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Datasheet for the decision of 3 December 2008

Case Number: T 0337/04 - 3.3.05

Application Number: 95937881.1

Publication Number: 0790962

IPC: C03C 13/00

Language of the proceedings: EN

Title of invention:
Man-made vitreous fibres

Patentee:
Rockwool International A/S

Opponents:
Isover Saint Gobain
Knauf Insulation GmbH
Paroc Oy Ab
Saint-Gobain Isover AB

Headword:
Mineral fibres II/ROCKWOOL

Relevant legal provisions (EPC 1973):
EPC Art. 100(b)

Keyword:
"Sufficiency of disclosure: no
- claimed subject-matter limited by a range of values of a parameter which is to be calculated, not measured
- incomplete teaching of the reference document setting out the calculation model to be used when determining the parameter value
- determination of the calculated parameter value not possible throughout the whole ambit of the claim due to a lack of the required data
- completing the teaching of the reference document requires an undue amount of experimentation"

Decisions cited:
T 0435/91, T 0409/91

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0337/04 **-** 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 3 December 2008

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Decision under appeal:

Decision of the Opposition Division of the European Patent Office posted 5 February 2004 revoking European patent No. 0790962 pursuant to Article 102(1) EPC 1973.

Composition of the Board:

Chairman: G. Raths
Members: B. Czech
S. Hoffmann

Summary of Facts and Submissions

I. The appeal lies from the decision of the opposition division revoking European patent No. 0 790 962.

II. The patent was amended during the opposition procedure. The amended claim 1 according to the sole request underlying the contested decision reads as follows:

"1. A method of making man-made vitreous fibre products comprising forming one or more mineral melt compositions and forming fibres from the or each melt characterised in that

the melt viscosity and the fibre dissolution rate as defined herein at a pH in the range 4-5 are determined for the or each composition,

a composition is selected which has a viscosity at 1400°C of 10 to 70 poise and provides fibres which have a dissolution rate as defined herein of at least 20nm per day when measured at a pH of 4.5 and a sintering temperature of at least 800°C and which includes, by weight of oxides,

SiO_2	32 to 48%
Al_2O_3	above 16 up to 28%
CaO	10 to below 28%
MgO	2 to 20%
FeO	2 to 15%
$Na_2O + K_2O$	0 to 12%
TiO_2	0 to 4%
Other Elements	0 to 8%

and the selected composition is utilised for making the man-made vitreous fibres."

III. The documents considered in the opposition procedure include the following:

A12: Glafo Report 008461-2;

A13: Glafo Report 008512

A14: Glafo Report 008629 - Fibre P;

C24a: Glafo Report 018693-2;

C26: T. Lakatos et al., "Viscosity and Liquidus Temperature relations in the Mineral-Wool part of the system SiO_2-Al_2O_3-CaO-MgO-Alkalies-FeO-Fe_2O_3"; Glasteknisk Tidskrift, 36(1981):4, pages 51 to 56

C28: Y. Bottinga and D. Weill, "The viscosity of magmatic silicate liquids: A model for calculation"; American Journal of Science, Vol.272, May 1972, pages 438 to 475;

A38: Glafo Reports 018693-D9 to 018693-D9

A43: Summary of the patent proprietor's arguments concerning the issue of sufficiency of disclosure;

A44: Letter of Ms Guldberg / reply of Prof. Dingwell dated 2 and 30 October 2001, respectively.

A46: Letter and comments ("Stellungnahme") of Prof. Conradt of 19 January 2001

IV. In the contested decision the opposition division inter alia found that the patent as amended during the

opposition procedure was not objectionable under Article 100(c) EPC and also met the requirement of sufficiency of disclosure. Having regard to the various objections raised under Article 100(b) EPC, the opposition division inter alia accepted (point 4.1 of the reasons) that the "analysis of the fibres so formed had a composition as indicated in the claim" and that "the viscosity criteria stated in the claim refer to a melt, but a melt having a composition equivalent to the fibres". It considered (see point 4.2 of the Reasons) that the melt viscosity values reported in the patent in suit were not measured, but calculated according to the approach published by Bottinga and Weill in document C28 ("BW/C28" hereinafter), and that the parameters appearing in the claim "define additional limitations to the compositional ranges". Concerning the calculation of melt viscosity values according to the BW/C28 model, the opposition division came to the following conclusions (point 4.2.1 of the reasons): "It can be accepted that BW does not allow calculating all viscosities within the claimed range. However, it was not disputed that certain, if not most compositions can be treated in the proposed way, with plausible results. By extrapolation of the missing D-values from neighbouring values, more compositions can be calculated. Still existing gaps can then be filled, if necessary, by experimental viscosity determination, using standard methods and equipment. The results so obtained can be calibrated against the calculated values in such a way that a consistent set of data is obtained. Although this could sometimes involve considerable experimental effort, compared with the suggested calculation according to BW, it does not imply that the patent could not be worked. Viscosity

measurements are routine in the art of mineral fibre manufacture. There is thus no undue experimental burden, as in T 32/85."

V. Together with its statement of grounds of appeal dated 15 June 2004, the appellant (proprietor of the patent - Rockwool International A/S) filed six sets of claims as main and as first to fifth auxiliary requests, respectively, the claims according to the main request being identical to the ones underlying the decision of the opposition division. The appellant approved the findings of the opposition division concerning sufficiency of disclosure without going into details. In support of its arguments relating essentially to novelty and inventive step issues, the appellant relied on its earlier written submissions and also filed a submission labelled "A39A - History of biodegradable mineral fibres" and further references.

VI. In its reply of 20 December 2004, respondent 2 (Knauf Insulation GmbH) maintained an objection under Article 100(c) EPC against an amendment made during the opposition procedure to dependent claim 4 (former claim 5 as granted). It referred to further documents in support of novelty and inventive step objections. Moreover, it contested the findings of the opposition division concerning the various objections under Article 100(b) EPC that had been raised during the opposition procedure. In particular, respondent 2 raised objections under Article 100(b) EPC inter alia having regard to the term "*composition*" and to the viscosity criterion comprised in claim 1. Concerning the latter, it discussed the information content of C28 and pointed out the lack of data for $KAlO_2$ and $NaAlO_2$ at

low SiO_2 mole fractions and for some of the "*other elements*", including B_2O_3 and P_2O_5, which according to claim 1 may be present in amounts of up to 8% in the melt composition. Referring to the further document

A57: An experimental report of Prof. Suvorov of 2003,

it also addressed the difficulties involved in measuring the melt viscosities of compositions as defined in claim 1.

Further objections raised under Article 100(b) EPC concerned the features "*fibre dissolution rate*" and "*sintering temperature*".

VII. In its reply dated 3 January 2005, respondent 3 (Paroc Oy AB) raised objections under Articles 100(a) and (b) EPC against the claims according to the appellant's main request. Having regard to sufficiency of disclosure, it inter alia pointed out the lack of data required for the viscosity calculations according to C28 for a part of the compositions defined in the claims. It moreover alleged a lack of proper guidance in the patent in suit for the determination and adjustment of the parameters appearing in the claims.

VIII. In its further written submissions dated 27 January 2006, 7 April 2006, 18 August 2006 and 18 February 2008 appellant 1 further developed its argumentation concerning insufficiency of disclosure having regard inter alia to the features "*composition*", "*viscosity*" and "*fibre dissolution rate*" by referring inter alia to the following further documents, and expressly making

the contents of A83 (an opinion of Prof. Jestädt) part of its argumentation:
A80.1: ARP Report A007/4133/06;

A80.2: Report LAB 849/06 Prof. Meisel - Leoben;

A82.1: Report of Prof. Mengel; and

A82.2: Report Dr Kirschner - Leoben.

