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Datasheet for the decision of 18 October 2006

Case Number: T 0749/04 - 3.4.02

Application Number: 97301050.7

Publication Number: 0791973

IPC: H01M 4/62

Language of the proceedings: EN

Title of invention:
Vinylidene fluoride polymer-based binder solution and electrode-forming composition

Patentee:
Kureha Corporation

Opponent:
Solvay (Société Anonyme)

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54(2), 54(3), 56

Keyword:
"Novelty"
"Inventive step"

Decisions cited:
T 0279/89, T 0751/94

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0749/04 **-** 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 18 October 2006

Appellant: (Patent Proprietor)	Kureha Corporation 3-3-2, Nihonbashi-Hamacho, Chuo-ku Tokyo 103-8552 (JP)
Representative:	Gillard, Richard Edward Elkington and Fife LLP Prospect House 8 Pembroke Road Sevenoaks, Kent TN13 1XR (GB)
Respondent: (Opponent)	Solvay (Société Anonyme) Rue du Prince Albert, 33 B-1050 Bruxelles (BE)
Representative:	Jacques, Philippe Solvay S.A. Département de la Propriété Industrielle Rue de Ransbeek, 310 B-1120 Bruxelles (BE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 1 April 2004 revoking European patent No. 0791973 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
C. Rennie-Smith

Summary of Facts and Submissions

I. The appellant (patent proprietor) has lodged an appeal against the decision of the opposition division revoking European patent No. 0791973 (based on European patent application No. 97301050.7).

The opposition filed by the respondent (opponent) against the patent as a whole was based on the grounds for opposition of lack of novelty and lack of inventive step (Article 100(a) EPC).

In the decision under appeal the opposition division referred *inter alia* to the following documents and evidence

D1: EP-A-0782208
D2: US-A-4615943
D3: US-A-4784915
D4: Derwent machine-assisted translation of JP-A-6093025
D5: EP-A-0601815
D6: EP-A-0676676
D7: Encyclopedia of Polymer science and engineering, H F Mark *et al.*, Vol. 10, 1987, John Wiles & Sons, New York (USA); pages 1 to 19
A1: graph filed by the patent proprietor/appellant with its letter dated 04.02.2004
A2: graph filed by the opponent/respondent with its letter dated 05.02.2004,

and held that the claims according to the requests then on file were not novel or did not involve an inventive step (Articles 52(1), 54 and 56 EPC).

II. During the written appeal proceedings the appellant submitted the following evidence in support of its case:

D8: EP-A-0730316
D9: technical brochure "PVDF for solutions", Solvay S.A. and Solexis, Internet site; update of 20.02.2003
D10: technical brochure "KF Polymer", Kureha Chemical Industry Co., Ltd., Tokyo (JP), "91.10.25:0.5"
D12: "Solution properties of poly(vinylidene fluoride): 1. Macromolecular characterization of soluble samples", G Lutringer *et al.*, Polymer, Vol. 32, No. 5, 1991; pages 877 to 883
D13: graph and experimental results filed with the appellant's letter dated 30.08.2005
D14: Photos of experimental results filed with the same letter.

III. Oral proceedings were held before the Board on 18 October 2006 in the presence of the parties.

The appellant requested setting aside of the decision and the maintenance of the patent in amended form on the basis of the main request or of one of the first to seventh auxiliary requests filed with its letter dated 7 September 2006 or on the basis of the eighth auxiliary request filed during the oral proceedings.

The respondent requested the dismissal of the appeal.

At the end of the oral proceedings the Board gave its decision.

IV. Claim 1 according to the main request reads as follows:

"Use of a binder solution comprising a solution of a vinylidene fluoride polymer having an inherent viscosity of above 0.20 m^3/kg (2.0 dl/g) and at most 2.0 m^3/kg (20 dl/g) in an organic solvent for forming an electrode suitable for use in a non-aqueous electrolytic solution."

In the first auxiliary request claim 1 differs from the main request in that the expression "at most 2.0 m^3/kg (20 dl/g)" is replaced by the expression "at most 1.0 m^3/kg (10 dl/g)".

