applicant, a percentage of thermoplastic binding material suitable for forming the panel ranges from 5 to 15% in weight of the fragments, and more specifically around 10%, which is the same order of magnitude as the percentage in weight of the thermoplastic fraction contained in cardboard-polyethylene or cardboard-aluminium-polyethylene multilayer sheets, so that the use of fragments made from scraps of this material ensures an adequate quantity of bonding resin.

It may prove advantageous, however, to add additives to the simple fragments of multilayer materials on the market, such as those used directly for packaging foodstuffs in particular.

These additives may consist of an additional quantity of the same plastic material contained in the multilayer material, as well as other thermoplastic substances. The thermoplastic resin added to the fragments will have a sufficiently fine particle size so as to be suitably distributed throughout the mass, typically with a basic particle size not exceeding the average size of the fragments.

It was found to be advantageous, in certain applications, to add other plastic materials of the

thermosetting class, in order to favourably affect the properties of the panel, and to facilitate the technique of forming the mass to be introduced into the mould, as well as to enable the panel to be removed easily from the mould. Synthetic resins which can be polymerized by adding a catalyst may also be used.

To form the two outer layers, use is made of wood shavings with a particle size ranging from 0.25 to 1.2 mm, with the addition of ureic resin or, preferably, melaminic resin, which gives better characteristics in terms of hygroscopicity and limited swelling.

Special care should be taken in preparing the initial slab, since it is essential to ensure a certain amount of compenetration between the wood shavings and the fragments of cardboard in order to prevent detachment of the surface layers composed of wood shavings from the support composed of fragments of multilayered material.

The thickness of the layers of wood shavings may vary from 0.3 to 1.5 mm.

It was found that the panels are formed satisfactorily when the initial slab is subjected to pressures in the region of 15-25 kg/cm² and heated to a temperature ranging from 120 to 190°C. The length of time that the fragments must remain under compression between the hot plates of the press varies according to the final thickness of the panel, in order to ensure a sufficiently even distribution of the temperature throughout the mass. It has proved to be advantageous, for example, to keep the panel under the heated press plates for a period ranging from 15" to 30" per millimetre of thickness of the panel obtained.

Whenever a thermosetting resin or a resin polymerized by catalysis is used as an additive, it was found that, in the time required for polymerization and cross-linking of the resin, the polyethylene melts to improve the aggregating action between the resin and the fragments of multilayered material, resulting in a singularly compact and sturdy product.

Resins of the most diverse kinds have proved useful in manufacturing panels according to the invention, such as for example:

phenolic resins (phenol-formaldehyde, cresol-formaldehyde, phenol-furfural), amino-plasts (urea-formaldehyde, melamine-formaldehyde), polyesters (phthalic, maleic), epoxy, vinyl, acrylic, polystyrene, polyolefin and isocyanate.

The mechanical properties and compactness of the end product can be improved by the addition of fillers of various different materials of suitable particle size, in widely varying percentages, typically from 5 to 10%, such as cellulose, cotton staple, sawdust, fibre glass, kaolin, calcium carbonate.

The addition of paraffin to the wood shavings and the use of melamine glues reduces the hygroscopicity and moisture expansion of the material.

The addition of monoammonium phosphate dispersed in the mass in percentages of 8-15% makes it possible to obtain a substantially fire-proof product.

This exemplificative indication obviously does not in any way limit the choice of inert fillers which can in any case be added during the formation of the panel according to the invention to give it any desired specific characteristics.

The procedures for carrying out the method according to the invention will be more clearly evident from the following practical example.

EXAMPLE

100 kg of dry ureic resin were treated with 52 kg of water to obtain a milky suspension to which ammonium chloride was added up to a percentage ranging from 2 to 3% (approximately 2.8 kg).

720 kg of fragments obtained by triturating scraps of multilayered materials (cardboard, aluminium and polyethylene) were added to approximately 53 litres of this mixture.

After having been vigorously stirred in appropriate apparatuses referred to as "resinators", this mixture was evenly distributed over a layer of previously resinated fine wood shavings.

The upper surface, composed of fragments of resinated multilayered material, was also covered with a further layer of resinated fine wood shavings.

The operation of distributing the three alternate layers was carried out by means of special distributing machines referred to as "moulding machines" placed in succession above a conveyor belt.

The slab thus formed was cut into suitably sized modules with a specific weight of approximately 1000 kg/m³, which were then introduced between the hot plates of a gang press.

After having reached the softening point of the polyethylene in the core of the panels, the press plates were cooled to reduce the temperature of the panels to below the softening point, while keeping the panels constantly subjected to a specific pressure higher than the pressure exerted by the water vapour at the same temperature, during the heating and cooling phases.

