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Datasheet for the decision of 27 November 2017

Case Number: T 0577/15 - 3.3.05

Application Number: 07786754.7

Publication Number: 2035198

IPC: B27K3/34, B27K3/15

Language of the proceedings: EN

Title of invention:
METHOD FOR MODIFYING WOOD AND WOOD THEREBY OBTAINED

Patent Proprietor:
Transfurans Chemicals

Opponent:
Kebony Norge AS

Headword:
Modifying Wood/Transfurans

Relevant legal provisions:
EPC Art. 100(a)

Keyword:
Novelty - (yes)
Inventive step - (yes)

Decisions cited:
T 0464/94

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 0577/15 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 27 November 2017

Appellant: (Patent Proprietor)	Transfurans Chemicals Industriepark, Leukaard 2 2440 Geel (BE)
Representative:	Brants, Johan P.E. Brantsandpatents bvba Pauline Van Pottelsberghelaan 24 9051 Ghent (BE)
Respondent: (Opponent)	Kebony Norge AS Hoffsveien 48 0377 Oslo (NO)
Representative:	Onsagers AS Munkedamsveien 35 P.O. Box 1813 Vika 0123 Oslo (NO)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 23 January 2015 revoking European patent No. 2035198 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

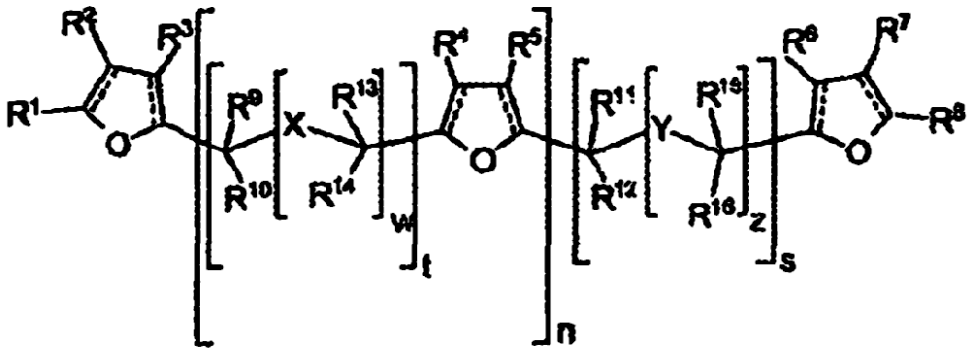
Chairman	E. Bendl
Members:	G. Glod
	O. Loizou

Summary of Facts and Submissions

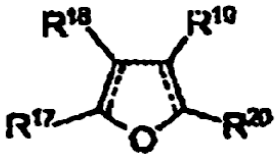
I. The present appeal of the patent proprietor (appellant) lies from the decision of the opposition division to revoke European patent EP-B-2 035 198.

The independent claims of the patent as granted read as follows:

"*1. Method for modifying wood comprising the steps of: a) impregnating said wood with a polymerizable composition comprising a compound of formula I and/or formula II*



Formula I



Formula II

wherein n is 0, 1, 2, 3, 4 or 5
wherein ***t*** *and* ***s*** *each independently are 1 or 2,*
wherein ***w*** *and* ***z*** *each independently are 0 or 1,*
wherein ***X*** *and* ***Y*** *each independently are O, S or N-* R^{21}
and
wherein R^2 R^3, R^4, R^5, R^6, R^7 R^9, R^{10}, R^{11}, R^{12}, R^{13} R^{14},