Claim 1 according to the second auxiliary request reads as follows:

"An electrode-forming composition for forming an electrode suitable for use in a non-aqueous electrolytic solution, comprising a mixture of a powdery electrode material with a binder solution, the binder solution comprising a solution of a vinylidene fluoride polymer having an inherent viscosity of above 0.20 $m^{3/}$kg (2.0 dl/g) and at most 2.0 m^3/kg (20 dl/g) in an organic solvent, wherein the weight ratio of the vinylidene fluoride polymer is 0.1 wt% or more with respect to the to the powdery electrode material and 4 wt% or less with respect to the total of the vinylidene fluoride polymer and the powdery electrode material."

Claim 1 according to the third auxiliary request reads as follows:

"A process for producing an electrode structure, comprising:
forming an electrode-forming composition comprising a mixture of a powdery electrode material with a binder solution formed by dissolving a vinylidene fluoride polymer having an inherent viscosity of above 0.20 m^3/kg (2.0 dl/g) and at most 2.0 m^3/kg (20 dl/g) in an organic solvent,
applying the electrode-forming composition at an elevated temperature onto at least one surface of an electroconductive substrate at an elevated temperature, and
evaporating the organic solvent to form a composite electrode layer comprising the powdery electrode material and the vinylidene fluoride polymer on the electroconductive substrate."

In the fourth to seventh auxiliary requests claim 1 differs from the third auxiliary request in that the expression "an elevated temperature" appearing twice in the wording of the claim is replaced by the expression "at least 30° C", "30-200° C", "at least 40° C", and "40-200° C", respectively.

In the eighth auxiliary request claim 1 differs from the second auxiliary request in that the expression "at most 2.0 m^3/kg (20 dl/g)" is replaced by the expression "at most 1.0 m^3/kg (10 dl/g)".

V. The arguments of the appellant in support of its requests can be summarised as follows:

Document D4 discloses a molecular weight of 50 000 to 500 000, but does not disclose the use of vinylidene fluoride polymers having an inherent viscosity above 2.0 dl/g. Document A1 shows a graph representing the correlation between inherent viscosity and number and weight average molecular weights for a preferred class of vinylidene fluoride polymers, the molecular weights being determined using the GPC (gel permeation chromatography) method of document D4. The Kureha polymers KF1000, KF1100 and KF1300 disclosed in the examples of document D4 have respectively an inherent viscosity of 1.0, 1.1 and 1.3 dl/g, a number average molecular weight of 114 000, 124 000 and 150 000, and a weight average molecular weight of 255 000, 288 000 and 350 000. However, according to document D4 the molecular weights of the polymers KF1000 and KF1100 are 150 000 and 170 000, respectively, i.e. they do not fit onto either correlation line of the graph of document A1. In addition, according to the graph of document A1 the upper value 500 000 for the number average molecular weight specified in document D4 would take the inherent viscosity well away from the polymers exemplified in D4, while the same value for the weight average molecular weight would have a maximum inherent viscosity of 1.7, i.e. more in agreement with the polymers KF1000, KF1100 and KF1300 exemplified in the document. Furthermore, as evidenced by document D12 (Tables 5 and 6), the determination of the molecular weight of a polyvinylidene fluoride polymer depends on the conditions and the method of determination (use of polystyrene or polyethylene oxide as standard, use of

DMF or NMP/LiBr as solvent, etc.), and document D4 is silent as to the solvent used in the GPC analysis. It follows that the disclosure of document D4 relating to the number average molecular weight is erroneous and that, in any case, the document does not contain a clear disclosure of an inherent viscosity above 2.0 dl/g.

Furthermore, there is correlation between molecular weight and inherent viscosity, but the correlation is not straight forward or reliable and changes markedly depending on the type of vinylidene fluoride polymer and on the specific GPC system (molecular weight standard, elution liquids, etc.) as shown in document D12. Thus, measures performed in the commercially available polymer Kynar 460 (number and weight average molecular weights of 115 000 and 572 500, respectively, see document D8, Table III) resulted in an inherent viscosity of 0.91 dl/g; in addition, the polymer left insoluble matter after the dissolution procedure and the measurement was based on the soluble fraction of the polymer. As document D4 is silent as to the precise solubility characteristics of the polymers, the document fails to provide a direct and unambiguous disclosure of the inherent viscosity of the polymers. In the absence of such a disclosure, the document does not deprive the claimed invention of novelty.