The panels were subsequently removed from the press, cut transversally and longitudinally and then smoothed. In view of the relatively low thermal conductivity of the material compacted to form the panel, it may be advantageous to preheat the mass before introducing it into the mould, thereby reducing the length of time it must remain inside the hot press for the core of the panel to reach the tem-

perature required for the thermoplastic resin to soften and for polymerization of any thermosetting binder that may be used.

The preheating temperature must obviously be below the point which causes the thermoplastic resin to soften to such a degree as to cause it to run or to adhere excessively on contact, which could negatively affect the distribution of the resin within the mass.

It was also found that a high degree of moisture in the scraps of multilayered material, as is generally the case, may negatively affect the properties of the panel, and especially its compactness.

A further feature of the manufacturing method according to this invention is consequently that of subjecting the fragments after milling to pre-drying in order to reduce the moisture content to values below 4%, preferably around 2%. The drying can easily be carried out under a stream of hot air.

In addition or as an alternative, also in order to speed up production and achieve better dimensional stabilization of the product, after the heating phase and after having exceeded the softening point of the raw material, the panel can be cooled under pressure, with release of any vapour that may have formed in the mass of material.

To compress fragments of multilayered materials use can be made, in particular, of the currently known single or multiple-die presses. In particular, the cycle can be carried out with:

- a) three single-die presses in line, the first of which presses hot, the second re-presses hot and the third cools and stabilizes the product;
- b) two single-die presses, the first of which heats and the second cools and stabilizes the product under pressure;
- c) multiple-die press with hot/cold cycle;
- d) continuous press with hot area upstream and cold area downstream.

On account of their compactness, the panels lend themselves satisfactorily to machining and surface finishing.

The panels obtained according to the invention lend themselves to a wide range of applications in the most diverse fields. In addition to the conventional uses for products of this kind, they can also be suitable for uses which call for resistance to passive stress, in view of their good mechanical strength. Moreover, due to their low degree of impregnability and expansion in water, the panels according to the invention can be used in the building industry.

Lastly, it should be pointed out that the utilization of scraps of multilayered materials is an aspect of considerable importance, since at present they do not prove to be of any practical use and are extremely difficult and expensive to dispose of, while they can be made into panels having the

same characteristics in terms of finish as the known panels manufactured with particle board and can consequently be subjected to the same finishing techniques as the latter.

Claims

1. Method for manufacturing panels characterized by the fact that fine particle-sized wood shavings, suitably mixed with resins, are distributed on the outside of a mass of fragments of sheet material composed of thermoplastic resin coated cardboard, the composition thus obtained being compressed in a mould at a temperature higher than the softening point of the thermoplastic material and higher than the polymerizing temperature of the resin used, and subsequently cooled.
2. Method as claimed in claim 1, in which said fragments are subjected to drying before being hot-pressed, to decrease their moisture content to values below 4%, preferably around 2%.
3. Method as claimed in claim 1, in which said fragments are subjected to preheating at a temperature lower than the softening point of the thermoplastic resin, before being hot-pressed.
4. Method as claimed in claim 1, in which, upon completion of the hot-compression phase, the compressed material is cooled under pressure until it reaches an internal temperature considerably lower than the softening point of the thermoplastic resin.
5. Method as claimed in claim 1, in which said fragments are compressed with pressure values ranging from approximately 15 to 25 kg/cm².
6. Method as claimed in claim 1, in which the hot-compression phase has a duration ranging from 15 to 30 seconds per millimetre of thickness of the finished panel.
7. Method as claimed in claim 1, in which thermoplastic resin is added as an additive dispersed in the mass to the fragments of multilayered material.
8. Method as claimed in claim 7, in which the thermoplastic resin is present in percentages ranging from 5 to 15% in weight of the fragments, preferably around 10%.

9. Method as claimed in claim 1, in which thermosetting resin is added as an additive dispersed in the mass to the fragments of multilayered material.
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10. Method as claimed in claim 9, in which the thermosetting resin is added as an additive in percentages ranging from 5 to 15% in weight of the fragments, preferably from 5 to 10%.
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11. Method as claimed in claim 1, in which an inert filler is added as an additive dispersed in the mass to the fragments of multilayered material.
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12. Panel obtained by hot compression of two layers of fine particle-sized wood shavings, suitably mixed with resins, bonded by moulding to the outside of a mass of fragments of sheet material composed of cardboard and thermoplastic resin-bonded material.
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13. Panel as claimed in claim 12, manufactured according to one or more of the claims from 1 to 11.
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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 2057

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US-A-4 382 108 (CARROLL ET AL.) 3 May 1983 * abstract *	1-13	B27N3/14

Y	EP-A-0 409 525 (FORTIFIBER CORP.) 23 January 1991 * abstract; figure 1 *	1-13	

A	GB-A-1 267 918 (PASKE) 22 March 1972		

A	DE-A-26 22 294 (SCHMID) 1 December 1977		

A	US-A-2 686 143 (FAHRNI) 10 August 1954		

The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 24 October 1994	Examiner Soederberg, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			