IX. The parties were summoned to oral proceedings.

X. In its letter dated 23 July 2008, the appellant commented on the objections raised and the documents submitted so far, including A80.1/A80.2 and A82.1/A82.2 (see points 7.12 and 7.22 to 7.26). It considered that the latter should not be admitted to the proceedings in view of their late filing and lack of relevance. The appellant also referred to further documents in connection with novelty and inventive step. It also commented on sufficiency of disclosure. In connection with its arguments relating to the calculation of viscosities according to BW/C28, it also relied on documents A43, C24a and on the further document

C48c: Table with viscosity calculations "according to the Bottinga-Weill model".

XI. In a letter dated 24 September 2008, respondent 2 submitted further arguments in support of its earlier objections, in particular with respect to the issue of sufficiency of disclosure, and relied on some further documents and evidence.

XII. In a letter dated 14 October 2008, respondent 1 submitted comments essentially focussed on the issues of novelty and inventive step.

XIII. In a letter dated 31 October 2008, respondent 3 submitted some further comments, inter alia concerning viscosity calculations and the measuring of fibre dissolution rates.

XIV. In a further letter filed on 11 November 2008, the appellant submitted detailed comments on the issue of sufficiency of disclosure having regard to the "*composition*" feature and the parameters "*viscosity*" (calculated according to BW/C28), "*sintering temperature*" and "*dissolution rate*" appearing in claim 1. Having regard to the calculated viscosity, he also referred to the further document

A87: M. Korsgaard et al., "Derivation of the temperature dependent constants for $KAlO_2$ and $NaAlO_2$ in a viscosity predictive model for high aluminosilicate melts"; Glass. Sci. Technol. 76 (2003) No.6, p. 270-275.

XV. On 13 November 2008 the board dispatched a communication in preparation for the oral proceedings, addressing inter alia the issues raised in connection with the questions of sufficiency of disclosure. More particularly the board indicated the following:
"6.2 It may also have to be assessed whether the disclosure of the patent in suit is sufficiently clear and complete to enable the skilled person to actually determine the four parameter values, individually or in

combination, for a given fibre / fibre composition without undue burden"; and

"6.3 Concerning the viscosity parameter, the board notes that the method to be used for determining its value is not indicated in the present claims. According to the description of the patent in suit (page 3, lines 34 to 36) the viscosity may be determined "*either by deduction from data, or by measurement and/or calculation*".

XVI. In a further letter of 17 November 2008, respondent 2 submitted further comments, inter alia concerning the "*composition*" feature.

XVII. On 21 November 2008 the appellant filed retyped versions of the sets of claims according to its pending requests. Claim 1 according to the appellant's main request is identical in wording with claim 1 of the sole request underlying the decision under appeal (see point II above).

XVIII. Oral proceedings were held on 2 and 3 December 2008.

At the oral proceedings, the issue of sufficiency was extensively discussed, inter alia having regard to the features "*composition*" and the parameters "*viscosity*", "*fibre dissolution rate*" and "*sintering temperature*". It was also controversially discussed whether the guidance given in the patent in suit was sufficient for finding suitable compositions, and whether the skilled person was able to correlate without undue burden the results of the parameter values determined according to the first part of claim 1 with the values to be satisfied by the compositions selected and utilised for

making the fibres according to the second part of claim 1.

During the oral proceedings, the appellant filed a further amended set of claims as new first auxiliary request replacing the auxiliary requests previously on file. Claim 1 of the said set reads as follows (amendments relative to claim 1 according to the main request **highlighted** by the board):

"1. A method of making man-made vitreous fibre products comprising forming one or more mineral melt compositions and forming fibres from the or each melt characterised in that

the melt viscosity ***calculated according to Bottinga and Weill, American Journal of Science Volume 272, May 1972, page 455-474*** *and the fibre dissolution rate* ***measured according to the test protocol*** *as defined herein* ***at*** *pH* ***4.5*** *are determined for the or each composition,*

a composition is selected which has a viscosity at 1400°C of 10 to 70 poise ***calculated according to Bottinga and Weill, American Journal of Science Volume 272, May 1972, page 455-474*** *and provides fibres which have a dissolution rate* ***when measured according to the test protocol*** *as defined herein of at least 20nm per day at a pH of 4.5 and a sintering temperature of at least 800°C and which includes, by weight of oxides,*

SiO_2	32 to 48%
Al_2O_3	above 16 up to 28%
CaO	10 to below 28%
MgO	2 to 20%
FeO	2 to 15%

$Na_2O + K_2O$	*0 to 12%*
TiO_2	*0 to 4%*
Other Elements	*0 to 8%*

and the selected composition is utilised for making the man-made vitreous fibres."

At the end of the oral proceedings the board announced its decision.

XIX. The arguments of the appellant, as far as they are of relevance for the present decision, can be summarised as follows:

The new auxiliary request was admissible since it was filed in response to arguments relating to the correlation of the data which are of relevance in the different steps of the claimed method, which arguments only emerged during the oral proceedings. Moreover, the amendments proposed did not impose a particular burden on the other parties.

The amended claims according to both requests found a basis in the application as originally filed.

Claim 1 according to the main request clearly related to a method comprising a first testing step (also called "scoping" step by the appellant) followed by a step comprising selecting a composition meeting the compositional, viscosity, dissolution rate and sintering temperature criteria, and using the selected composition for making the fibre end-product. The scoping step comprised making fibres from one or more melt compositions, measuring the dissolution rate of

the fibres made, and determining the viscosity of the one or more melts, either by measurement or by calculation, as indicated in the description of the patent in suit (page 3, lines 30 to 36). For instance, another calculation approach as described in C26 could also be used in the scoping step, as long as the value obtained could be correlated to a corresponding viscosity value calculated according to the BW model. Based on the results of the scoping test and knowing their correlation with the values to be satisfied by the composition to be used for making the final fibre product, the skilled person was in a position to select compositions meeting the criteria recited in claim 1 without undue burden.

As could be inferred from page 5, lines 54 to 55 of the patent in suit, the composition selected to be used for producing the end-products had to be chosen such as to have a viscosity value calculated according to BW/C28 falling in the range of 10 to 70 poise. The insertion, into claim 1 according to the auxiliary request, of the reference to BW/C28 in connection with the "*selecting*" step, was merely made "for absolute clarity".

The "*composition*" indicated in claim 1 was the composition of the melt and the fibres made therefrom, which was the same. Since the viscosity value was a calculated one, it could also be quoted with respect to a fibre composition. The definition of the composition also embraced compositions not having the required calculated viscosity. Although according to claim 1 boron and phosphorus oxides could be present in amounts of up to 8 weight %, the two components were only

optional components. In practice, boron would often be absent in naturally occurring raw materials.