R^{15}, R^{16}, R^{18} R^{19}, R^{21} are each independently hydrogen or selected from the group comprising C_1-C_2 alkyl, carboxaldehyde, hydroxyalkyl, carboxyl, aminoalkyl, alkylaminoalkyl, hyoxyalkylfurylalkyl [sic], *alkyloxy, alkoxyalkyl, alkylcarbonylalkenyl, alkylcarbonyloxyalkyl, alkyloxycarbonylalkenyl, alkenylcarbonyloxyalkyl, oxiranyl, isocyanate, isocyanate-alkyl, alkylcarboxy, alkenylcarboxy, alkylcarbonyl, alkenylcarbonyl, halocarbonyl, haloalkyl, haloaryl, haloalkenyl, imino, thioalkyl, alkylthioalkyl, cyano and any mixtures thereof, whereby each group is optionally substituted with one or more substituents selected from C_1-C_2 alkyl, C_2-C_4 alkenyl, C_2-C_4 alkynyl, hydroxyl, carboxyl, nitro, amino, alkylfuryl, hydroxyalkylfurylalkyl, isocyanate, formyl, halocarbonyl, and thiol,*
wherein R^1, R^8, R^{17} and R^{20} are each independently selected from the group comprising carboxaldehyde, hydroxyalkyl, carboxyl, aminoalkyl, alkylaminoalkyl, hydroxyalkylfurylalkyl, alkyloxy alkoxyalkyl, alkylcarbonylalkenyl, alkylcarbonyloxyalkyl, alkyloxycarbonylalkenyl, alkenylcarbonyloxyalkyl, oxiranyl, isocyanate, isocyanate-alkyl, alkylcarboxy, alkenylcarboxy, alkylcarbonyl, alkenylcarbonyl, halocarbonyl, haloalkyl, haloaryl, haloalkenyl, imino, thioalkyl, alkylthioalkyl, cyano and any mixtures thereof, whereby each group is optionally substituted with one or more substituents selected from C_1-C_2 alkyl, C_2-C_4 alkenyl, C_2-C_4 alkynyl, hydroxyl, carboxyl, nitro, amino, alkylfuryl, hydroxyalkylfurylalkyl, isocyanate, formyl, halocarbonyl, and thiol, and
wherein the dotted line represents a double bond
wherein said compounds are water-soluble, and
wherein said composition comprises water and further comprises a catalyst which is an ammonium salt, an

organic acid, an anhydride, an inorganic acid, magnesium chloride, magnesium sulfate, magnesium nitrate, zinc chloride, zinc nitrate, aluminum chloride, aluminum nitrate, aluminum sulfate or any mixtures thereof.
and
b) reacting said impregnated wood at a temperature of between 70 and 200°C."

"*10. Wood obtained by the method of any of claims 1 to 9 having a weight percentage gain (WPG) of at least 10%.*"

"*11. Use of wood according to claim 10 as knife handles, kitchenware (spoons, forks, cutting boards, bowls), furniture, indoor flooring, countertops, building parts (facia, cornice, siding, sills, frames, millwork), boat parts (frames, planking, decks, rails, flooring, deck trim, deck flooring, furniture, fittings), marine items (docks, piers, lobster traps, weir poles), outdoor items (furniture, decks, railings and stairs, walkways, boardwalks, playground equipment), bridge parts (beams, railings, decking), gunstocks and pistol grips, musical instrument parts (piano keys, violin and guitar fingerboards and bridges), railway sleepers, cooling tower slats, utility poles, outdoor walkways, flooring, heavy timbers, fenceposts, stakes, highway items (guard rail posts, guard rail plates, sign posts, light poles), containers (tanks, buckets), machine parts (conveyor slats, saw guides, saw and planer table tops), joinery parts (window frames, doors).*"

Claims 2 to 9 are dependent on claim 1 and describe preferred embodiments thereof.

II. The following documents cited in the decision under appeal are of relevance here.

D1: CA 1200336
D2: Lande, S., Eikenes, M., Westin, M., Chemistry and Ecotoxicology of Furfurylated Wood, Scandinavian Journal of Forest Research 19 (Suppl. 5), pages 14-21, 2004
D3: US-A-5 741 914
D4: WO-A2-2004/011214
D9: Henriksson, M. et al., MDF boards with modified fibers and bioderived adhesive, Part of EcoBuild Project 9, SP Technical Research Institute of Sweden, pages 1 to 21, March 2012
D10: Copy of applicant's submission during examination procedure, dated 21 April 2008

III. In its communication under Article 15(1) RPBA of 8 May 2017, the board was of the preliminary opinion that the grounds of opposition did not prejudice the maintenance of the patent as granted.

IV. The respondent gave notice on 20 October 2017 that it did not intend to participate in the scheduled oral proceedings.

V. By letter of 27 October 2017 oral proceedings scheduled for 27 November 2017 were cancelled.

VI. The arguments of the **appellant (patent proprietor)**, as far as relevant to the present decision, can be summarised as follows:

D1 did not anticipate the novelty of the subject-matter of the claims of the patent as granted. To arrive at the subject-matter of claim 1, several selections

within D1 were needed. It was not disclosed that the composition impregnated wood. The impregnation was presented as an undesired property of the binder. D1 did not disclose water as a solvent suitable for carrying compounds of formula I and/or II inside wood. According to claim 1 of the patent at issue, the entire composition was to enter the wood.