In addition, an increase in the molecular weight lowers the solubility of the polymer leading to gelation and swelling, and prior to the present invention the upper limit of the molecular weight of the polymers, measured in terms of viscosity, was believed to be 2.0 dl/g. Documents D9 and D10 disclose vinylidene fluoride

polymers such as SOLEF 6020, KF1000 and KF1300 having an inherent viscosity below 2.0 dl/g. The experimental tests and the graph of document D13 show a marked increase in viscosity of a polyvinylidene fluoride solution in NMP at an inherent viscosity above 2 dl/g, and the photos shown in document D14 and obtained in an experimental test show the difficulties in forming an electrode using a high inherent viscosity polyvinylidene fluoride. Accordingly, in view of this prejudice, the skilled person would not have considered before the priority date of the patent using a high inherent viscosity vinylidene fluoride polymer unless he were aware of the specific advantages set out in the patent, i.e. he would not have seriously contemplated working in the area above 2.0 dl/g in the sense of decision T 751/94.

For analogous reasons, the skilled person would not have seriously contemplated working above an inherent viscosity of 2.0 dl/g when implementing the disclosure of document D1 which refers to an inherent viscosity of "0.5 or higher". In fact, the broadest specific range disclosed in document D1 is, not surprisingly, between 0.5 and 2.0 dl/g, and all the specific examples fall within the latter range. Thus, there is no direct and unambiguous disclosure in document D1 of an inherent viscosity greater than 2.0 and at most 20 or, alternatively, 10 dl/g. In addition, the claimed range is narrow, is far removed from the examples of D1 and does not constitute an arbitrary selection of the range disclosed in document D1 in view of the effects shown in the examples of the invention (Tables 2 and 3 and Figure 5 of the patent).

Document D2 relates to coatings for bridges, towers, vehicles, etc., and document D3 relates to piezoelectric films. These documents are therefore wholly irrelevant to binders according to the invention.

The claimed "elevated temperature" involves raising the temperature. There is however no disclosure in document D4 of the temperature being elevated during the step of application of the composition to the substrate as claimed, and the document makes no suggestion as regards the necessity of heating the electro-forming composition or the substrate. In addition, none of the documents suggests working with high inherent viscosity polymers, still less suggests heating the composition for solving the gelling problem peculiar to the formation of an electrode with a composition having the claimed characteristics. It would require hindsight selecting in the prior art high inherent viscosity polymers and then to consider working at elevated temperatures.

As regards inventive step, the provision according to the invention of a composite electrode using a vinylidene fluoride polymer having an increased inherent viscosity allows a reduced amount of the polymer to be used, resulting in a reduction of the size and the weight of composite electrodes for use in a non-aqueous electrolytic solution. In addition, the invention leads to better cycle performance of the battery (Figure 5 of the patent) while resisting the dissolving power of the solvent in the electrolytic solution (Examples 6 to 10 in Table 2 of the patent). Prior to the invention it was considered that 2.0 dl/g was the upper limit for the inherent viscosity, above

which the solubility of the polymer decreases resulting in gelation and hence in a poor quality electrode. Thus, since such high viscosity polymers are difficult to handle (see document D14), there was no expectation prior to the invention towards the present invention. The examples of the patent show that the high inherent viscosity polymers can be used, under appropriate conditions, as binders and that the resulting batteries exhibit a stable discharge capacity.

VI. The arguments of the respondent in support of its request can be summarised as follows:

Documents D12, D13 and D14 constitute late-filed evidence that is not more relevant than the evidence previously considered during the proceedings and for this reason these documents should not be admitted into the proceedings.