BW/C28 was a highly respected document and calculation techniques very closely based on the teachings of BW were also used by at least two of the respondents. The compositions as defined in claim 1 also encompassed compositions having a calculated viscosity falling outside the claimed range. However, the skilled person would have no difficulty in calculating the viscosity value according to BW across the entire compositional ranges in claim 1. Although BW/C28 did not indicate any D_i values for inter alia B_2O_3, P_2O_5, and $NaAlO_2$ and $KAlO_2$ as major components when $0.35 < X_{SiO2} < 0.45$, the skilled person would follow the suggestions in C28 and make the necessary extrapolations and approximations. Concerning P_2O_5, the approach expressly suggested by C28 was to add phosphorus to silicon. Concerning boron, the same approach was appropriate. C28 did not say that these approaches cannot be used or would lead to wrong values for these components present in minor amounts. There was no evidence that this approach was wrong. Generally speaking, C28 did not say that calculations cannot be made when data are missing, it rather invited the skilled person to make estimations. As far as necessary at all, the skilled person could check by doing a little bit of research whether the adopted estimation approaches were appropriate. In fact, there was no need to conduct a research programme. Work of the type described in A87, a master student's project, merely allowed to check whether a particular approximation approach suggested in C28 was correct.

XX. The arguments of the respondents, as far as they are of relevance for the present decision, can be summarised as follows:

The new auxiliary request was not admissible in view of its late filing and considering also that it gave rise to new objections and did not overcome at least some of the other pending objections.

Some of the amendments to the claims (both requests) were objectionable under Article 123(2) EPC.

Claim 1 was broader than asserted by the appellant and did not clearly impose a certain order of the steps or a necessity to actually carry out the first step.

In connection with its objections concerning sufficiency of disclosure, respondent 2 argued that it was not clear whether, considering the contents of the description of the patent in suit, the "*composition*" defined in claim 1 by virtue of its chemical composition related to the composition of the raw material mix and/or of the melt and/or of the fibres. Depending on the particular components and processing equipment and conditions, it was possible that the composition of the melt differed from the one of the raw material mix and that the composition of the melt could change to some extent (documents A80.1/A80.2) before it was actually formed into fibres.

The respondents accepted that the mandatory calculation of viscosities according to BW/C28 was possible for certain compositions falling within the ranges indicated in claim 1, but emphasised that such

calculations were not possible for a substantial number of compositions comprising components and/or amounts of components with respect to which C28 did not contain any or at least not enough information on how to consider them in the calculation. More particularly, C28 did not contain any information whatsoever concerning inter alia melts comprising B_2O_3 and melts comprising P_2O_5 in more than very small amounts. Such compositions were, however, encompassed by the compositional ranges in claim 1. Claim 1 was not limited to usual rock wool compositions und could contain inter alia up to 8 % of other elements, e.g. B_2O_3 and P_2O_5. Therefore, in the absence of indications in C28 concerning the D_i values to be applied for inter alia B_2O_3, P_2O_5 at higher concentrations, and $NaAlO_2$ and $KAlO_2$ as major components when $0.35 < X_{SiO2} < 0.45$, and of indications concerning their estimation by approximation or extrapolation, the skilled person could not calculate the viscosity of such compositions using the model described in C28. As could be inferred from document A14 with respect to the handling of missing $NaAlO_2$ data, there was no general agreement amongst experts on how to apply BW/C28 in such cases. The respondents also emphasised that compositions as defined in claim 1 in terms of their oxide components also encompassed compositions having viscosities falling outside the claimed viscosity range. Consequently, the skilled person could not, based on the patent in suit, C28 and common general knowledge, reproduce the claimed invention. Moreover, the skilled person could not be expected to find the required D_i values experimentally. The necessary experimental effort amounted to an undue burden. In particular, referring to C57, respondent 2 argued that the mineral

melts under consideration were not Newtonian liquids. High temperature melt viscosity measurements were difficult and not a usual routine for the skilled person (documents A82.1/A82.2), and would lead to different results depending on the measuring method used. The patent did not contain any information on how the viscosities could be measured and how a measured viscosity could be correlated with a viscosity calculated according to BW/C28. Moreover, a measured viscosity could deviate substantially from the corresponding viscosity calculated according to BW/C28.

XXI. The appellant requested that the contested decision be set aside and the patent be maintained on the basis of the claims according to the main request filed on 21 November 2008 or, in the alternative, on the basis of the claims according to the new first auxiliary request filed during the oral proceedings.

The respondents (opponents 1, 2, 3 and 4) requested that the appeal be dismissed.

Reasons for the Decision

Late filed evidence (A80.1/A80.2 and A82.1/A82.2)

1. As noted in the board's communication in preparation for the oral proceedings (point 6.6), the appellant had the opportunity to comment and did comment in detail on the relevance of documents which were cited by respondent 2 at a relatively late stage of the appeal proceedings, inter alia A80.1/A80.2 and A82.1. and A82.2; see the appellant's letters dated 23 July 2008

(points 7.22 to 7.26) and 11 November 2008 (points 2.2.3 and 2.2.5). The board also considered that more than two years elapsed between the filing of said evidence and the date of the oral proceedings, that said evidence was filed by respondent 2 to further corroborate some of its earlier statements, and that said evidence is of prima facie relevance (see points 6.1 and 15.4.1 below).

The board exercising its discretionary power under Article 114(2) EPC thus decided to consider the said documents despite their late filing.

Main request - Amendments

2. The respondents raised no objections under Article 100(c) EPC against present claim 1. The board sees no reason for deviating from the positive finding of the opposition division concerning the allowability of a claim with the wording of present claim 1 (see point II hereinabove) and is thus satisfied that claim 1 in its present wording is not objectionable under Article 100(c) EPC.

3. The board does not consider it necessary to discuss the allowability of the amendments to dependent claim 4, since the patent as amended suffers in any case from an insufficiency of disclosure having regard to the features of claim 1 which relate to the calculated melt viscosity (see points 7 to 17 below).

Main request - Claim 1 - Meaning of the terms

4. The process steps involved

The board accepts that, taking into account the description of the patent (page 3, lines 30 to 40 and lines 53 to 54), claim 1 can be understood to include processes comprising:
i) a scoping stage comprising forming one or more mineral melt compositions, measuring the dissolution rate of fibres made from the or each melt, and determining the viscosity of the melt composition by measurement or calculation; and
ii) based on the results of the scoping stage, selecting a composition falling within the compositional ranges indicated in the claim and having specific properties, inter alia a viscosity at 1400°C of 10 to 70 poise, and utilising the selected composition for making fibres.

5. Viscosity values are calculated according to BW/C28

On page 5, lines 54 to 55 of the patent in suit (see also page 12, lines 25 to 28 of WO 96/14272 A2), the following is stated: "*In this specification the viscosity **in poise at 1400°C** is calculated according to Bottinga and Weill, American Journal of Science Volume 272, May 1972, page 455-475*" (emphasis added). Considering that according to claim 1 "*a composition is selected which has a viscosity **at 1400°C** of 10 to 70 **poise** ...*" (emphasis added), the board also accepts that the latter range must be understood as referring to the viscosity values of the selected compositions which are to be calculated according to Bottinga and

Weill, American Journal of Science Volume 272, May 1972, page 455 [sic] to 475.

6. The "*composition*" defined in terms of weight-% ranges

6.1 The board acknowledges that in the description of the patent in suit (page 2, lines 5 to 9; page 5, lines 5 to 10 and lines 57 to 58) the term "*composition*" is sometimes also used in connection with the composition of the mineral raw material mix to be melted in the course of the fibre fabrication. Depending on the process conditions and the nature of the raw materials, the composition of the melt may differ from the composition of the raw material mix and may change during the melting due to volatilisation, reduction and/or oven lining dissolution phenomena (see e.g. the results reported in A80.1/A80.2). This was not disputed by the appellant, see e.g. A43, points 67 to 69; points 7.22 and 7.23 of its letter dated 23 July 2008.

