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Datasheet for the decision of 18 January 2024

Case Number: T 0238/22 - 3.2.05

Application Number: 12887460.9

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IPC: B29C70/14, G10K11/165, B32B5/12, C08K7/02, C08L97/02, E04B1/82

Language of the proceedings: EN

Title of invention:
A composite structure with vibrational properties

Patent Proprietor:
UPM-Kymmene Corporation

Opponent:
Aronova S.A.

Relevant legal provisions:
EPC Art. 83, 84
EPC R. 111(2), 103(1)(a)
RPBA 2020 Art. 12(4), 12(6)

Keyword:

Substantial procedural violation - appealed decision sufficiently reasoned (no)
Late-filed document - admitted (yes)
Sufficiency of disclosure (no)
Reimbursement of appeal fee (yes)

Decisions cited:

G 0003/14, T 0074/98, T 1123/04, T 1570/19

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Case Number: T 0238/22 - 3.2.05

D E C I S I O N
of Technical Board of Appeal 3.2.05
of 18 January 2024

Appellant: (Opponent)	Aronova S.A. 10-12, Avenue du Rock n'Roll 4361 Esch-sur-Alzette (LU)
Representative:	Gill Jennings & Every LLP The Broadgate Tower 20 Primrose Street London EC2A 2ES (GB)
Respondent: (Patent Proprietor)	UPM-Kymmene Corporation Alvar Aallon katu 1 00100 Helsinki (FI)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 2 December 2021 concerning maintenance of the European Patent No. 2914412 in amended form.**

Composition of the Board:

Chairman	P. Lanz
Members:	T. Vermeulen
	C. Heath

Summary of Facts and Submissions

I. The opponent lodged an appeal against the interlocutory decision of the opposition division finding that European patent No. 2 914 412 as amended according to the main request filed in reply to the notice of opposition met the requirements of the European Patent Convention.

II. The opposition had been filed against the patent as a whole on the basis of the grounds for opposition under Article 100(a) together with Article 54(1) EPC (lack of novelty) and Article 56 EPC (lack of inventive step), under Article 100(b) EPC and under Article 100(c) EPC.

III. The following documents are of importance for the present decision.

D11 D. Hull, "An introduction to composite materials", Cambridge University Press, 1981, 76, 78-81

D12 "Wood-polymer composites", Woodhead Publishing Limited, 2008, v-xv, 1-353

D13 "speed of sound", Oxford Reference dictionary, 2021

D18 "D18 - reworking of EP2914412", experimental data

IV. A summons to oral proceedings was issued on 10 May 2023.

V. In a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal in the 2020 version (RPBA) issued on 15 December 2023, the parties

were informed of the board's provisional opinion that the patent was likely to be revoked.

VI. By letter dated 18 December 2023 the appellant informed the board that it would not attend, or be represented at, the oral proceedings.

VII. Oral proceedings before the board were held by videoconference on 18 January 2024 in absence of the appellant.

VIII. The appellant requested that the decision under appeal be set aside and that the patent be revoked. They also requested to reimburse the appeal fee by reason of a substantial procedural violation.

The respondent (patent proprietor) requested that the appeal be dismissed (main request) or that the decision be set aside and the patent be maintained as amended on the basis of the claims of one of auxiliary requests 1 to 3 filed in reply to the statement of grounds of appeal.

IX. Claim 1 of the respondent's main request has the following wording (the feature numbering used by the board appears in square brackets).

"1. [**1.1**] A composite comprising a melt flow direction (f_m), the composite comprising
- [**1.2**] thermoplastic polymer matrix material, and
- [**1.3**] fiber components (100) of organic natural fiber material comprising a hollow interior,
[**1.4**] wherein at least part of the longitudinal dimensions of the fiber components have been oriented substantially parallel with a direction of the melt flow (f_m),

[**1.5**] wherein the ratio (v_T/v_x) of the speed of sound (v_T) in a direction perpendicular to the melt flow (f_m) to the speed of sound (v_X) in a direction of the melt flow (f_m) is in the range of 0.15-0.9, and
[**1.6**] wherein the organic natural fiber material is wood material."

X. Claim 1 of the respondent's auxiliary request 1 has the following amendment in feature 1.6.

"[**1.6'**] wherein the organic natural fiber material is wood material comprising lignin under 15 percentage by weight."

XI. Compared to claim 1 of auxiliary request 1, claim 1 of auxiliary request 2 has the following additional feature.

"[**1.7**] and wherein the fiber components (100) comprise a longitudinal dimension, a horizontal dimension and a vertical dimension, and at least 60% of the fiber components (100) have a shape ratio of the longitudinal dimension (D1) to the vertical (D3) dimension of at least 10:1".

XII. Claim 1 of auxiliary request 3 corresponds to claim 1 of auxiliary request 2 with the following amendment to feature 1.4.