According to document D4, the vinylidene fluoride polymers have a number average molecular weight between 50 000 and 500 000, preferably between 100 000 and 300 000. In addition, as shown in the graph of document A2, there is a clear correlation between inherent viscosity and number average molecular weight. In particular, this correlation is satisfied by the polymers KF1000 and KF1100 exemplified in document D4 having respectively a number average molecular weight of 150 000 and 170 000 and an inherent viscosity of 1.0 and 1.1 dl/g (document D4, paragraphs [0038] and [0047], document D5, page 5, lines 1 and 2, and document D6, page 4, lines 3 and 4) as well as by a vinylidene fluoride polymer considered by the opponent and having a number average molecular weight of 240 000 and an

inherent viscosity of 2.23 dl/g. The correlation shown in document A2 implies that a vinylidene fluoride polymer having a number average molecular weight of 500 000 or of 300 000 as disclosed in document D4 has an inherent viscosity of above 8.3 and 3.35 dl/g, respectively. It follows that the binder solution according to the invention is not novel over document D4, and that in any case there is a clear implicit teaching in the document to use polymers having a very high inherent viscosity.

There is no evidence that there was a technical prejudice in the use of polymers having an inherent viscosity above 2.0 dl/g. On the contrary, documents D2 and D3 already mention the use of soluble vinylidene fluoride polymers having an inherent viscosity up to 10.0 dl/g in coating compositions. In addition, in the absence of internal contradictions in the disclosure of document D4 or of other pertinent disclosure, the skilled person had no reason to question the disclosure of document D4 and, consequently, the disclosure of document D4 belongs to the state of the art. The experimental tests carried out by the appellant are not conclusive because the tests left insoluble matter and, as disclosed in document D7 (page 9, line 42 to page 10, line 2), measures have to be adopted in the measure of the viscosity of high molecular weight polymers in order to avoid degradation of the corresponding solution; in addition, the polymer Kynar 460 has a number average molecular weight of 115 000, i.e. lower than the values 300 000 and 500 000 disclosed in document D4. Document D4 mentions the determination of the molecular weight by the GPC method, which requires soluble polymers (document D7, page 12, lines 11 to 13)

and the document also mentions the appropriate solvents (paragraph [0022]), so that document D4 refers to polymers having precise solubility characteristics. Documents D13 and D14 are also insufficient in showing a prejudice because there is no evidence that a solution having a cinematic viscosity of 50 000 or 100 000 mPa sec cannot be prepared for electrode compositions and the photos of document D14 do not show any particular technical effect of the use of a polymer having an inherent viscosity above 2.0 dl/g. It is also known to change the temperature for solving problems of solubility and/or viscosity.

Document D1 discloses binder solutions of vinylidene fluoride polymers having an inherent viscosity of 0.5 dl/g or higher, preferably of 0.5 to 2.0 dl/g. Applying the criteria set forth in decision T 279/89, the claimed inherent viscosity ranges are

- very large with respect to the range "0.5 or more" disclosed in document D1 in view of the fact that such polymers cannot generally reach an inherent viscosity value of 10.0 or 20.0 dl/g which correspond to unrealistic values of the molecular weight of several millions,
- immediately close to the preferred range 0.5 to 2.0 dl/g disclosed in document D1, and
- arbitrarily selected from the ranges disclosed in document D1 since, as can be inferred from the examples of the patent (Table 2), the effects within the selected range are the same as those in the range disclosed in document D1. For these reasons, the claimed range does not confer novelty over document D1.

In addition, document D1 also discloses compositions having at least 0.1, preferably 1 part by weight of vinylidene fluoride polymer per 100 parts by weight of powdery electrode material (page 5, lines 25 and 26).

The feature "elevated temperature" does not allow for a clear distinction over the prior art. In addition, document D4 mentions steps in which the composition is at 50° C (paragraphs [0046] and [0049]) and the document does not require that the composition is cooled before the deposition step. In any case, as explained in the patent (paragraphs [0010], [0034] and [0040]), working at elevated temperatures is required in order to avoid gelation and to improve the uniformity characteristics of the deposited composition. Thus, the skilled person would consider working at elevated temperatures obvious to improve solubility and to lower the viscosity and, by routine experiments, he would obtain the optimal coating temperatures, see in this respect document D2 where the glass plate is at 35°C.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

After consideration of the submissions of the parties in respect of the amendments made to the claims according to each of the main and the first to eighth auxiliary requests of the appellant, the Board came to the conclusion during the oral proceedings that the

requests were formally admissible and that the amendments comply with the requirements of Articles 84, 123(2) and 123(3) EPC. Nonetheless, in view of the Board's decision to dismiss the appeal (see points 4 to 9 below), this need not be discussed in detail.