6.1.1 However, despite the somewhat misleading references to the composition of the raw material mix in the description, it is clearly apparent from the patent as a whole including the description that the aim is to identify compositions for providing fibres having controlled properties (inter alia a certain minimum *dissolution rate* and a certain minimum *sintering temperature*), which properties inter alia depend on the composition of the fibres formed. Therefore, the board accepts the view of the appellant, that the skilled person would understand that the term "*composition*" in claim 1 designates the composition of the chemical composition of the fibres actually made and of the melt from which said fibres are spun, notwithstanding the

fact that the latter composition may change over time during industrial fibre production, and that it may differ from the compositions of the raw material mix and/or of the melt at some intermediate processing stage.

Main request - Insufficiency of disclosure

7. Insufficiency of disclosure, inter alia with respect to the viscosity feature, was one of the main issues in the present case. According to established jurisprudence of the boards of appeal, the requirement of sufficiency of disclosure is only met provided the invention as defined in the independent claim can be performed by the person skilled in the art within the whole area claimed without the burden of an undue amount of experimentation, taking into consideration common general knowledge and the whole information content of the patent in suit (see decisions T 435/91, OJ 1995, 188, point 2.2.1, third paragraph, of the reasons, and T 409/91, OJ 1994, 653, point 2, first paragraph, penultimate sentence).

8. As mentioned under point 4 hereinabove, the invention as claimed comprises a step of "***selecting***" a composition having inter alia both

i) a composition falling within the indicated compositional ranges

and

ii) a viscosity, calculated according to the model of BW/C28, of 10 to 70 poise at 1400°C,

and utilising the selected composition for making fibres.

8.1 In order for the requirement of sufficiency of disclosure to be fulfilled in the present case, the skilled person must thus be able to ascertain that the composition he selects for making fibres therefrom meets inter alia the said viscosity criterion. The skilled person can, for instance, check this by directly calculating the viscosity at 1400°C of the selected composition according to the BW/C28 model.

8.2 Alternatively, according to the appellant, he can derive the value to be compared to the claimed viscosity range from a value obtained in the scoping test (see page 3, lines 30 to 36 of the patent in suit). This alternative however requires that the skilled person can correlate the values as obtained in the scoping test and the corresponding values calculated according to the BW model.

However, irrespective of whether or not establishing such correlations on the basis of the information available to the skilled person amounts to an undue burden as submitted by the respondents, it presupposes that the skilled person is actually able to calculate the viscosities at 1400°C according to the BW/C28 model for all compositions that may potentially be selected, i.e. throughout the compositional ranges indicated in claim 1. To correlate viscosity values determined in the scoping test, corresponding target values, i.e. values calculated according to BW/C28, must be available in the first place. Otherwise correlation "curves" or "tables" as referred to by the appellant cannot be created.

In the particular case mentioned at the oral proceedings, where the melt viscosity determination in the scoping test is carried out by a calculation according to BW/C28, but at a temperature different from 1400°C, this calculation must also be possible across the whole compositional area defined in claim 1 in order to permit an extrapolation to the calculated value at 1400°C along the lines indicated in BW/C28 (page 457, 4th full sentence; page 468, last paragraph, first sentence).

8.3 The skilled person wanting to work the invention must thus in any case be able to calculate viscosities at 1400° according to the BW model as described in C28 for compositions having analyses throughout the ranges indicated in claim 1. Otherwise, he will not be able to perform the step consisting in selecting a composition to be utilised for making the man-made vitreous fibres which has a viscosity value falling within the range indicated in claim 1 and to disregard compositions which don't meet this viscosity criterion.

8.4 As will appear from the following, the appellant's position that the invention is sufficiently disclosed cannot be accepted, since the skilled person cannot simply rely on what is disclosed in C28 to calculate viscosities across the whole area defined by the compositional ranges indicated in claim 1, and is thus not in a position to carry out the claimed invention over the whole ambit of claim 1.

9. Ambit of claim 1

9.1 Compositions embraced by the compositional ranges

9.1.1 Besides the five mandatory components SiO_2, Al_2O_3, CaO, MgO and FeO, the composition as defined in claim 1 may also comprise substantial amounts of further optional components. For instance, they may comprise TiO_2 in amounts of up to 4% by weight and $Na_2O + K_2O$ in amounts of up to 12 % by weight.

Moreover, the composition may also comprise one or more optional "*other elements*" in significant amounts (calculated as oxides) of "*up to 8%*" by weight in total. Claim 1 is, however, silent about the nature of these "*other elements*".

9.1.2 Only the description of the patent in suit (page 4, lines 26 to 28) contains a non-exhaustive list of "*other elements*" that "*can be present in the composition in any amount that does not detract from the desired properties and which does not exceed 8%*": P_2O_5, B_2O_3, BaO, ZrO_2, MnO, ZnO and V_2O_5 are specifically mentioned as examples of such "*other elements*".

9.1.3 With regard to the amounts of these "*other elements*", it is indicated in the description only (page 4, lines 33 to 35), that "*each of the other elements is **normally** present in an amount of not more than 2%, except than **P_2O_3*** [sic] ***and/or B_2O_3 may be present in larger amounts***" (emphasis added by the board). Moreover, it is expressly mentioned (page 4, lines 29 to 32) inter alia that "*often B_2O_3 is absent*", but also that "***preferably**, there is 1 to **8%** ... **P_2O_5** and 0 to **5%** **B_2O_3***".

On page 5, lines 5 to 8, it is stated that the composition to be melted is "***typically***" formed by blending naturally occurring rock and sand materials and waste materials. It is noted that phosphorus-containing (apatite) and boron-containing materials are expressly mentioned as possible raw materials.

9.1.4 Claim 1 itself contains no qualitative indications concerning the nature of the raw materials that may be used or of the so called "***other elements***", and the only quantitative limitation with respect to the latter is that their total amount may be "***up to 8 %***" by weight. In the description, amounts of up to 8% P_2O_5 are expressly preferred. The upper limit of 5% B_2O_3 indicated in the description is only a preferred limit, larger amounts are thus not excluded by the claim.

9.1.5 Therefore, for the board, the definition of the fibre composition selected and utilised for making fibres according to claim 1 is not even limited to compositions formed from the specific raw materials "***typically***" used according to the description of the patent in suit (page 5, lines 5 to 8). So, the compositions that may potentially be selected according to present claim 1 are defined rather broadly and may even comprise oxide components not expressly mentioned as examples on page 4, lines 26 to 28 of the patent in suit.

9.1.6 From the above, the board concludes that present claim 1 embraces the making of man-made vitreous fibres from selected compositions comprising one or more oxide forming elements not specifically mentioned in the claim or in the description in amounts of up to 8% by

weight in total, provided these compositions meet - inter alia - the recited viscosity requirement. The set of compositions which have a composition as defined in claim 1 by weight of oxides and which may thus potentially be selected, embraces the subset of all those compositions comprising up to 8 % by weight of one "*other*" element, e.g. B_2O_3 or P_2O_5.

9.2 Calculated viscosity range as a further limitation

As expressly reconfirmed by the appellant at the oral proceedings, the compositional ranges recited in claim 1 embrace compositions with viscosities falling outside of the claimed range (see e.g. the two examples mentioned in point 2.2.9 of the letter dated 11 November 2008), the viscosity range thus constituting a limiting feature. Claim 1 is thus restricted to the making of fibres from those selected melt compositions which not only have a composition falling within the recited compositional ranges, but which additionally meet inter alia the requirement of a melt viscosity value falling within the recited numerical range, the value to be considered being the viscosity value calculated according to the model of BW/C28 (see point 5 above).