According to the present invention, a chemical reaction took place in the cell wall and bonding occurred with the cell wall polymers. Such a chemical bonding did not take place in the process of D1. The filling and/or reaction of the wood cell wall with the polymerised impregnant was completely different from gluing parts together and providing a binder function as disclosed in D1. The wood reacting with the impregnated compounds was paramount for the reduced aqua toxicity and improved durability. In D1, a surface cover was intended and not an immersion.

Claim 1 was also novel over D3, since there was no disclosure of a composition comprising water and a catalyst. The resins of D3 were not applied to wood.

D4 was the closest prior art. The problem to be solved vis-à-vis D4 was to reduce safety risks before, during and after use, associated with furfuryl alcohol. The problem was solved with the mix of monomers/oligomers as specified. D10 showed that the problem was indeed solved. D4 and D3 were silent about the aqua toxicity of impregnation modified wood.

D3 provided resinous binder compositions obtained by reaction of furfuryl alcohol and formaldehyde, but it did not disclose BHMF as a result. Further, D3 related to VOC emissions of impregnation modified wood.

When wood was impregnated with the mixture featured in claim 1, the vapor emissions of furfuryl alcohol were non-existing and the wood could safely be heated above the flammability point of furfuryl alcohol and of BHMF. This safety aspect was dealt with by neither D3 nor D4.

VII. The arguments of the **respondent (opponent)**, as far as relevant to the present decision, can be summarised as follows:

The subject-matter of at least claim 1 of the patent as granted lacked novelty over D1. A preferred product used according to D1 contained 20-40% BHMF (2,5-bis(hydroxymethyl)furan). The examples in D1 referred to BHMF resin, but the skilled person would understand from the whole content of D1 that this resin contained BHMF. By performing one of the examples of D1 the skilled person would perform a method according to claim 1.

Only one compound of formula I or II present in the composition must be water-soluble. Although the main purpose of D1 was to provide a binder, the wood particles were sprayed with a composition according to claim 1. The composition would impregnate at least the outer layer of the wood particles, the subsequent heating would result in reacting said impregnated wood and said reaction would modify the wood. Claim 1 did not require a covalent bond to be formed between the wood and the composition.

D9 confirmed that the process of D1 would lead to chemically modified wood.

Claim 1 also lacked novelty over D3.

Claim 1 did not require any limitation of the amount of compounds of formula I and/or II or the amount of catalyst or water, so that it was not credible that the alleged problem was solved over the whole range claimed. Further, there was no evidence that any improvement with respect to aquatic toxicity was obtained as compared with D4.

Table 2 of D3 disclosed BHMF. A person skilled in the art wanting to change the impregnation method of D4 to reduce the emission of VOC would refer to D3 because it related to polymerization of furfuryl compounds. It also mentioned the environmental problem of VOC emission and provided a solution of using resin of prepolymers, wherein furfuryl alcohol was reacted with formaldehyde to produce less volatile compounds.

There was no evidence that the wood obtained by the process of claim 1 had a reduced aquatic toxicity as compared with the wood of D4. D2 confirmed that furfurylated wood had a low toxicity towards *Daphnia magna*.

The problem relating to reduced safety risks was also not solved over the whole range claimed, since there was no limitation of the amount of compounds with a flash point lower than 75°C. Further, the combination of D4 and D1 led the skilled person directly to a solution according to claim 1.

VIII. The appellant requested that the decision under appeal be set aside and that the patent be maintained as granted; alternatively, that the patent be maintained in amended form on the basis of one of the set of

claims of auxiliary requests 1 to 4 submitted with the statement of grounds of appeal of 2 June 2015.

The respondent (opponent) requested that the appeal be dismissed.

Reasons for the Decision

1. Article 100(b) & (c) EPC.

The respondent did not substantiate its objections with respect to Article 100(b) and (c) EPC. The board does not see any reason to question the position taken by the opposition division.

2. Article 100(a) in combination with Article 54 EPC

2.1 The subject-matter of the claims is considered to fulfill the requirements of Article 54 EPC for the following reasons:

2.1.1 Claim 1 of the patent as granted relates to a method comprising the impregnation of wood with a composition comprising a compound of formula I and/or formula II, water and a catalyst, and the reaction of the impregnated wood at a temperature of between 70 and 200°C.