"[**1.4'**] wherein at least part of the longitudinal dimensions of the fiber components have been oriented substantially parallel with a direction of the melt flow (f_m), at least 80% of the fiber components (100) comprising an averaged deviation angle ($\alpha 1$) less than 40 degrees at a direction of the melt flow (f_m) of the composite,".

XIII. The appellant's submissions may be summarised as follows.

Substantial procedural violation

Rule 111(2) EPC gave parties a fundamental procedural right to be provided with the reasons for a decision. Lack of compliance with this was a fundamental deficiency. In particular, the reasoning given in a decision open to appeal had to enable the appellant and the board of appeal to examine whether the decision was justified or not. In the case in hand, the decision under appeal lacked adequate reasoning in respect of the clarity objection raised against claims 1 and 2 of the respondent's main request with the appellant's letter of 6 August 2021 and again at the oral proceedings before the opposition division. The argument in question was noted in the minutes of the oral proceedings, but was not dealt with in the decision under appeal. At the end of sections 2.1.1 and 2.1.2 of the reasons for the decision under appeal, the opposition division simply commented on the objection without elaborating on the question whether the term "wood material" in claims 1 and 2 of the main request was clear. As such, it was not possible to tell from the decision under appeal (i) whether the opposition division heard or considered the above-noted clarity objection and if so (ii) why it disagreed with the objection and found claims 1 and 2 of the main request to be in line with Article 84 EPC. This amounted to a substantial procedural violation.

Admittance of document D18

Document D18 showed the results of two tests carried out in direct response to the opposition division's findings in point 3.3.1 of the reasons for the decision under appeal. It could not have been filed earlier and should therefore be admitted to the appeal proceedings.

Main request - sufficiency of disclosure

The skilled person in the field of composite materials had general knowledge about common reinforcing fibres (such as flax and wood), common matrix materials (such as polypropylene) and their impact on the basic properties of a composite (such as Young’s modulus and density), see for instance sections 1.1, 1.2, 1.3 and 5.4 of textbook D12. They were also aware that causing the composite mixture to flow (as in injection molding) resulted in some fibre alignment along the flow direction, as demonstrated by pages 78 to 80 of textbook D11. Furthermore, they knew that the speed of sound of a material was determined by its elastic modulus and density, see document D13.

Being able to determine the speed-of-sound ratio for any particular material did, however, not make the disclosure of the invention sufficient. Adopting the test set out in point 3.3.1 of the reasons for the decision under appeal would lead to the conclusion that the patent was considered sufficient as long as the skilled person was capable of making any flow-orientated composite comprising a thermoplastic matrix and hollow wood fibre reinforcement, whether or not it turned out to have a speed-of-sound ratio in the claimed range. This was plainly wrong. In order to be considered sufficient, the patent had to disclose how

to reliably manufacture composites that predictably had a speed-of-sound ratio within the claimed range.

To demonstrate this point, the appellant had manufactured a composite by following the teaching of the patent. The methodology and results were set out in document D18. However, despite best efforts, the resulting composite specimens were found to have speed-of-sound ratios falling outside the scope of claim 1. Therefore, the opposition division's approach could not be correct, since the claimed invention had not been reproduced. It could therefore be seen that simply producing a mixture of thermoplastic polymer and hollow wood fibre component and using a flow processing method such as the one described in paragraph [0088] of the patent such that the fibre component was apparently oriented substantially parallel with a direction of the melt flow did not reliably lead to a composite falling within the terms of the patent.

The patent did not provide any relevant teaching or guidance going beyond the skilled person's common general knowledge in relation to how to control fibre alignment other than by flow processing in general. It failed to teach the skilled person how to reliably arrive at a composite meeting the terms of claim 1. The patent proprietor had chosen not to disclose in the patent a single fully worked example, both in terms of the materials selected and process conditions used, which the skilled person could follow in order to reliably make a composite falling within the terms of claim 1. In doing so, they denied the skilled person the promise of the invention. Instead, the patent did no more than identify a desired material property (a speed-of-sound ratio in the range 0.15 to 0.9), list a huge range of possible options for the starting

materials (fibre and matrix options), mention a known fact (flow of such a composition achieved some fibre alignment) and then demonstrate that the desired result was achieved at least twice (Table 2), all without giving away the crucial information which would allow anyone else follow suit.