3. *Admissibility of documents D12, D13 and D14*

Documents D12, D13 and D14 have been filed by the appellant during the appeal proceedings and the respondent has contested the admissibility of the documents into the proceedings. However, in view of the fact that these documents were filed by the appellant as evidence in support of its previous submissions and, more particularly, in response to the subsequent submissions of the respondent relating to the determination of the molecular weight and the characteristics of high molecular weight polymers, the Board has considered it appropriate to admit these documents into the proceedings.

4. *Main request*

4.1 It has been undisputed during the proceedings that document D4 discloses the use of a binder solution comprising a vinylidene fluoride polymer in an organic solvent for forming an electrode suitable for use in a non-aqueous electrolytic solution, see in particular section "Summary of the invention" on page 3 and paragraphs [0003], [0022], [0028] and [0029] of the English translation D4.

The question of novelty and of inventive step of claim 1 of the main request reduces in the present case

to the question of whether the range of inherent viscosity of the vinylidene fluoride polymer specified in the claim is anticipated, or at least rendered obvious by the disclosure of document D4.

4.2 The respondent has submitted in this respect that document D4 specifies that the number average molecular weight of the vinylidene fluoride polymers considered in the document is between 50 000 and 500 000, and preferably between 100 000 and 300 000 (paragraph [0016] of document D4), and that the upper values 500 000 and 300 000 correspond to vinylidene fluoride polymers having intrinsically an inherent viscosity falling within the claimed range 2.0 to 20 dl/g. In support of its view, the respondent submitted as evidence a graph (document A2) showing a correlation between the number molecular weight and the inherent viscosity of the particular examples KF1000 and KF1100 disclosed in document D4. Although the values of the inherent viscosity of these examples is below 2.0 dl/g, according to the approximately linear correlation shown in the graph the value of the inherent viscosity of polymers having a number molecular weight of 300 000 and 500 000 is of about 3 and of about 8 dl/g, respectively, i.e. fall within the claimed range 2.0 to 20 dl/g.

4.3 The appellant for its part has submitted that in document D4 there was confusion between the number and the weight average molecular weights and that the disclosure in paragraph [0016] of the document contains an error in that the proposed values could not correspond to the number average molecular weight. However, the disclosure of the document itself does not,

in the Board's view, reveal any internal inconsistency or implausible disclosure or teaching. In addition, the fact that the data submitted by the appellant fails to reproduce the precise values given in document D4 for the molecular weight of polymers exemplified in the document does not constitute sufficient evidence to conclude that the disclosure of document D4 relating to the proposed value ranges of the number average molecular weight of the polymers is wrong. In particular, as submitted by the appellant, the value of the molecular weight of a polymer depends on the method of determination and, in addition, the values of the molecular weight of the examples given in document D4 are closer to the corresponding values of the number average molecular weight than to the corresponding values of the weight average molecular weight according to the graph shown in document A1 filed by the appellant. Accordingly, the Board cannot follow the appellant's contention in this respect and concludes that, in the absence of evidence to the contrary, document D4 refers in paragraph [0016] to the number average molecular weight according to the literal wording of the paragraph and that the corresponding disclosure is comprised in the state of the art (see in this respect "Case Law of the Boards of Appeal" 4th ed. 2001, EPO, chapter I, section C.2.10).

The appellant has also submitted that the approximately linear correlation between the number average molecular weight and the inherent viscosity is not sufficient to conclude that polymers having a number average molecular weight corresponding to the upper values disclosed in document D4 would necessarily have an inherent viscosity falling within the claimed range.

The Board accepts this line of argument only to the extent that it may be no precise correlation between the two quantities. However, in addition to the graph submitted by the respondent, the graph submitted by the appellant itself also shows that the two quantities correlate with each other to a predetermined extent, and in any case at least to an extent sufficient to conclude that polymers having a high value of the number average molecular weight of 300 000 or 500 000 will intrinsically have an inherent viscosity well within the claimed range from 2.0 to 20 dl/g.

