BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

| A | | B | | C | X |
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File Number: T 284/91 - 3.4.2

Application No.: 82 303 388.1

Publication No.: 0 069 523

Title of invention: Concentration of aqueous pseudoplastic solutions by membrane ultrafiltration

Classification: B01D 13/00

# D E C I S I O N
of 28 January 1993

Applicant: PFIZER INC.

Opponent: 01) RHÔNE-POULENC CHIMIE
02) Merck & Co., Inc.
03) Shell Internationale Research Maatschappij B.V.

Headword:

EPC Article 56

Keyword: "Inventive step - no"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 284/91 - 3.4.2

# D E C I S I O N
## of the Technical Board of Appeal 3.4.2
## of 28 January 1993

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| **Decision under appeal :** | **Interlocutory decision of the Opposition Division of the European Patent Office dated 16 May 1990, posted on 26 February 1991 concerning maintenance of European patent No. 0 069 523 in amended form.** |

**Composition of the Board :**

**Chairman :** E. Turrini
**Members :** C. Black
L.C. Mancini

## Summary of Facts and Submissions

I. European patent No. 0 069 523 was maintained in amended form by the Opposition Division on the basis of Claim 1 reading as follows:

"A method of concentrating an aqueous, highly pseudoplastic Xanthomonas biopolymer fermentation broth or preconcentrate thereof, having an apparent viscosity of at least 3,000 centipoise (3 Pa.s), to an apparent viscosity of at least 10,000 centipoise (10 Pa.s), which method comprises subjecting said fermentation broth or preconcentrate to membrane ultrafiltration at a linear flow velocity of at least about 40 cm/s across said membrane surface while exerting an average pressure differential across said membrane of at least about 2.0 atmospheres ($2x10^5$ Pa)."

II. In the opposition proceedings some 19 documents were referred to, of which, the following remain pertinent:

D1: EP-A-0 049 012
D2: GB-A-8 031 404
D3: US-A-3 856 569
D4: N.C. Beaton - the application of ultrafiltration to fermentation products - Edited by Anthony R. Cooper (Plenum Publishing Corporation) 1980 - pages 373 to 404
D6a: Whistler - Industrial Gums - 2nd Edition - 1973 - page 128
D7: Porter & Michaels - "Membrane ultrafiltration" - Chemical Technology - January 1971 - pages 56 to 63
D8: Perry's Chemical Engineers Handbook - 6th Edition, pages 17-27 to 17-34
D12: Kelco Algin, 2nd Edition, Kelco - 1977 - pages 30, 32

D16: H.D. Graham - Food Colloids - Avi Publishing Co. Inc., 1977 - pages 506 to 509

D17: M.R. Doshi et al. Ultrafiltration of Colloidal suspensions and Macromolecular solutions in an unstirred Batch cell - Ind. Chem. Fordam. - 1981 - pages 221 to 229

D18: Stavenger P.1 - putting semipermeable membranes to work - Chemical Engineering progress - volume 67 - 1971 - pages 30 to 36

D19: Whistler - Industrial Gums - 2nd Edition - 1973 - pages 490, 491.

III. The gist of the Opposition Division's argumentation is as follows:

D1, to the extent that it can correctly claim the priority date of D2, does not disclose explicitly or implicitly all of the features of Claim 1, so that novelty in accordance with Article 54(3) is not in question.

D3 is the closest document for judging inventive step. It discloses the concentration of polysaccharides produced by marine algae using ultrafiltration. It teaches however in effect an upper limit of 3.5 Pa.s for the viscosity of the solution to be treated, therefore leads away from the subject-matter of Claim 1. Moreover, it does not mention pseudo-plasticity so that the skilled person has no incentive to consult documents relating to pseudo-plasticity. Therefore, there is no reason to combine the teaching of D3 with such documents.

IV. Appeals against the said decision have been filed by the Opponents OI, OII and OIII. In addition to the documents cited in paragraph II above, the following documents cited in the appeal proceedings have been taken into consideration in this decision:

OII's appendix C, which is page 33 of D12
OII's appendix D, which is a graph based on Figure 30 of appendix C comparing apparent viscosity and shear rate for xanthan gums and sodium alginate dispersions.