From paragraph [0092] of the patent it was apparent that at least five factors affected the acoustic properties of the composite. However, no selection of each of those factors was disclosed, which together would reliably arrive at a composite with a speed-of-sound ratio in the range 0.15 to 0.9. The respondent and the opposition division heavily relied on the examples presented with reference to Table 2 and Table 4 of the patent. Whereas Table 2 demonstrated that two composite materials comprising 40 wt% organic natural fibre material yielded a speed-of-sound ratio of 0.33, there was absolutely no indication of the composition of these materials and no reason to presume they comprised a thermoplastic matrix or a hollow wood fibre reinforcement. Moreover, there was no information as to the shape ratio of the fibres or to the process conditions necessary to achieve the required fibre orientation. Regarding Table 4, the composition of the materials was not identified. The material mentioned earlier in paragraph [0062] of the patent was not directly linked to Table 4. Even if for the sake of argument it were assumed that Tables 2 and 4 related to materials of that composition, the information given did not clearly support the hypothesis that the speed of sound increased with fibre content. And the examples of Table 4 provided no information as to the shape ratio of the fibres or to the process conditions necessary to achieve the required fibre orientation.

The patent was particularly deficient on the process conditions necessary to achieve the required degree of fibre alignment. No examples of suitable process parameters (e.g. temperatures and flow velocities) were given, let alone ones linked to particular composite recipes. Paragraph [0088] of the patent primarily contained observations relating to the rotational orientation of the fibres about their long axes. It was not suggested that this was relevant for achieving an anisotropic speed of sound, and nor were the claims limited in this respect. Rather, the speed-of-sound ratio would depend on the extent to which the long axes of the fibres were parallel to one another. Considering that, as was confirmed in paragraph [0090] of the patent, the orientation of the fibres along the direction of the melt flow occurred both in the surface zones and in the interior zone, adjusting the temperatures of the mould and the melt and, hence, changing the proportion of surface zone vs. interior zone would not control the degree of orientation of fibres in the melt flow direction, as was suggested by the respondent. The patent was completely silent on how to ensure that there was sufficient alignment of the long axes of the fibres with the flow direction so that an anisotropic speed of sound was achieved. Whilst the skilled person was aware that some fibre alignment along the flow direction arose during injection moulding (or other flow processing), they did not possess the knowledge as to how to reproduce the microstructures described in the patent. At most, they would know that achieving a certain fibre alignment was complex and depended on many factors. As there was no guidance whatsoever on how the flow velocity and the temperatures of the melt and the mould might impact the end result, and given the vast array of options for the materials, the skilled person was left to essentially

guess which of the possible permutations was to be selected. This amounted to nothing more than an invitation for the skilled person to perform a research programme, since only through trial and error could they establish whether a particular choice of numerous parameters provided a satisfactory result.

In conclusion, the opposition division was incorrect to find that the invention of claim 1 met the requirements of Article 83 EPC.

Auxiliary requests - sufficiency of disclosure

The amended claims of auxiliary requests 1 to 3 did not remedy the objection to the main request under Article 83 EPC, but actually highlighted further issues of lack of sufficiency. As regards feature 1.6', the patent failed to disclose how the lignin content had to be determined. Actually, a number of test procedures existed that would yield significantly different values for one and the same sample. As regards feature 1.4', there was absolutely no teaching in the patent on how to control the degree of fibre alignment along the flow direction, let alone on how to ensure that at least 80% of the fibre components comprised an averaged deviation angle less than 40 degrees at a direction of the melt flow of the composite. The patent simply assumed that fibre orientation along the melt flow direction would be achieved in any injection moulding scenario in which the mould temperature was less than the melt temperature.

Therefore, also with the amendments of auxiliary requests 1 to 3 the patent failed to disclose the invention in a sufficiently clear and complete manner

for it to be carried out by a person skilled in the art.

Refund of appeal fee

On account of the substantial procedural violation in the decision under appeal, a refund of the appeal fee was requested.

XIV. The respondent's submissions were essentially as follows.

Substantial procedural violation

Contrary to the appellant’s allegation, their right to be heard had not been violated. The appellant was given the opportunity to present arguments under Article 84 EPC, including on the issue of clarity, during the oral proceedings, as evidenced by point 3 of the minutes. However, the appellant confined their arguments to the issue of the description as granted being inconsistent with the amended claims since the description disclosed non-wood material as well as wood material. The appellant's focus on the absence of an adapted description was evident from the summary of the parties’ arguments and the chairman’s comments in section 3 of the minutes. The decision under appeal contained adequate reasoning in view of the extent of the arguments under Article 84 EPC presented by the appellant during the oral proceedings. As acknowledged by the appellant, it was stated in sections 2.1.1 and 2.1.2 of the reasons that claims 1 and 2 of the respondent's main request were clear in the sense of Article 84 EPC. Therefore, there was no procedural violation, still less a substantial procedural violation.