10. The Bottinga and Weill model as described in C28

10.1 C28 describes a model for calculating, instead of measuring, the viscosities of multi-component silicate liquids (i.e. melts) based on their composition according to the formula

$$\ln \eta = \sum_i X_i D_i \qquad (1),$$

wherein η is the viscosity, X_i is the mole fraction of the ***i***-th component, D_i is a constant associated with component ***i*** over a restricted range (in terms of mole percent SiO_2) of composition, and each temperature has a particular set of D_i constants. The D_i constants tabulated in C28 (Table 3 on pages 452 to 456) were determined by mathematical methods based on measured viscosity data (2440 data points) extracted from a preferred set of published references that were available to the authors (C28: page 441, Table 1).

10.2 C28 is primarily concerned with a model for predicting, by means of calculations, the viscosities of naturally occurring magmatic liquids, and the application of the model to geologic problems involving viscosity (see e.g. the title; the abstract; page 460, second paragraph, first and last sentence; page 471, "Concluding remarks", first sentence). Applications in the field of mineral fibre manufacturing are not addressed. The authors of C28 specifically mention (in the paragraph bridging pages 442 and 443) that having regard to the evaluation of the reliability of the method more measured data would be "very desirable" for the components K_2O, Fe_2O_3, TiO_2, FeO and MnO, i.e. even for some of the components explicitly recited in present claim 1.

10.3 The authors of C28 indicate (see page 451, section "Viscosity calculations", first paragraph) that in some cases a direct viscosity calculation is not possible for lack of input data in Table 3, which "makes it necessary to estimate ***Di*** values for certain components". Since the "paper is concerned primarily with geological applications", the authors have "chosen several compositions representative of the magmatic range in

order to discuss the calculations and necessary approximations". The authors of C28 recommend (see page 457, second paragraph) that "for all major components", i.e. components present in amounts of > 5 mole %, "only the D_i values actually listed in table 3 be used" and they consider that viscosity calculations will only be possible as far as the D_i values are available for the temperature ranges concerned, although the linear temperature dependence may be extrapolated to some extent.

10.4 Having regard to some specific cases where the necessary D_i values are missing for the relevant SiO_2 mole fraction range in Table 3, the authors of C28 give some specific guidance on how to carry out the calculations based on certain estimations or approximations (see the section "Viscosity calculations" extending over pages 451 and 457 to 460). Some express guidance is given (see page 451, last paragraph, page 458, first paragraph, to page 459, first paragraph) on how to deal with certain components of the representative magmatic compositions, i.e. with iron, "small amounts" of phosphorous, with potassium in the form of $KAlO_2$, with "minor amounts" (< 5 mole%) of TiO_2 or sodium oxide in the form of $NaAlO_2$ in the composition range $0.35 < X_{SiO2} < 0.45$ (page 458, last paragraph), and with "minor" MO components (i.e. bivalent metal oxides).

10.5 According to C28 (page 457, first paragraph), a "small amount of phosphorous usually present in magmas is added to silicon (compare calculations in table 4)". From the said Table 4, which lists the compositions of several representative magma types, it can be gathered

that the amounts considered as "small" are in the range of 0.5 to 0.53 % by weight.

10.6 However, in developing and testing their model, the authors of C28 have not considered compositions comprising significant amounts of some of the other oxides specifically mentioned in the patent in suit as possible "*other elements*" in the description of the patent in suit. For instance, ZnO, B_2O_3 and ZrO_2 are not mentioned in C28 at all, and V_2O_5 is only mentioned in connection with measurements which were disregarded as source of input data by the authors (see C28: page 441, last full sentence; Tables 1, 4 and 6).

11. The board notes that it has not been disputed by the respondents that the viscosities of **certain** SiO_2 based melt compositions to be used in mineral fibre production can actually be calculated using the BW model described in C28, instead of being measured, see e.g. the Glafo report A38.

The board is aware that each oxide of an "*other element*" which is present only in a minor amount of up to e.g. 1 mole % (corresponding to a mole fraction of 0.01) may - at least when considered individually - only have an insignificant impact on the viscosity as determined according to formula (1) because the corresponding term D_iX_i may be very small and thus contribute very little to the sum of these terms and hence to the calculated viscosity.

11.1 However, the question that must be answered in the first place in the present case is whether or not the person skilled in the art, considering the contents of

the patent in suit and of C28, as well as common general knowledge on the filing date of the patent in suit, was in a position to calculate the viscosities of melt compositions having analyses throughout the ranges indicated in claim 1.

11.1.1 As already set out under point 9.1.6 hereinabove, the compositional ranges in claim 1 embrace, inter alia, the subset of compositions comprising relatively high amounts of up to 8 % by weight of B_2O_3 or P_2O_5. Only when the skilled person is in a position to actually calculate the viscosity values of such compositions up to the limit of 8 % by weight of B_2O_3 or P_2O_5 he will be able to check whether this calculated value falls within or without a given range.

12. The limitations in the teaching of document C28

C28 describes a model for predicting instead of measuring the viscosities of multi-component silicate melts. At first glance C28, which is praised as a most respected reference in viscosity calculations, appears to describe a simple calculation of the viscosity of multi-component melts requiring not much more than filling in available data in the formula (1). However, when trying to apply the calculation model of C28 to all of the compositions embraced by the compositional ranges in claim 1 (see point 9.1 above), the skilled person is in certain cases confronted with difficulties due to a lack of data and to gaps in the information provided in C28. The teaching in C28 is incomplete insofar as the BW model as set out therein is not fully applicable to all the compositions as defined in present claim 1.

12.1 Teaching in C28 is incomplete insofar as certain D_i-values are missing

12.1.1 The straightforward viscosity calculation according to formula (1) of C28 requires that for each component of the melt composition present in a significant amount, the corresponding D_i value must be known. This is not the case for a substantial number of compositions belonging to subsets embraced by the compositional definition in claim 1 and thus falling within the compositional ranges indicated.

12.1.2 In particular, the said straightforward viscosity calculation according to formula (1) of C28 is not possible for compositions comprising amounts up to 8 weight % of B_2O_3 or P_2O_5 for lack of the required D_i values.

12.2 Teaching in C28 is incomplete insofar as certain necessary estimations are not indicated

12.2.1 As mentioned under point 10.3 above, the authors of C28 indicate that in some cases, estimated or approximated D_i values of certain components may be used in the calculation when the required D_i values are not tabulated.

12.2.2 However, C28 contains no guidance whatsoever (see sections "Chemical dependence of viscosity – General", pages 443 to 444, and section "Viscosity calculations", pages 451 and 457 to 460) having regard to approximations or estimations that could be applied in the case where a composition contains B_2O_3 in more than

just a negligible amount, let alone in a higher amount of up to 8% by weight.

12.2.3 Having regard to phosphorus, C28 does not comprise any express information on how to deal with amounts substantially higher than the "small amounts" of at most 0.53 % by weight reported in Table 4.

12.2.4 Having regard to compositions comprising B_2O_3 or P_2O_5 in amounts of up to 8 % by weight, C28 thus not only lacks the required D_i values but also lacks indications concerning the specific approximations to be applied. The board thus concludes that the skilled person was not in a position to calculate, based on estimations or approximations, in a reliable way a viscosity value according to BW/C28 as required by claim 1 for at least those compositions falling within the compositional ranges of claim 1 which comprise B_2O_3 or P_2O_5 in an amount which is not "small" in the sense of C28 but relatively high, and which may be up to 8 % by weight.