V. Oral proceedings were held, at the end of which the Appellants requested that the decision under appeal be set aside and the patent revoked. The Respondent requested that the patent be maintained in further amended form on the basis of Claims 1 to 4 handed over at the oral proceedings, of which Claim 1 reads as follows:-

"A method of concentrating an aqueous, highly pseudoplastic Xanthomonas biopolymer whole fermentation broth or preconcentrate thereof, having an apparent viscosity of at least 3,000 centipoise (3 Pa.s), to an apparent viscosity of at least 10,000 centipoise (10 Pa.s), which method comprises subjecting said fermentation broth or preconcentrate to membrane ultrafiltration at a linear flow velocity of 50-200 cm/s across said membrane surface while exerting an average pressure differential across said membrane of at least about 2.0 atmospheres ($2 \times 10^5$ Pa)."

VI. The reasoning of the Appellants, which to a large extent overlaps, in support of their requests may be summarised as follows:

The subject-matter of Claim 1, also as further amended, is not novel under Article 54(3), because those features not disclosed expressis verbis in D1 are inherent in a membrane ultrafiltration process and therefore implicit.

The said subject-matter moreover does not involve an inventive step. D3 discloses that solutions containing polysaccharides derived from marine algae and known from

other documents to be pseudoplastic can be concentrated using ultrafiltration. It is obvious to apply this technique to the highly pseudoplastic polysaccharide xanthan obtained by the fermentation of a Xanthomonas. For the skilled person there is no prejudice against doing so, e.g. because of the presence of cell debris, since D4 discloses the application of ultrafiltration to fermentation products.

Objection also arises under Article 83 EPC, because viscosity depends on shear rate and this is not specified.

VII. The gist of the Respondent's counter-arguments is as follows:

The subject-matter of Claim 1 differs from the D1 disclosure in that the viscosity of the concentrated broth (at least 10 Pa.s or 10,000 centipoise) is much higher than the upper limit indicated in D1 (4 Pa.s or 4,000 centipoise). Further, the required linear flow velocity of 50 to 200 cm/s can be seen as a selection from the much broader range disclosed in D1. For these reasons at least Claim 1 is novel.

Its subject-matter also involves an inventive step. A process claim is defined by the starting material, the end product and the steps leading from one to the other. The starting material according to Claim 1 differs from that disclosed in D3 in that it is a fermentation broth, therefore containing cell debris, and not an extract derived from marine algae. The polysaccharide xanthan is also different from those disclosed in D3. The viscosity of the starting material is also different, being substantially the same as the end product in D3. As to the

process steps, D3 does not disclose a linear flow velocity and D17 cited by OII refers to a range of 1.18 to 61.3 cm/s (mostly in the lower part of the range) and therefore not to be compared with the rate of 50 to 200 cm/s required by Claim 1. Moreover, D3 discloses inlet pressures of at least 10 psig, preferably 80 to 100 psig, and outlet pressures of 0 to 100 psig, therefore pressure differentials well outside the limit of at least $2x10^5$ Pa or 2.0 atmospheres required by Claim 1.

The viscosity of the final product is also important, and is a feature of the process to the extent that it dictates the time required. D3 refers to final concentrations of 1.9 and 5.3 wt%, corresponding to viscosities of 1,300 and 3,500 centipoises respectively, and suggest 8 wt% as a practical upper limit. Claim 1, however, requires a final viscosity of at least 10,000 centipoises, and Example 4 of the patent in suit discloses a final concentration of 13.3 wt%. D4, cited by the Appellants to demonstrate the absence of a prejudice against using ultrafiltration for fermentation products, proposes first of all removing cell debris from the broth (pages 373, 374 and 384) whereas in the current Claim 1 the whole broth is treated. D4 moreover mentions starting viscosities of up to 600 centipoise (page 399) and linear flow rates of 250 to 300 cm/s (page 397) again quite different from the features of Claim 1. D7 (page 60) warns against concentrating high-molecular weight solutes beyond a certain point because of the risk of secondary membrane formation.