Main request - sufficiency of disclosure

The patent disclosed that the composite of claim 1 could be produced by melt moulding, such as injection moulding. This gave rise to a melt flow direction (f_m) in the composite, see paragraph [0071]. Suitable thermoplastic polymers were disclosed in paragraphs [0049] to [0053] of the patent, and suitable wood materials were disclosed in paragraphs [0034] to [0036] of the patent. Paragraphs [0046] and [0054] of the patent highlighted the suitability of thermoplastic polymers for melt moulding with fibres and other components. From Table 1 it was apparent that wood material was inherently anisotropic. Effectively, paragraph [0060] confirmed that the speed of sound in the direction across the wood grain was as low as one third compared to the direction of the grain, i.e. the direction in which the longitudinal dimensions of the wood fibres were aligned. Paragraph [0087] of the patent then explained that the speed of sound in the melt flow direction could be made higher than the speed of sound perpendicular to the melt flow direction by controlling the orientation of the fibres. Figures 1b, 2a and 2b depicted the alignment of the longitudinal dimensions of fibres in the melt flow direction. Paragraph [0088] and Figure 1b of the patent were relevant in that they set out that an alignment could be achieved by melt flow moulding, wherein the velocity of the melt, the temperature of the melt and temperature of the mould were controlled. The melt velocity was also referenced as a variable in paragraph [0092], along with the fibre content. The resulting composite material would have an anisotropic acoustic behaviour akin to wood material, so the skilled person would understand that adapting the melt velocity would

result in a composite with a speed-of-sound ratio within the claimed range. Paragraph [0088] of the patent also mentioned the longitudinal dimension of the fibres and their aspect ratios, and disclosed that not all of the fibres had to be oriented completely parallel with the melt flow direction. The fibre orientation could be examined by electron microscopy or X-ray imaging. Furthermore, paragraph [0030] of the patent taught that fibres with a high shape ratio had a higher stiffness, and therefore a higher Young's modulus and a higher speed of sound which was defined in paragraph [0058] of the patent as the square root of the material's Young's modulus divided by the material's density. Paragraph [0109] of the patent explicitly indicated that the anisotropic nature of the composite could be modulated by increasing the fibre content. Suitable amounts of the fibres were disclosed in paragraphs [0062] and [0065] of the patent.

Table 2 of the patent set out experimentally determined values of the speed of sound perpendicular and parallel to the melt flow direction in a number of specific composites. It was not decisive that Table 2 did not provide any specific information on the materials used. Material 1 had a v_T of 850 m/s and a v_x of 2600 m/s, and therefore the ratio was 0.3. Material 2 has a v_T of 770 m/s and a v_x of 2400 m/s, and therefore the ratio was also 0.3. This value fell squarely within the range defined in claim 1. In view of the disclosed preference for a thermoplastic polymer matrix and wood fibres, the skilled person would understand that a speed-of-sound ratio comparable to that calculated for materials 1 and 2 of Table 2 could be achieved for composites containing a thermoplastic polymer matrix and wood fibres. The skilled person would be able to select a suitable fibre shape ratio and manufacturing conditions

based on the patent description. The results in Table 2 for material 4 clearly showed that the speed of sound increased as the fibre content increased.

Further relevant experimental information was provided in paragraph [0062] and Table 4 of the patent. Undoubtedly, Table 4 provided specific modulus values for composites containing polypropylene and different amounts of soft wood cellulose (kraft pulp), i.e. the material mentioned earlier in paragraph [0062]. Table 4 was a part of that paragraph. In a common sense reading, the last sentence of the paragraph unmistakably referred to the materials mentioned before. In addition, the increase "over 140 percent" was consistent with the first and last specific modulus values in Table 4. It had to be considered that polypropylene was the most suitable matrix material for melt flow moulding and that the specific type of polypropylene or softwood cellulose was not so critical. The speed-of-sound values given in Table 1 of the patent were only typical; they could deviate in reality. On account of the softwood fibres, the acoustic behaviour of the composites of Table 4 was already anisotropic. Regarding the lignin content of the fibres, it was clear that this must have been reduced by the kraft pulp process. The results in Table 4 illustrated that the Young's modulus increased to a greater extent than the density as the fibre content, such that the specific modulus increased with the fibre content. Since the speed of sound was proportional to the specific modulus, it also had to increase with the fibre content. For example, a fibre content of 40 wt% would yield a speed of sound of 1909 m/s. This demonstrated how the speed of sound could be controlled by adjusting the content of wood fibres in a thermoplastic polymer matrix. The fact that the values

in Table 2 for 40 wt% were slightly different could mean that the direction of measurement was different. But the skilled person would conclude from the data that a fibre content of 40 wt% was likely to result in a composite material with longitudinally oriented fibres so that the speed-of-sound ratio was conform to claim 1.

In paragraph [0111], it was demonstrated with reference to the scanning electron microscope images in Figures 7 and 8 that lowering the velocity of the melt during moulding increased the thickness of the surface zones, in which the longitudinal dimensions of the fibres were oriented in the melt flow direction and the major axes were substantially parallel to the surface of the composite. The transverse orientation mentioned in this paragraph was less critical.