4.4 Nor is the Board convinced by the further submission of the appellant that the skilled person would not have seriously contemplated working at the upper end of the ranges disclosed in paragraph [0016] of document D4. In particular, the fact that, among the available prior art, no document in the field of electrode-compositions for non-aqueous-type batteries discloses working with vinylidene fluoride polymers having a high inherent viscosity above 2.0 dl/g does not constitute *per se* a reason for not following the clear teaching of document D4, the more so as vinylidene fluoride polymers having an inherent viscosity well above 2.0 dl/g have already being used in coating compositions as exemplified by documents D2 (column 3, lines 14 to 34) and D3 (column 3, lines 49 to 66) cited by the respondent.

4.5 The appellant has also submitted that the determination of the molecular weight of the polymers depends on the method of determination as evidenced by document D12 (Tables 5 and 6) and that document D4 does not specify the solvent used in the GPC determination of the molecular weights with the consequence that the values

proposed in the document are not unambiguously defined. However, although the use of different solvents in the determination of the molecular weights by GPC analysis may result in appreciable differences in the measured values, the Board cannot agree with the appellant's argument that these differences would be substantial enough to invalidate the conclusion drawn above that polymers having a number average molecular weight of 300 000 or 500 000 will have an inherent viscosity well above 2.0 dl/g.

According to the submissions and the evidence presented by the appellant (documents D13 and D14 showing an increase in the viscosity of NMP solutions of vinylidene fluoride polymers with increasing inherent viscosity of the polymer and the difficulties in preparing electrode-forming compositions on the basis of high inherent viscosity polymers), problems of solubility (gelation and swelling) may arise when analysing and working with polymers having a high molecular weight. The Board notes that document D4 already addresses this issue and proposes, among other measures, the use of solvents which specifically dissolve the vinylidene fluoride polymer (see claims 1 and 4 and paragraphs [0022] and [0032] of document D4). It is therefore to be expected that the skilled person, when confronted with the problem of implementing the corresponding teaching, will adopt the appropriate measures (appropriate polymers and solvents, physical conditions, etc., see in this respect document D7 cited by the appellant, sentence bridging pages 9 and 10) to ensure that the solubility problems are appropriately controlled so as not to jeopardize the formation of the composition and its application on the substrate.

4.6 The Board is therefore of the view that document D4 gives a clear teaching towards the use of vinylidene fluoride polymers having a number weight molecular weight as high as 300 000 and even 500 000. In addition, the skilled person, confronted with the problem of implementing this teaching in a binder solution as disclosed in the document, would then consider appropriate vinylidene fluoride polymers having a number average molecular weight of, or at least close to, the values 300 000 and 500 000 disclosed in the document. Following this approach, the skilled person will arrive at a binder solution of a vinylidene fluoride polymer having intrinsically an inherent viscosity between 2.0 and 20 dl/g, and therefore, following the remaining teaching of the document relating to the use of the solution for forming an electrode suitable for use in a non-aqueous electrolytic solution, will arrive in an obvious way at the use of a binder solution as claimed.

In view of the measures that the skilled person would possibly have to adopt in order to implement the teaching of the document at the disclosed upper values of the number average molecular weight (see the previous paragraph and point 4.5 above), the Board cannot agree with the respondent that the claimed subject-matter lacks novelty over document D4. However, in view of those considerations, the Board does conclude that the subject-matter of claim 1 according to the main request does not involve an inventive step (Articles 52(1) and 56 EPC). This conclusion is not affected by the technical effects and advantages of the claimed subject-matter alleged by the appellant in view

of the obviousness of the claimed invention over the teaching of document D4 (see in this respect "Case-Law of the Boards of Appeal", 4th ed. 2001, EPO, chapter I, section D.7.7).

5. *First auxiliary request*

Claim 1 of the first auxiliary request differs from claim 1 of the main request considered in point 4 above only in that the range of values of the inherent viscosity (2.0 to 20 dl/g) has been restricted to a range from 2.0 to 10 dl/g. However, lowering the upper value of the claimed range from 20 to 10 dl/g does not have any influence on the discussion in point 4 above and, accordingly, the same conclusion of lack of inventive step (Articles 52(1) and 56 EPC) reached in point 4 above with regard to claim 1 of the main request also applies to claim 1 of the first auxiliary request.