The significant features of Claim 1 are not known individually from the prior art and there is nothing to lead the skilled person towards these features. But even if there was, the said features, particularly in combination, cannot be arrived at by routine experimentation.

The Appellants have referred to Decision T 581/89 where the issues were somewhat similar. Here however the then Appellant (Patentee) declared that certain features of the attacked Claim 1 were trivial and the Board's decision took account of this. The present Respondent however does not consider any features of Claim 1 to be trivial, so that T 581/89 should not be binding on the Board. As to OII's objection under Article 83 EPC, this is considered to have been correctly dealt with by the Opposition Division.

**Reasons for the Decision**

1. The appeal is admissible.

2. The Board is satisfied that the amended Claim 1 is clear and that the requirements of Article 123(2) and (3) EPC are met. Since the appeals are successful for other reasons, this need not be gone into in more detail here.

3. The question of novelty of the subject-matter of Claim 1 under Article 54(3) EPC over the disclosure in D1 requires investigation of whether and to what extent D1 can claim the priority date of D2 and also whether features of Claim 1 not expressis verbis disclosed in D1 can be said to be implicit. The Board has elected not to go into this question in the decision, again because the appeals succeed for other reasons.

4. This applies also to OII's objection under Article 83 EPC.

5. The question remaining to be answered therefore is whether the subject-matter of Claim 1 involves an inventive step.

5.1 The patent concerns the concentration of the polysaccharide xanthan gum contained in a Xanthomonas fermentation broth. Xanthan gums are used inter alia in the secondary and tertiary recovery of oil from oil wells, their physical properties being such that they displace oil which would otherwise be trapped. For economical transport from the site of production to the site of use the broth has to be concentrated. All this is common knowledge in the art as is clear from the introductory part of the description of the patent. The problem on which the patent is based can be seen as achieving a concentration process which does not add to process costs or alter the physical properties of the xanthan polymer (cf. page 3, lines 28, 29 of the description).

5.2 According to Claim 1 the concentration is effected using membrane ultrafiltration. This process is recognised as being relatively inexpensive and requiring relatively mild conditions (see e.g. D7, page 56, right-hand column and page 58, right-hand column) and therefore is one which is of interest in solving the said problem.

5.3 Now D3 discloses a process for concentration aqueous solutions of polysaccharides derived from marine algae using ultrafiltration, which is effective in spite of the high viscosity of the starting solution (see e.g. column 1, line 52, column 8, line 25). For the person of average skill in the art it would seem prima facie to be obvious to investigate whether ultrafiltration known to be applicable to the viscous polysaccharides disclosed in D3 could also be applied to the xanthan polysaccharide, still more viscous, to which Claim 1 relates. An inventive step could accordingly be seen in the subject-matter of Claim 1 only if it could be derived from the specific features of

the ultrafiltration process, singly or in combination, or if a prejudice against applying the known process in the case of Xanthomonas fermentation broths could be demonstrated.

5.4 The said features may be sub-divided as follows:

(a) the substrate to be submitted to ultrafiltration is an aqueous, highly pseudoplastic Xanthomonas biopolymer whole fermentation broth or pre-concentrate thereof;

(b) this starting fermentation broth has an apparent viscosity of at least 3,000 cp;

(c) the concentration is conducted up to an apparent viscosity of at least 10,000 cp;

(d) the membrane ultrafiltration is conducted at a linear flow velocity of 50 to 200 cm/s across said membrane;

(e) the ultrafiltration is conducted under an average pressure differential across said membrane of at least about 2.0 at.

This corresponds in substance to the Respondent's sub-division as set out in the response to the appeals, amended to take account of the current wording of Claim 1.

5.5 As regards feature (a) this mainly serves to identify the starting material. That it is highly pseudoplastic results from the content of xanthan gum which is known to exhibit this property - see D16 and D19. The process does not require any initial removal of cell debris and is

therefore applied to the whole fermentation broth. Optionally, the broth may be preconcentrated. According to Example 4, this involves diluting the broth, then carrying out an initial concentration treatment also using ultrafiltration. The Board can see nothing inventive in this optional process feature; in any case no arguments were advanced in this respect, nor was the feature made the subject of an auxiliary request.