Paragraph [0118] of the patent disclosed that, for any given mould, it was possible to predict the orientation of the organic natural fibres.

Based on these disclosures, the skilled person would understand that the content of the organic natural fibre material was a key factor for determining the speed-of-sound ratio and that a higher degree of orientation of the fibres in the melt flow direction gave rise to a higher speed of sound in this direction relative to the perpendicular direction, i.e. a lower speed-of-sound ratio. The orientation could be controlled by adjusting the melt moulding conditions including the velocity and the temperature. The speed-of-sound ratio could then be calculated based on the Young's moduli in the perpendicular and parallel directions. Further, the patent explained that the Young's modulus of fibres could be increased by

increasing the shape ratio of the fibres. Suitable fibre lengths and shape ratios were disclosed in the patent.

Regarding the experimental report D18 filed by the appellant, the speed-of-sound ratio reported for Test 2 was 0.93. This value fell within the range of 0.15 to 0.9 defined in claim 1 of the patent, when expressed to the same degree of accuracy as the upper limit of the claimed range. Thus, the appellant actually demonstrated with that test that composites in accordance with claim 1 could be produced without undue burden.

In sum, the appellant did not show that there were serious, substantiated doubts regarding the performance of the claimed invention. In contrast, the opposition division's reasoning set out in the decision under appeal was sound. Even if the patent did not have a self-contained "examples" section, it contained technical information throughout the description which made it plausible that the composites according to claim 1 could be produced. Hence, the requirements of Article 83 EPC were met.

Auxiliary requests - sufficiency of disclosure

Claim 1 of auxiliary requests 1 to 3 also specified the lignin content of the wood material. It followed from paragraph [0075] of the patent that the Kraft process could be used to reduce the lignin content so that the fibres would orient more easily in the melt flow direction rather than stick together. The appellant's objection against claim 1 of auxiliary request 1 in view of the lignin content was no more than a disguised

clarity attack. The patent was not required to disclose multiple ways of achieving the claimed lignin content.

Claim 1 of auxiliary requests 2 and 3 was further limited by specifying the dimensions of the fibre components. Together with the lignin content, this was relevant to the Young's modulus and, thus, to the speed-of-sound ratio achieved by the composite, see paragraph [0030] of the patent. The shape ratio of feature 1.7 also contributed to the longitudinal alignment of the fibres and therefore yielded a higher speed of sound in the melt flow direction.

For the above reasons, the requirements of Article 83 EPC were met for each of auxiliary requests 1 to 3.

Reasons for the Decision

Substantial procedural violation

1. In the proceedings before the opposition division, the appellant had raised several objections under Article 84 EPC against claims 1 and 2 of the respondent's main request. This is evident from pages 3/24 and 4/24 of its letter dated 6 August 2021 which was the final date for making written submissions in preparation for the oral proceedings held before the opposition division. In that letter, it was argued that the term "wood material" used in claims 1 and 2 of the main request did not have a well-defined meaning, as it encompassed an infinity of materials that consisted of or comprised wood, or that were derived from wood but could not be distinguished over other non-wood materials. Furthermore, an objection of lack of support by the description was raised with regard to the same feature of claims 1 and 2 of the main request.

2. The appellant's grievance with the clarity of claims 1 and 2 of the respondent's main request was acknowledged by the respondent on page 3 of its letter dated 4 October 2021 ("*The Opponent not only alleges lack of clarity, but also alleges that the amended claims do not satisfy the support requirements of Article 84 EPC [...]*").

3. Point 3 of the minutes of the oral proceedings held before the opposition division indicates that the matter was discussed between the parties. The top paragraph on page 4 of the minutes explicitly states that, following a deliberation break from 10:56 to 11:03, the chairman ("CH") announced that the opposition division ("OD") was of the opinion that claim 1 of the main request was clear. Moreover, from pages 7 and 8 of the minutes it is clear that the support by the description was discussed at the end of the oral proceedings.

4. Nevertheless, the opposition division's finding on the matter of clarity is not reflected in the decision under appeal. Clarity is only addressed at the end of points 2.1.1 and 2.1.2 (on pages 7 and 9) of the reasons in the following terms:

> "*The introduction of the amendment to the granted claim does not raise a clarity issue (G3/14), such that the Division is of the view that claim [...] is clear, and to satisfy* [sic] *the requirements of Article 84 EPC*".

5. This somewhat cryptic formulation can be understood to mean either that the appellant's clarity objections were found not to arise out of amendments made to

claims 1 and 2 in opposition proceedings so that, pursuant to decision **G 3/14**, these claims might not be examined for compliance with the requirements of Article 84 EPC, or that they *did* arise out of the amendments but were not considered to be convincing. Either way, the opposition division did not explain how it arrived at its conclusion. The board and the parties are left to speculate why the meaning of the term "wood material" was held to be clear, or why the unclarity invoked by the appellant was found to have already existed in the claims of the patent as granted.