6. *Second auxiliary request*

6.1 Document D1 constitutes prior art within the meaning of Article 54(3) and (4) EPC for three of the contracting states (DE, FR and GB) designated in the application in suit. The document discloses compositions for forming an electrode for use in non-aqueous electrolytic solutions, the compositions comprising a mixture of a powdery electrode material with a binder solution of a vinylidene fluoride polymer in an organic solvent (page 2, line 56 to page 3, line 15).

6.2 Document D1 further specifies that the electrode-forming composition contains 0.1 to 50 parts by weight,

particularly 1 to 20 parts by weight of the vinylidene fluoride polymer per 100 parts by weight of the powdery electrode material (page 5, lines 25 and 26), and this disclosure anticipates the range of weight ratio of the polymer to the powdery electrode material defined in claim 1 according to the second auxiliary request.

6.3 Document D1 specifies in addition that the vinylidene fluoride polymer preferably has an inherent viscosity "of 0.5 or higher, more preferably 0.5 - 2.0, particularly 0.8 - 1.5" (page 4, lines 6 to 8). In the Board's view, this disclosure anticipates the use of vinylidene fluoride polymers having an inherent viscosity of above 2.0 and at most 20 dl/g as defined in claim 1 of the second auxiliary request.

The appellant has submitted that the broadest specific range disclosed in the document is 0.5 to 2.0 dl/g and that all the specific examples fall within the later range so that the skilled person would not have seriously contemplated working within the preferred range "0.5 or higher" above a value of 2.0 dl/g within the meaning of decision T 751/94. However, there is no factual technical reason why the skilled person would not have considered applying the technical teaching of document D1 for values of the inherent viscosity above 2.0 dl/g; in particular, for reasons analogous to those given in point 4.4 above with regard to the disclosure of document D4, the arguments of the appellant relating to the alleged existence of a prejudice are not sufficient to conclude that the skilled person would find difficulties that would dissuade him from working with inherent viscosities above 2.0 dl/g. Furthermore, the line of argument of the appellant would render

meaningless the express disclosure in document D1 of the preferred range "0.5 or higher" prior to the more preferred range "0.5 - 2.0"; consequently, the Board cannot accept this argument.

The parties have also referred to the criteria of novelty of the selection of a sub-range set forth in decision T 279/89 and according to which the selected sub-range should be narrow and sufficiently far removed from the known range illustrated by means of examples and, in addition, constitute a purposive selection (point 4.1 of the decision). The Board notes in this respect that the upper value 20 dl/g of the claimed range is, qualitatively speaking, a very high value of the inherent viscosity and corresponds - as submitted by the respondent and undisputed by the appellant - to polymers having an unrealistically high molecular weight of the order of millions. In addition, the lower value 2.0 dl/g of the claimed sub-range, although not properly exemplified in document D1, corresponds with the upper value of the more preferred range "0.5 to 2.0". Therefore, although the claimed range 2.0 to 20 appears to define arithmetically a relatively narrow sub-range of the range "0.5 or higher" disclosed in document D1, the claimed range cannot be considered to be qualitatively a "narrow" selection of the disclosed preferred range "0.5 or higher" within the meaning of decision T 279/89. For this reason at least, the claimed range cannot be considered to constitute a novel selection over the disclosure of document D1.

6.4 Having regard to the above, the Board concludes that the subject-matter of claim 1 of the second auxiliary request lacks novelty over the disclosure of document

D1 within the meaning of Articles 52(1) and 54(3) and (4) EPC for the designated states DE, FR and GB.

7. *Third to seventh auxiliary requests*

7.1 It has been undisputed by the parties that the binder solution disclosed in document D4 and referred to in point 4 above is used in a process for producing an electrode structure, whereby the binder solution is mixed with a powdery electrode material for forming an electrode-forming composition, the resulting composition is then applied onto a surface of an electro-conductive substrate, and the organic solvent is evaporated to form a composite electrode layer comprising the powdery electrode material and the vinylidene fluoride polymer on the electro-conductive substrate (D4, paragraph [0028] *et. seq*.).