Nor can any prejudice be seen against applying ultrafiltration to the whole broth. D4, which relates to the ultrafiltration of fermentation products, indeed states, on pages 373, 374: "In many operations involving fermentation, the first essential step ... is to separate the microbial cells or cell debris from the broth" and on page 384: "Enzyme fermentation broths are normally clarified ... before being subjected to ultrafiltration". The wording employed indicates that this pretreatment is not always necessary and, in fact, later on page 384, it is stated that in some instances concentration of unclarified broths is practised. It is one of the constant endeavours of the average skilled person to avoid any unnecessary process steps and it is to be expected of him that he will at least investigate whether preclarification is necessary. If, as in the present case, it turns out to be inessential, he may be pleasantly surprised, but this is not an indication of inventivity.

5.6 Feature (b) corresponds to the concentration of material, particularly xanthan gum, in the broth at the end of fermentation, or after the preconcentration step. It may vary from case to case but within certain limits it is fixed. It is a property of the material to be treated and does not in itself contribute to inventivity.

The Respondent has argued that the value of 3,000 centipoise for the starting viscosity corresponds to that of the end product in D3, so that the skilled person would not contemplate applying ultrafiltration to material of such already high viscosity. However, in view of the known high pseudoplasticity of xanthan gum, it is not the apparent viscosity which matters, but the actual viscosity under the shear rates encountered in ultrafiltration. The skilled person knows, e.g. from OII's appendices C and D, that with increasing shear rate, xanthan gum becomes less viscous than alginate, one of the polysaccharides disclosed in D3 and it is therefore obvious for him to investigate if it is more amenable to ultrafiltration. This applies even though D3 does not mention the pseudoplasticity of the disclosed polysaccharides. In any case, this is known - see D6a, D12 and OII's appendices C, D. Accordingly the Board does not agree with the view of the Opposition Division that in the absence of a mention of pseudoplasticity in D3, the skilled person has no reason to associate the ability to undergo ultrafiltration with this.

5.7 Feature (c) results from the concentration of the broth to make it more easily transportable to the site of subsequent use. The final concentration will be a compromise between the desire to have the broth as concentrated as possible and the difficulty and expenditure in carrying out later stages in concentration. The claimed final viscosity value merely reflects this compromise and also does not contribute to inventivity. It would seem to be obvious to continue ultrafiltration until the pumping rate or flux rate becomes too low - e.g. because of high viscosity or secondary membrane formation respectively. The warning in D7 referred to by the Respondent can be seen as reflecting this rather as a

teaching not to concentrate high-molecular weight solutes beyond a certain point.

5.8 Features (d) and (e) are stated by the Appellants to correspond to what is usual in the ultrafiltration art and the Board can agree with this. In particular, as argued by OII, D3 discloses pressure differentials which embrace $2x10^5$ Pa (2 atmospheres) required by Claim 1; D4, page 378 discloses 1 to $6x10^5$ Pa. D17, page 227 discloses linear flow velocities of 1.18 to 61.3 cm/s and D18 60 cm/s. D8 page 17 to 28 discloses velocities of 152-762 cm/s. The proper linear flow velocities and pressure differentials are arrived at by the average skilled person using routine experimentation having regard in particular to achieving optimum flux rate. Accordingly the claimed parameters cannot be seen as involving an inventive selection from those quoted above.

5.9 Moreover, once the average skilled person has elected to investigate the application of ultrafiltration to the concentration of the Xanthomonas broth, this having shown to be obvious, the combination of features (a) to (e), each non-inventive in itself, is also not inventive.

6. Claims 2 to 4 fall because they are dependent on Claim 1 which has been found to be not allowable. In any case, none of the features of these claims was the subject of an auxiliary request.

**Order**

**For these reasons, it is decided that:**

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

P. Martorana E. Turrini