6. The absence of explanation is at odds with the principle that, for a decision to be reasoned pursuant to Rule 111(2) EPC, it must be complete and self-contained (**T 1123/04**, Reasons 3.3). In view of the above considerations, the decision under appeal is insufficiently reasoned, contrary to the requirements of Rule 111(2) EPC, and, hence, suffers from a substantial procedural violation.

Admittance of document D18

7. The appellant filed document D18 for the first time with their statement of grounds of appeal. The late-filed document entitled "D18 - reworking of EP2914412" describes the methodology and results of two tests carried out by the appellant in an attempt to rework the invention by following the teaching of the patent.

8. The appellant's reasoning for admitting document D18 is convincing. The board is satisfied that the experimental data are a direct reaction to the opposition division's reasoning provided in point 3.3.1 of the decision under appeal and, as such, could or should not have been filed already in the proceedings

before the opposition division. At the oral proceedings held before the board the respondent no longer maintained their initial request not to admit document D18 into the appeal proceedings, but instead presented a line of argument based on the second test of document D18.

9. Having regard to the above considerations, the board exercised its discretion under Article 12(4) and (6) RPBA to admit document D18 into the appeal proceedings.

Main request - sufficiency of disclosure

10. The main issue to be decided in this appeal is whether the claimed invention is disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 EPC). More specifically, it has to be established whether the patent, supplemented where necessary with common general knowledge, provides sufficient information to enable the skilled person to manufacture a composite comprising a melt flow direction (feature 1.1), a matrix of thermoplastic polymer material (feature 1.2) and fibre components of wood material (features 1.3 and 1.6), which satisfies the following conditions:
- at least part of the longitudinal dimensions of the fibre components has been oriented substantially parallel with a direction of the melt flow (feature 1.4), and
- the ratio v_T/v_x of the speed of sound lies in the range of 0.15 to 0.9 (feature 1.5).

11. Paragraph [0088] of the patent explains that during the manufacture of a composite, the fibre components flow inside the melt between the surfaces 104 of a mould 160 (illustrated in Figure 1b) "*such that the longitudinal*

dimension D1 of the fibre component 100 is substantially oriented along the direction of the melt flow f_m". Injection moulding is mentioned in paragraph [0054] and [0108] of the patent. Thus, it is reasonable to assume that the injection of a mixture of a thermoplastic polymer with wood fibres between the plates of a mould has the effect that the fibres tend to take an orientation parallel to the flow direction. This is confirmed by document D11, see pages 78 to 80. Sufficient disclosure is thus provided to enable a person skilled in the art to manufacture a composite with the condition of feature 1.4. This conclusion does, however, not extend to feature 1.5, for the following reasons.

12. The orientation of the fibres with the melt flow direction entails some degree of anisotropy which, as paragraph [0090] of the patent suggests, likely has an effect on the acoustic properties of the composite structure. Indeed, it follows from the definition of the speed of sound in paragraph [0058] of the patent (speed of sound = √(Young's modulus/density)) that an increase in Young's modulus for a given density yields a higher speed of sound. Furthermore, the values provided in Table 1 of the patent indicate that sound waves propagate at higher speed along wood fibres than in a thermoplastic matrix material. A composite which complies with features 1.1 to 1.4 and 1.6 is therefore likely to have a lower speed of sound in a direction perpendicular to the melt flow (v_T) than in a direction parallel to the melt flow (v_X). Paragraph [0087] of the patent confirms that the speed of sound may be highest in the direction of the melt flow due to the orientation of the fibre components. Against this background, the respondent's argument that a change in

the ratio v_T/v_x can be achieved by controlling the orientation of the fibres is persuasive.

13. The question that poses itself is then: how does one control the orientation of the fibres such that a predetermined value for the ratio v_T/v_x is achieved? Paragraphs [0088] and [0092] of the patent reveal that the velocity v1 of the melt flow and the temperatures tp1 and tp2 of melt and mould, respectively, are process conditions that influence the fibre orientation in the melt flow direction. But the patent does not further elaborate how this works. No explanation is provided how the simulation software mentioned in paragraph [0118] operates to predict the fibre orientation. In fact, the patent does not contain any example, in terms of a given velocity v1 and temperatures tp1 and tp2 resulting in a composite with desired fibre orientation, which the skilled person could follow in order to reliably make a product falling within the terms of claim 1. The skilled person would thus be at a loss how to determine the process conditions resulting in a fibre orientation that would ensure a ratio v_T/v_x in the claimed range of 0.15 to 0.9.