In addition, as already concluded in point 4.6 above, in the implementation of the teaching of document D4 the skilled person would consider, without the exercise of an inventive step, the use of vinylidene fluoride polymers having intrinsically an inherent viscosity within the range 2.0 to 20 dl/g.

7.2 The subject-matter of claim 1 according to the third auxiliary request requires in addition that the electrode-forming composition is applied at an elevated temperature onto a surface of the substrate at an elevated temperature. Document D4 specifies that the binder composition stands "at a room temperature (about 25 degrees-Celsius)" at a stage before the composition is coated on the substrate (paragraph [0042]), but is silent as to the actual temperature of the electrode-

forming composition and of the substrate when the composition is applied onto the substrate.

However, as submitted by the respondent and held by the opposition division in the decision under appeal, the skilled person working in this field is aware of the fact that the characteristics of the formation of a layer on a substrate by application of a polymer composition on the substrate depend on different conditions and in particular on the temperature. This is in particular the case when the characteristics of the coating composition itself (viscosity, solubility, gelation, etc.) are highly dependent on the temperature. Accordingly, the Board cannot accept the contention of the appellant that it requires hindsight knowledge of the present invention to consider elevated temperatures for the application of the composition on the substrate, especially when according to the patent specification (page 3, line 24 *et seq*., and page 6, lines 14 to 17 of the patent in suit) the expression "elevated temperatures" is meant to encompass temperatures of 30° C, i.e. only slightly above room temperature. On the contrary, the skilled person would, according to the circumstances and as illustrated in document D2 (column 6, lines 31 to 34), consider, if necessary by trial-and-error, the optimal temperature conditions for the application of the composition on the substrate. In addition, no other effect than those that can be readily considered in advance appear to be associated with the relatively broad temperature range specified in the claim. This applies in particular to the effect mentioned in the patent in connection with the use of elevated temperatures and relating to the solubility

characteristics of the composition (page 5, lines 35 and 36 of the patent).

Having regard to the above, the Board cannot acknowledge the presence of an inventive step in the subject-matter of claim 1 of the third auxiliary request (Articles 52(1) and 56 EPC).

7.3 Claim 1 of each of the fourth to seventh auxiliary requests differs from claim 1 according to the third auxiliary request considered in point 7.2 above only in that the "elevated temperature" has been specified as being "at least 30° C", "30-200° C", "at least 40° C", and "40-200° C", respectively. However, none of these broad ranges of temperature circumvent the reasoning given in point 7.2 above with regard to claim 1 of the third auxiliary request. In particular, the skilled person trying to optimize the conditions of application of the composition mentioned in point 7.2 above, and in particular the temperature, would arrive, if necessary by trial-and-error, at the optimal temperatures for the application of the composition and would therefore arrive at temperatures falling within the relatively broad ranges specified in claim 1 according to the fourth to the seventh auxiliary requests. In addition, none of the claimed ranges appears to involve technical effects other than those that are expected when following this procedure.

Accordingly, the Board concludes that none of the fourth to seventh auxiliary requests involves an inventive step (Articles 52(1) and 56 EPC).

8. *Eighth auxiliary request*

Claim 1 of the eighth auxiliary request differs from claim 1 of the second auxiliary request considered in point 6 above only in that the inherent viscosity is at most 10 dl/g instead of being at most 20 dl/g. This amendment renders the claimed range of the inherent viscosity arithmetically narrower than the range claimed in claim 1 of the second auxiliary request, but not qualitatively narrower in the sense put forward in point 6.3 above because, as submitted by the respondent and already advanced in point 6.3 above, polymers having an inherent viscosity between 10 and 20 dl/g generally have a very high molecular weight which is difficult to achieve and in any case renders them almost unpractical for the present purposes. Thus, replacement of the inherent viscosity range 2.0 to 20 dl/g by the range 2.0 to 10 dl/g does not constitute qualitatively speaking a real technical limitation and, in any case, does not affect the reasoning given in point 6 above in relation to the lack of novelty of claim 1 of the second auxiliary request (Articles 52(1) and 54(3) and (4) EPC).

9. In view of the conclusions reached in points 4 to 8 above, the Board concluded during the oral proceedings that the appeal was to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Eickhoff A. G. Klein