13. Incomplete teaching in C28 calls estimations to be made by the skilled person into question

13.1 According to the appellant, C28 teaches to make best efforts to approximate or estimate or derive averages when a particular value is missing (see e.g. A43, point 36). By doing so, the skilled person would be able to calculate the melt viscosities of the compositions throughout the whole area claimed. These considerations are, however, not convincing for the board since reliable estimations cannot be made for all the compositions falling within the compositional ranges in claim 1 for the following reasons.

13.2 The authors of C28 indeed state that in some cases "lack of sufficient input data makes it necessary to estimate D_i values for certain components" (page 451, section "Viscosity calculations", second sentence). Notwithstanding the fact that some guidance is given in C28 on how to estimate or approximate the required values for some components of typical magmatic compositions reported in Table 4 of C28, no guidance is given in C28 on how to estimate, approximate or derive appropriate $\boldsymbol{D_i}$ values for B_2O_3 or P_2O_5 when present in relatively high amounts of up to 8% by weight (see point 12.2.4 hereinabove).

13.3 Instead, it must be noted that the authors of C28 emphasise (see the first sentence on page 446) that "a satisfactory quantitative model of viscosity-composition variation must be more discriminating than the usual "network former" and "network modifier" categories". However, C28 does not contain theoretical considerations which could be considered as a basis for enabling the skilled person to make the appropriate, scientifically sound estimations of the missing $\boldsymbol{D_i}$ values required in the case of the compositions mentioned under point 12.2.4 above.

13.3.1 In particular, nothing can be derived from C28 itself concerning the interaction of B_2O_3 with a silicate network in a multi-component melt and the appellant did not present arguments in this respect.

13.3.2 As far as phosphorus is concerned, the specific considerations that actually lead the authors of C28 to recommend adding "small amounts" of phosphorus to silicon are not indicated either. Hence, no information

can be gathered from C28 concerning an appropriate way for approximating or estimating the D_i value for P_2O_5 present in the composition in amounts of up to 8 % by weight, i.e. in amounts that may be several times higher than the "small amounts" reported in Table 4 of C28, irrespective of whether they have to be considered as a "major" or "minor" component in the sense of C28.

13.4 Since the authors of C28 recommend that for components present in relatively high amounts, in particular for components present in amounts beyond the somewhat arbitrary limit of > 5 mole % (see A46, page 2 of the "Stellungnahme", first paragraph), only the D_i values listed in Table 3 are to be used, the board takes the view that the skilled person would consider that at least for containing B_2O_3 or P_2O_5 in relatively high amounts of up to 8 % by weight, and in particular in amounts towards the upper end of this range, an estimation of the corresponding D_i value would not be appropriate, let alone without experimental confirmation (in this respect, see point 15 below).

13.5 The patent in suit contains no information concerning the D_i values to be used when calculating the viscosities of compositions comprising significant amounts of B_2O_3 or P_2O_5. Little information is given concerning the qualitative and quantitative impact of boron or phosphorus on the viscosity of the compositions. In particular, the patent in suit comprises no example of a composition containing boron or phosphorus. The board notes that in the description of the patent in suit (page 4, line 29) it is merely stated that "*it is often desirable to include* P_2O_5 *and/or* B_2O_3 ***for instance*** *to adjust melt properties* ***or*** *to*

adjust solubility" (emphasis added by the board), which melt properties include in particular the viscosity and the liquidus temperature (see page 2, lines 10 to 12). Concerning phosphorus, it is also stated in the description (page 4, lines 4 to 6), that a decreased amount of SiO_2 (tending to lower the viscosity) is to be compensated by the addition of P_2O_5 "*in order to maintain melt properties*". The skilled person could thus arguably derive therefrom that an addition of P_2O_5 tends to raise the viscosity. The board however considers that the information contained in the quoted passages is not specific enough to constitute guidance for estimating the appropriate D_i value to be used when calculating the viscosity of compositions containing B_2O_3 or P_2O_5 in relatively high amounts of up to 8 % by weight according to formula (1) given in C28.

13.6 No evidence was brought to the board's attention showing that a specific approach for estimating the respective D_i values for the B_2O_3 or P_2O_5 components present in relatively high amounts of up to 8 weight % in compositions as referred to in present claim 1 belonged to common general knowledge at the filing date of the patent in suit.

13.6.1 Neither documents C24a and C48c referred to by the appellant in connection with the issue of viscosity calculation, nor any of the other documents relied upon by the appellant in the present appeal proceedings, provides further information in this respect. C24a is silent about the presence of boron or phosphorus. Document C48C relied upon by the appellant reports results of "viscosity calculations according to the

Bottinga-Weill model", but P_2O_5 is expressly referred to as being "outside model".

13.6.2 Concerning B_2O_3 the appellant asserted at the oral proceedings that it was textbook knowledge that boron at low levels of up to about 5% as mentioned in the patent in suit acted like silicon, and because it had small atoms and was a network former, it would tend to increase viscosity. Hence, at such low levels boron would have to be handled in the same way as phosphorus when making the calculation according to BW, i.e. by adding it as mole % to the amount of silica. The validity of this assertion was, however, contested by respondent 1, who pointed out that usually boron was rather known as a fluxing agent ("un fondant"). The skilled person could thus not assume that boron would behave like silicon, in particular when present at relatively high amounts, and that the same coefficient could be applied for these two oxides.

Since there is no evidence on file which corroborates the contested assertion of the appellant, the board does not take the said assertion into account. But even if the assertion were to be taken into account, it would be too general to constitute guidance for estimating the appropriate D_i value to be used in the calculation.

13.6.3 At the oral proceedings, the appellant also held that the skilled person would follow the suggestion given in C28 and would also apply the approach indicated with respect to "small" amounts of phosphorus when calculating the viscosity of compositions comprising higher amounts. It asserted that the same approach was

applicable, since phosphorus behaved in this manner, i.e. like silica, over a wider range of concentrations, up to the levels mentioned in the patent in suit.

However, in the absence of corroborating evidence, and considering also C48c (see point 13.6.1), the board does not accept that the skilled person would understand that C28 actually suggests this approach and that he would necessarily envisage using this approach even in the case of compositions comprising P_2O_5 in much higher amounts of several % by weight and up to 8 % by weight.

13.6.4 The board thus considers that the approaches suggested by the appellant merely represent conceivable possibilities for approximation amongst others. The skilled person would thus not necessarily envisage a calculation based on these approximations, the validity of which would have to be tested and possibly confirmed by experimental investigations as indicated in C28 (in this respect see point 15. below).

14. Incomplete teaching in C28 does not permit the extension of the applicability of the BW model

14.1 Having regard to conceivable ways of estimating or approximating D_i values that might potentially be used by the skilled person in the calculation of viscosities along the lines indicated in C28, it is expedient to also consider documents A12, A13 and A14, which are reports issued by the renowned Glafo Research Institute. The contents of these reports confirm that the skilled person familiar with the model of BW/C28 would not necessarily consider extending the applicability of the

BW model beyond the approximations explicitly taught by C28.