14. For the sake of completeness, the board wishes to point out that the velocity v1 and temperatures tp1 and tp2 not only influence the fibre orientation in a longitudinal, melt flow direction, but also in a *transverse* direction, at least when they have a so-called "flake form" (see paragraphs [0032], [0072] and Figure 1a of the patent). Based on the explanations given in paragraphs [0099] and [0111] of the patent, it seems that the width axis Ax1 of most of the fibre components is typically oriented in a different manner in the surface zones (the thickness of which depends on

the velocity v1 and on the temperatures tp1 and tp2, see paragraph [0088]) compared to the interior zone of the melt flow. Given that a different fibre orientation in a transverse direction will most likely have an impact on the tensile stress of the composite in all the possible transverse directions perpendicular to the melt flow direction, it is reasonable to assume that the speed of sound v_T in any direction perpendicular to the melt flow direction will also change with the process conditions v1, tp1 and tp2. Yet the patent does not provide any information at all on how this is put into practice, i.e. which melt velocity v1 and which temperatures tp1 and tp2 yield a ratio v_T/v_X within the claimed range of 0.15 to 0.9.

15. The respondent referred to Table 2 in paragraph [0085] of the patent, which sets out experimentally determined values for v_X and v_T for composites with different fibre contents. However, the table does not contain any indication whatsoever of process conditions, such as melt velocity or mould temperature, under which the desired change in fibre orientation and, ultimately, the values for the speed of sound were achieved. Moreover, Table 2 relates to "[s]*peed of sound in some composite materials (1, 2, 3 and 4) comprising organic natural fibre material (between 30 and 50 w-%)*" (emphasis by the board). The actual materials used in the composites of Table 2 are unknown. The matrix material may comprise a thermoplastic polymer in accordance with feature 1.2, but it may also be a thermoset polymer (see paragraph [0045] of the patent). The fibre material does not necessarily have to be a wood material (see paragraph [0029] of the patent). In sum, the fact that the ratio v_T/v_X of the first two composites of Table 2 equals 0.33 and 0.32,

respectively, is not helpful in the absence of any information on materials or process conditions.

16. Table 4 of the patent is different in that it lists the density (in g/cm^3), the tensile (or: Young's) modulus (in MPa) and the specific modulus (in $MPa/g/cm^3$) of four different samples referred to in the table heading as "*some composite materials comprising natural organic fibre material*". The mere fact that Table 4 is part of paragraph [0062] and that some of the values in Table 4 correspond with the increase in specific modulus "*over 140 percent*" mentioned in the paragraph does not demonstrate beyond doubt that the samples of Table 4 were manufactured as a mixture of "*polypropylene and soft wood cellulose (kraft pulp)*" (cf. the second sentence of paragraph [0062]). It is thus a matter of conjecture which of the many options presented in paragraphs [0044] to [0053] of the patent served as the matrix material for the samples of Table 4. Nor is it apparent which organic fibre material from among those listed in paragraphs [0033] to [0042] of the patent was used. But even if the samples comprised a polypropylene matrix material and softwood cellulose fibres, the skilled person would still be left to guess what the *exact* composition of the matrix was, which type of softwood was used (see the options in paragraph [0036] of the patent), how much lignin was left in the softwood fibres (see paragraph [0035] of the patent), which form and length the fibres had and how they were treated (see paragraphs [0030] to [0035] and [0037] to [0039] of the patent), and which fillers were added to the respective composite mixtures (see paragraph [0055] of the patent). Irrespective of any link between Table 4 and the materials mentioned in paragraph [0062], however, it remains a fact that the process conditions

for obtaining the density and tensile modulus values of Table 4 are unknown.

17. At this junction it is not without importance to note that Table 4, which the respondent argues is key in proving that the invention is sufficiently disclosed, does not specify in which direction the tensile moduli of the different samples were measured. The theoretical values for the speed of sound that can be calculated from each tensile modulus and density value provided in the table are therefore meaningless when determining how the ratio of a speed of sound in a melt flow direction and a speed of sound in a direction perpendicular thereto can be controlled. Assuming for a moment that Tables 2 and 4 relate to the same materials - for which there is no basis in the patent - it is striking to the board that the values provided in Table 2 for the material with fibre content 40 wt%, i.e. a speed of sound of 2400 resp. 2600 m/s in melt flow direction, are nowhere close to the speed of sound that can be obtained from the corresponding sample with fibre content 40 wt% of Table 4 ($\sqrt{}$(tensile modulus/ density) = $\sqrt{}(3900.10^6/1{,}07.10^3)$ = 1909 m/s). Contrary to the respondent's assertions, Table 4 is thus unable to fill the disclosure gap the patent leaves in respect of feature 1.5.