2.1.2 D1 is directed to the use of furan resins diluted with substantial amounts of water to act as binders in the manufacture of composite articles (page 1, lines 16 to 18). Compositions comprise a high hydroxymethyl furan-formaldehyde condensation product, water (up to 50%) and a catalyst that cures the resin to a hardened thermoset condition (page 3, lines 13 to 18). In particular, D1 discloses a binder composition

comprising a BHMF (2,5-bis(hydroxymethyl)furan) resin, water and a maleic anhydride that is a catalyst according to claim 1 (Table I). The resin is prepared according to the method described in the example (page 4, line 14 to page 5, line 13). It is unambiguous that a small undefined amount of 2,5-(bis-hydroxymethyl)furan is present in the BHMF resin that also contains 2% furfuryl alcohol, 1% formaldehyde and 1% water (page 5, lines 7 to 10). The binder composition is sprayed on the wood particles (page 7, lines 4 to 6).

2.1.3 In the context of the patent in suit the term "impregnation" is understood as meaning that the impregnation solution penetrates into the wood (see also paragraph [0028] of the patent in suit). It is not directly and unambiguously derivable that spraying on the wood particles according to D1 will inevitably lead to the impregnating of the wood with 2,5-(bis-hydroxymethyl)furan. In other words, it is not derivable that 2,5-(bis-hydroxymethyl)furan that is only present in small amounts diffuses into the cell wall. This interpretation is also in line with the formulation "over a period of about 2 minutes to insure uniform distribution of the binder on the wood particles" (D1, page 7, lines 8 to 11), which shows that the goal is to uniformly distribute the composition **on** the wood and does not imply that the formulation enters the wood particles. The impregnation is dependent on the type of wood (see also D4, page 5, lines 5 to 15) and it cannot simply be assumed that impregnation occurs **inevitably** once wood is brought into contact with a liquid. Although it appears to be possible that some impregnation may occur under specific conditions, there is no proof that this is actually the case under the conditions described in D1.

However, whether a document is prejudicial to novelty cannot be decided on the basis of probability (see T 464/94, Reasons 16).

Hence, it also cannot be concluded beyond a doubt that at the curing conditions used (41 bar (600 psig), 176,6°C (350°F), see page 7, lines 14 to 18), the composition becomes an integral part of the wood cell-wall structure, so the reacting **of said impregnated wood** within the meaning of step (b) of the method according to claim 1 of the patent is not directly and unambiguously derivable from D1.

2.1.4 The diffusion of the composition into the wood and the subsequent reaction leads to a modification of the wood cell wall (page 3, lines 29 and 30 of the patent in suit). Therefore, the structure of the wood according to claim 10 obtainable by a process according to claim 1 is considered to be modified with respect to untreated wood. It is not apparent from D1 that the process described therein also leads to a modification of the wood cell wall. Rather, it seems that only the binder is polymerised (page 7, lines 17 and 18).

Although the post-published document D9 indicates that the non-water-soluble FA70res (waste product from the "Kebony process") possibly modifies the fiber cell wall during curing (see Tables 1 and 2 for curing conditions), when used as an additive (page 12, lines 2 to 4), it cannot be concluded that the same necessarily happened in the process of D1 (page 7), since the curing of the product of D1 was conducted with a different resin composition at different conditions.

2.1.5 To summarise, the subject-matter of claims 1 and 10 is not directly and unambiguously derivable from D1. As a

consequence, the same applies to claims 2 to 9 that represent preferred embodiments of claim 1 and claim 11 that relates to the use of the wood according to claim 10.

2.2 D3 discloses resin binder compositions diluted with water and applied in accordance with known manufacturing procedures to a substrate that is subjected to heat so as to cure the binder into a rigid thermoset condition. Curing catalysts such as cadmium nitrate, cobalt nitrate, nickel nitrate, zinc nitrate, ammonium nitrate, ammonium chloride, aluminum sulfate, copper sulfate, ammonium sulfate, malic acid, citric acid, tartaric acid, malonic acid, maleic acid, oxalic acid, chloroacetic acid and salicylic acid can be used (column 5, lines 26 to 40). It is not unambiguously derivable from D3 that the substrate is wood and that an impregnation in the sense of a diffusion into the cell wall is covered by the expression "with known manufacturing procedures". Therefore, the same conclusion as for D1 applies.