14.1.1 In A12 (see the viscosity of 6.7 poise given for sample 11976) and A13 (see the viscosities of 6.7 versus 12.2 poise for sample 11976; and of 7.7 versus 13.3 poise for sample 12410) the Glafo experts report the results of calculations made either with or without the approximations stated in pages 457 to 459 of C28 (see A13, last full sentence). From A14, it can be gathered that the experts of Glafo expressly consider the text of C28 to be not "fully conclusive" and that there can be "difficulties with these calculations" (C14, page 1, sentence underneath the table of values). Referring to the specific composition which is identical to the composition "P" of the patent in suit, the Glafo experts conclude (see page 2, penultimate paragraph; page 3, first sentence) that the model of BW is "**not suitable** to calculate melt viscosities at 1400°C" (emphasis added by the board) of certain compositions containing a component (10.1 mole % $NaAlO_2$) for which the required D_i value and a specific estimation methodology are missing in C28 (see entire page 2). In A14, the Glafo experts also report a viscosity value calculated by taking into account only D_i values reported in C28, and based on choosing 0 as the value for the missing D_i factors (bottom of page 2), although they were obviously aware of the impact that disregarding approximations indicated in C28 may have on the calculated viscosity values. In this connection, the board also notes that the Glafo experts had no difficulty to calculate the viscosity of the composition referred to in document C24a invoked by the appellant. C24a however concerns a different

composition (9.0 mole % NaAlO2, but X_{SiO2} of 0.45) for which more the data are available in C28 (D_{NaAlO2} value reported in Table 3) than for composition "P" referred to in A14.

14.1.2 The board gathers from A14 that even the Glafo experts did not consider it expedient to estimate or approximate the missing D_i value for D_{NaAlO2}. More particularly, they did not consider it appropriate to follow the approach that the appellant considered to be "suggested" by C28, namely to take the D_{NaAlO2} value from the adjacent X_{SiO2} range (called "neighbouring table approach" by the appellant). In fact this approach was only adopted by BW in the case of compositions comprising much smaller amounts (0.63 and 0.10 % by weight) of Na_2O, which amounts are far below the minor/major threshold of 5 mole-% (see C28, the sentence bridging pages 458 and 459, and Table 4, columns (5) and (6)).

14.1.3 The appellant considered that the approach as adopted by the Glafo experts was not appropriate (see A43, points 35 to 40) since no effort was made to estimate or derive a suitable average value. In its view, the information contained in C28 and the patent in suit permitted an estimation of a D_i value for $NaAlO_2$ in the X_{SiO2} range form 0.35 to 0.45, which was more appropriate than choosing the value "0" and led to a lower error in the calculation. This view of the appellant is confirmed by Professor Dingwell and Professor Conradt, but only as far as the amount of $NaAlO_2$ comprised in a composition with X_{SiO2} in the 0.35 to 0.45 range is relatively close to the 5 mole % (i.e. the threshold value distinguishing minor from major components

according to C28); see A44; third paragraph of Ms Guldberg's letter; second, third and fifth paragraph of Professor Dingwell's reply and A46; page 2 of the "Stellungnahme". The opinions of these two experts are thus not in contradiction with the conclusions of the Glafo experts in A14, which relate to a different composition (10.1 mole % $NaAlO_2$, i.e. as major component) for which C28 contains less data than needed for calculating the viscosity. Therefore A44 and A46 have no bearing on the probative force of document A14.

14.2 Although the composition specifically dealt with in A14 does not comprise boron or phosphorus, A14 corroborates the board's view that the skilled person would not necessarily consider extending the applicability of the BW model beyond what is specifically taught by C28 in terms of approximations and estimations that may be made. More particularly, the skilled person would not necessarily consider applying the approach suggested in C28 concerning "small amounts" of P_2O_5, i.e. the "addition to silicon", in the calculation of viscosities of compositions comprising B_2O_3 or P_2O_5 in much higher amounts of up to 8% by weight.

14.3 The skilled person, taking into account common general knowledge, could thus not derive from C28 and the patent in suit the estimation or approximation to be applied in the case of compositions comprising B_2O_3 or P_2O_5 in relatively high amounts of up to 8 % by weight. To fill these gaps in C28, in order to be able to calculate the viscosities of such compositions "according to" BW/C28, the skilled person could thus only speculate about the "correct approach" (A43, point 42) for estimating or approximating "an

appropriate value" (A43, point 32) based on considerations not addressed in C28, and the viscosity calculated would thus depend on speculative D_i values.

14.4 In other words, depending on the specific underlying assumptions adopted by the skilled person, the estimations would not in any case give the same results.

Under these circumstances, for the board, the skilled person would have to grope in the dark because he is not in a position to calculate the viscosity of these compositions as required by claim 1, i.e. based on the information comprised in C28, the patent in suit and common general knowledge alone.

15. Incomplete teaching in C28 calls for undue amount of experimentation

15.1 According to the appellant, C28 also invited the skilled person to fill the gaps in the set of available data by means of additional measurements. Generating the measurements was within the competence of the skilled person, even though it may be rather time consuming (see A43, point 26). Such measurements were not necessary in the present case, since the D_i values for B_2O_3 or P_2O_5 present as minor components could be estimated along the lines given in C28. Experimental work of the type described in A87, which would merely confirm that the approaches were the right ones, would not go beyond what ought to be expected from the skilled person. The board also does not agree with these arguments for the following reasons.

15.2 The authors of C28 indeed suggest that their model can be improved and/or completed by gathering data from further viscosity measurements (see e.g. the sentence bridging pages 442 and 443, the first full sentence on page 458). Whilst their work was focussed on magmatic liquids and geologic applications and therefore did not consider compositions containing high amounts of certain components, they expressly left it "to others to **develop** additional applications and also to **test further its validity** as additional data are gathered" (see page 471, "Concluding remarks") (emphasis added by the board).

15.3 In order to be able to calculate viscosity values according to the model of C28 for the compositions referred to under point 13.4 above, the skilled person would thus first have to investigate experimentally the quantitative impact of specific components such as B_2O_3 and P_2O_5 on the viscosity of multi-component silicate melts in the SiO_2 mole fraction range(s) concerned. The investigations necessary for obtaining the correct D_i values or for checking the validity of an approximation not disclosed in C28 involve carrying out high temperature melt viscosity measurements, evaluating the data and cross-checking how they fit with the BW model.

15.4 The necessary viscosity measurements and the subsequent evaluative work cannot, however, be considered as a matter of mere experimental routine. As will appear from the following, the obtainable results will depend to some extent on choices to be made when carrying out the measurements and when evaluating their significance. Different choices will inevitably lead to different results.

15.4.1 As noted in C28 (and confirmed in point 34 of A43), accurate high-temperature viscosity measurements on multi-component silicate melts are difficult to perform and imply various considerations concerning inter alia the appropriate experimental setup, method and parameters. The difficulties to be expected by the person skilled in the art wanting to measure the high-temperature melt viscosity of compositions as defined in claim 1 are also illustrated by documents A82.1/A82.2 (see in particular point 3 of A82.2).

15.4.2 Difficulties having a potential impact on the results of the measurements, such as bubble formation, volatilisation of components and contamination of sample by the crucible proper control of the compositions are also extensively addressed in C28 itself, e.g. at page 440, third paragraph; page 441; page 442, first paragraph; page 461, second paragraph; page 465; page 466, first paragraph.

15.4.3 In this connection it is worth noting that Bottinga and Weill excluded several scientific publications of viscosity measurements, i.e. measurements carried out by persons skilled in the art of viscosity measurements, as data sources due to their contradiction with other measurements or because of insufficient evidence for the control of composition, and in particular measurements relating to the system SiO_2-Al_2O_3-CaO with additions of inter alia $\mathbf{P_2O_5}$ (see C28, page 441, lines 5 to 8). The skilled person reading C28 would thus expect these measurements to be particularly critical.

15.5 Moreover in C28 it is assumed that the melts behave as Newtonian fluids under the conditions considered in the

document (page 439, second paragraph). As can be gathered from the undisputed experimental results presented in A57, this is not necessarily the case in compositions as defined in claim 1. Moreover, a measured viscosity value for a given melt may deviate substantially from the viscosity calculated according to C28 for the same melt (see e.g. Table 5 of C28, calculated versus measured viscosity values at low X_{SiO2} values).

15.6 Neither the patent in suit nor C28 contains more specific instructions on how to carry out the viscosity measurements and evaluations required for determining the results to be used in the BW model for B_2O_3 or P_2O_5 in compositions as defined in claim 1. Moreover, a calibration of the measured data against C28 or patent data is not possible for these two oxides due to the lack of example compositions comprising a significant amount of B_2O_3 and/or P_2O_5 in more than "small amounts". The skilled person is thus forced to develop his own research program. For the board, there are however limitations to what can be expected from the skilled person.

15.7 As indicated in C28, with the newly gathered experimental data the skilled person will have to verify the validity of the calculation model, and of any approach based on approximations (see points 13.6.2 and 13.6.3 hereinabove). Using the words of the authors of C28, such work must be considered as the development of an additional application.

15.8 From the above, the board thus concludes that the experimental and evaluative work required from the

skilled person represents an undue amount of experimentation in the sense of decision T 435/91 (loc. cit.) The skilled person would actually be forced to generate all necessary data in order to be in a position to calculate the viscosities of melt compositions having analyses throughout the full ranges indicated in claim 1. This undue amount of experimentation requires more than routine means and manipulations and requires more than merely common general knowledge. The skilled person cannot be expected to embark on the scientific research programme required for testing the validity of given approximations and/or for finding the correct D_i values for the calculation of the parameter value which is needed for identifying those amongst the compositions falling within the compositional ranges of claim 1 which are actually the ones to be used according to the invention. Or, in other words, it is not up to the skilled person to overcome the limitations of the patent in suit and fill gaps left by the patentee in the information.

15.9 However, even if the skilled person would decide to carry out such experimental work, he would not be in a position to know with certainty whether Bottinga and Weill and/or the scientific community would also qualify the results obtained as the "right" ones to be used in calculating the melt viscosity "*according to Bottinga and Weill, American Journal of Science volume 272, May 1972, page 455-475*". So, the skilled person would be left in doubt whether or not he can rely on his results. Hence, the viscosity definition as chosen by the patentee does not allow the skilled person to decide in a reliable manner and for a substantial set

of compositions embraced by the compositional ranges of claim 1, whether or not he is actually working the claimed invention.

15.10 The board's view, that variations in the quality of the data or of the approximations used when applying the model of BW/C28, can lead to widely varying results, are illustrated by post-published document A87. Whereas the D_i value for $NaAlO_2$ at 1400°C to be used in the X_{SiO2} range of from 0.35 to 0.45 is 9.15 according to the "neighbouring table approach" described in C28, it was determined to be much lower, namely 4.50, based on the experimental work done according to A87 (see Table 5). Moreover, as it was pointed out by respondent 2 during oral proceedings, Figure 4 of A87 displays the correlation between the logarithm of the viscosity (lg η) and temperature. Considering the corresponding η values in poise for the data points at about 1400°C (1673 K), the value obtained using the neighbouring table approach (triangle) and the value obtained using the newly calculated D_i values (circle) do not match very closely.

15.11 At the oral proceedings, the appellant did not rely on one of the further documents cited in the course of the present appeal proceedings in connection with the specific issue addressed hereinabove. The board is also not aware of a document cited by the appellant in the present appeal proceedings which comprises further information in this respect and which would lead to a different conclusion.

16. Summarising, on the filing date of the patent in suit the skilled person was not in a position to calculate,

at least not without the burden of an undue amount of experimentation, the melt viscosity value "*according to Bottinga and Weill, American Journal of Science volume 272, May 1972, page 455-475*" as implicitly required by present claim 1 (see point 5) for a substantial number of melt compositions falling within the compositional ranges recited in the claim. Consequently, the skilled person wanting to carry out the claimed process would not be able to ascertain in a reliable way throughout the whole ambit of claim 1 whether or not a given composition falling within the indicated compositional ranges also meets the viscosity requirement and may thus be "*selected*" and "*utilised for making the man-made vitreous fibres*".

17. The board thus concludes that the patent in suit does not disclose the invention as claimed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 100(b) EPC).

18. Consequently, the appellant's main request cannot be allowed.

Auxiliary request - Admissibility

19. The difficulties encountered by the skilled person trying to establish a correlation between, on the one hand, the values obtainable in first, broadly defined scoping tests and, on the other hand, the parameter values to be respected when selecting a composition and utilising it for making the fibre products became more apparent during the oral proceedings. The proposed amendments are an attempt to overcome these concerns by defining more narrowly the ways in which certain

parameter values are to be determined. The amendments in the claims according to the new auxiliary request relate to aspects (measuring protocols for the fibre dissolution rate, viscosity calculation methods) that were extensively discussed during the oral proceedings before the new request was actually presented, and did not raise issues that could not be dealt with by the respondents at the oral proceedings.

Therefore the board, exercising its discretion under Article 13 RPBA, decided to admit the new auxiliary request.

Auxiliary request - Amendments

20. The present claim 1 refers to the same compositional ranges for the selected composition as claim 1 according to the main request, but it now comprises an explicit indication that the viscosity value to be considered when "***selecting***" is the viscosity calculated according to BW/C28.

20.1 The allowability of the amendment to claim 1 consisting in the said insertion of a reference to C28 was not objected to under Article 100(c) EPC by the respondents. The amendment in question finds a basis in the application as filed (see page 12, lines 25 to 28 of WO 96/14274) and is thus not objectionable under Article 100(c) EPC.

20.2 Questions raised by the other parties concerning the allowability of the other amendments to the claims need not be addressed since, as set out below (points 21 to

24), the auxiliary request fails in any case for the same reasons as the main request.

Auxiliary request - Sufficiency of the disclosure

21. The particular amendment to claim 1 consisting in the insertion of an express reference to BW/C28 is prima facie not suitable for overcoming the specific objection under Article 100(b) EPC which concerns the impossibility of calculating, according to the model of BW/C28, viscosities of certain subsets of compositions embraced by the compositional ranges of present claim 1, since the latter are identical to the ones recited in claim 1 according to the main request. The appellant also did also not argue accordingly.

22. However, a skilled person wanting to carry out the invention as defined in claim 1 must inter alia be in a position to ascertain, by means of a calculation according to BW/C28, the viscosity of melts having compositions across the whole area defined by the compositional ranges, and in particular also the sets of compositions mentioned under point 13.4 hereinabove.

23. Therefore, the considerations under points 4 and 6 to 17 hereinabove apply mutatis mutandis to the present auxiliary requests.

24. The present auxiliary requests are thus likewise objectionable under Article 100(b) EPC (insufficient disclosure).

25. The appellant's auxiliary request is thus not allowable either.

Other objections concerning sufficiency of disclosure

26. Since none of the appellant's requests is allowable for the above reasons, it is not necessary to deal with the respondent's other objections under Article 100(b) EPC addressed during the oral proceedings, concerning the "*parameters fibre dissolution rate*" and "*sintering temperature*", the lack of D_i values for $NaAlO_2$ and $KaAlO_2$ as major components, the alleged lack of correlation between the results obtained in the first scoping test and the parameter values to be satisfied by the composition selected and utilised for making the fibres, and the alleged lack of guidance in the patent in suit on how to find suitable compositions meeting all the criteria of claim 1.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chairman

C. Vodz G. Raths