18. In a further line of argument, the respondent referred to document D18 and submitted that the speed-of-sound ratio of 0.93 reported for the second test fell within the range of 0.15 to 0.9 when expressed to the same degree of accuracy as the upper limit of the claimed range. The board cannot accept this argument. Firstly, interpreting the upper end point (0.9) of the claimed range to include all values that could be rounded down to 0.9 inevitably results in expanding the subject-

matter of claim 1 beyond the indicated limits (see also **T 74/98**, Reasons 3.2, and **T 1570/19**, Reasons 6.2.3). Secondly, in view of the accuracy of the lower end point (0.15) of the claimed range, any rounding should be carried out, if at all, to the second digit after the decimal point (the hundredths). With the values for v_T and v_X given on page 16 of document D18, a speed-of-sound ratio of 1707/1833 = 0.93126 is obtained, which, rounded down to the hundredths, yields 0.93, i.e. well outside of the claimed range. A further aspect to consider when relying on the content of document D18 in the context of sufficiency of disclosure is that the vast number of parameters and process conditions listed on pages 1 and 2 of document D18, all of which seem to have been essential for the methodology of the tests, would require the skilled person to embark on a research programme that is so extensive that it has to amount to an undue burden.

19. The opposition division's reasoning in point 3.3.1 on page 12 of the decision under appeal that the skilled person based on the disclosure of the patent was able to prepare composites with features 1.2, 1.3, 1.4 and 1.6 and "*determine the v_T/v_X without difficulty*", seems to confuse the ability to ascertain whether a product satisfies a certain condition with the skill of reproducing a product that fulfills this condition. As set out above, the absence in the patent of adequate information on the process conditions would force the skilled person to carry out extensive trial-and-error experiments on arbitrarily selected mixtures of thermoplastic polymer and wood fibre components in an attempt to reproduce a composite that satisfies the condition of feature 1.5.

20. Therefore, the opposition division erred in its finding that the requirements of Article 83 EPC are met. The respondent's main request is thus not allowable.

Auxiliary requests - sufficiency of disclosure

21. In the board's view, none of the amendments to claim 1 of the respondent's auxiliary requests 1 to 3 overcomes the objection under Article 83 EPC against claim 1 of the respondent's main request. Neither the upper limit on the lignin content (feature 1.6'), nor the lower limit on the share of fibre components that have a certain shape ratio (feature 1.7), nor the definition of the fibre orientation in terms of an averaged deviation angle less than 40 degrees (feature 1.4') is able to remedy the insufficient guidance in the patent on the materials and the process conditions required to arrive at a ratio v_T/v_X within the claimed range of 0.15 to 0.9 (see points 10. to 20. above).

22. The respondent submitted, with reference to paragraphs [0030] and [0088] of the patent, that the shape ratio of the fibre components limited by feature 1.7 had an impact on the longitudinal alignment of the fibres and therefore yielded a higher speed of sound in the melt flow direction. The board observes that paragraph [0088] of the patent does not refer to a shape ratio of the longitudinal dimension (D1) to the vertical dimension (D3) but to "*an aspect ratio D1/D2 of at least 5 to 1*", which means that the length of the fibre must be at least five times the *width* of the fibre (see also paragraph [0032] of the patent). Nonetheless, while the shape ratio defined in paragraph [0030] of the patent certainly influences the alignment of the fibres in the melt flow direction and, thus, the ratio ratio v_T/v_X (see point 14. above), it remains totally

unclear under which process conditions a composite with the condition of feature 1.5 would be achieved.

23. As regards the amended feature 1.4' of auxiliary request 3, it is noted that the expression "deviation angle (α1)" is only mentioned in paragraphs [0088] and [0089] of the patent, where it is defined as "*the angle between the longitudinal axis Ax3 and the direction S_x of the melt flow f_m, as illustrated in Figure 1c*". The parameter is introduced in an attempt to quantify the requirement mentioned before in paragraph [0088] that "*the longitudinal dimension D1 of the fibre component 100 is substantially oriented along the direction of the melt flow f_m*". As set out in point 13. above, no information is provided by the patent on the process conditions necessary to control the fibre orientation in the direction of the melt flow. It is then all the more difficult to deduce from the patent how an averaged deviation angle less than 40 degrees is obtained for at least 80% of the fibre components.

24. In view of the above considerations, the board concludes that claim 1 of each of the respondent's auxiliary requests 1 to 3 fails to meet the requirements of Article 83 EPC. Auxiliary requests 1 to 3 are therefore not allowable.

Conclusion

25. As none of the respondent's requests is allowable, the patent must be revoked.

Refund of appeal fee

26. In the present case, the requirements of Rule 103(1)(a) EPC are fulfilled: the board deems the appeal allowable

and the reimbursement of the appeal fee is clearly equitable by reason of the substantial procedural violation in the decision under appeal. Therefore, the full reimbursement of the appeal fee is justified.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

3. The appeal fee is reimbursed.

The Registrar: The Chairman:

N. Schneider P. Lanz

Decision electronically authenticated