3. Article 100(a) in combination with Article 56 EPC

The subject-matter of claims 1 to 11 is based on an inventive step for the following reasons:

3.1 Invention

The invention relates to the modification of wood (see paragraph [0001]).

3.2 Closest prior art

In agreement with the parties, D4 is the closest prior art. It relates to polymer-impregnated wood that has

been impregnated with a polymerizable furfuryl alcohol monomer mixture containing at least water, furfuryl alcohol, a stabilizer and at least one initiator (page 1, lines 3 to 6). It discloses the impregnation of wood with furfuryl alcohol and the subsequent reaction of the wood (page 2, lines 19 to 25). One of the objects was to provide a furan polymer-impregnated wood by altering the wood cell wall (page 3, lines 10 and 11).

3.3 Problem

The problem to be solved can be seen as providing a method for producing **modified wood** having lower VOC emissions and low aquatic toxicity (paragraphs [0016], [0017] and [0132]).

3.4 Solution

As a solution to the problem, a method according to claim 1 is proposed, characterised in that wood is impregnated with a composition comprising a compound of formula I and/or formula II.

3.5 Success of the solution

D10 confirms that the problem has been solved. Table B1 shows that the VOC emissions are reduced when impregnating and reacting pine sapwood with MIX BHMF as compared with MIX FA (composed of 22% furfuryl alcohol, 1% maleic anhydride and 77% water). Although D4 discloses a composition comprising 1% maleic acid and 12% furfuryl alcohol based on water (page 2, lines 19 to 21), a stabiliser is considered essential to the composition used for impregnating (claim 1). This stabilizer allows the initiated monomer to be water-soluble and to remain stable in storage (page 4, lines

22 and 23). There is no evidence that the presence of the stabilizer has an influence on the stability of the modified wood post-reaction, so MIX FA is considered representative of D4. There are also no comparative examples that would render the success of the solution doubtful.

D10 also shows in Table C1 the benefit with respect to aquatic toxicity. D2 is not considered to be relevant here, since D2 does not compare wood obtained according to a method of claim 1 with wood obtained according to the process of the closest prior art D4, so D2 cannot cast doubt on the success of the solution vis-à-vis D4.

Although the results shown in Table C1 of D10 were only obtained with very few substances covered by claim 1 in a composition containing only those substances, there is no evidence that the results are not representative for the composition used in step (a) of the process according to claim 1. In other words, there is no data proving that wood modified with other compounds covered by formulae 1 or 2 would lead to a different result than the one shown in Table C1 of D10.

Therefore, the board has no reason to doubt that the problem has been successfully solved.

3.6 Evidence of the solution

The question arises whether the prior art teaches the compounds of formula I and/or formula II for solving the posed problem.

3.6.1 D3 does not relate to the VOC emissions of the modified wood - the already reacted wood - but to the VOC emissions occurring during curing (Table 2 and column

1, lines 35 and 36). Further, D3 is not concerned with the aquatic toxicity of leaching water. As indicated above (see point 2.2), D3 is not concerned with the impregnation of wood, contrary to D4, so the wood products obtained by the process of D3 do not necessarily have altered wood cells. As a consequence, the board cannot recognise why the skilled person would turn to D3 when trying to solve the posed problem.

3.6.2 As explained above, D1 does not relate to the **impregnation** of wood (point 2.1.3) and the benefits of modified wood with respect to aquatic toxicity and VOC emissions. Although D1 discloses that the use of solvents such as furfuryl alcohol or furfural is linked to certain fire risks and toxic hazards (page 6, lines 4 to 7), this only relates to their use as solvents for a binder solution, but not to modified wood as disclosed in D4. In that context, the impregnation is rather presented as something undesirable (page 6, lines 7 to 9). Therefore, D1 is not relevant to the skilled person trying to solve the posed problem.

3.6.3 As a consequence, the solution to the problem is not rendered obvious by the prior art, and the subject-matter of independent claim 1 and claims 2 to 9 depending thereon involves an inventive step.

3.7 A similar argumentation also applies to claims 10 and 11, since the benefits of the process are ultimately reflected in the wood obtained (see also point 3.3).

3.8 To conclude, the subject-matter of the claims as granted meets the requirements of Article 56 EPC.

4. Since the main request is considered allowable, there is no need to comment on auxiliary requests 1 to 4.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated