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D E C I S I O N
of 19 October 1998

Case Number: T 0361/95 - 3.3.3

Application Number: 91201200.2

Publication Number: 0459560

IPC: C08L 3/08

Language of the proceedings: EN

Title of invention:

Composition containing a polymer of unsaturated hydrocarbon and a starch derivative

Applicant:

Cargill B.V.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes); non-obvious combination of known features"

Decisions cited:

T 0181/82, T 0035/85

Catchword:

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Boards of Appeal

Chambres de recours

Case Number: T 0361/95 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 19 October 1998

Appellant: Cargill B.V.
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Decision under appeal: Decision of the Examining Division of the
European Patent Office dated 4 November 1994
refusing European patent application
No. 91 201 200.2 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: C. Gérardin
Members: R. Young
J. A. Stephens-Ofner

Summary of Facts and Submissions

- I. European patent application No. 91 201 200.2, filed on 17 May 1991, published under No. 0 459 560, and claiming a NL priority of 28 May 1990 (NL 9001212), was refused by a decision of the Examining Division dated 4 November 1994. The decision was based on two sets of Claims 1 to 7 filed on 18 March 1994, viz. a first set for all the Designated states except ES, and a second set for the Designated state ES. Claim 1 of the first set was worded as follows:

"Composition containing a polymer derived from unsaturated hydrocarbon monomer and a C₁₋₄ alkyl or hydroxyalkyl starch ether having a degree of substitution of at least 0.25, and furthermore a compatibilizing agent, characterized by the fact that the compatibilizing agent comprises one or more esters of C₁₋₄ alcohols and C₆₋₂₀ carboxylic-acids."

Claims 2 to 5 were dependent claims directed to elaborations of the composition according to Claim 1.

Claim 6, an independent claim, was worded as follows:

"A process for producing articles based on polymer of unsaturated hydrocarbon, characterized by the fact that a composition obtained according to any of claims 1-5 is subjected to a shaping treatment with the use of heat."

Claim 7, an independent claim, was worded as follows:

"Articles obtained with the use of the process according to claim 6".

Claim 1 of the second set of claims (ES) was worded as follows:

"A process for preparing a composition containing a polymer derived from unsaturated hydrocarbon monomer and a C₁₋₄ alkyl or hydroxyalkyl starch ether having a degree of substitution of at least 0.25, and furthermore a compatibilizing agent, characterized by using as said compatibilizing agent one or more esters of C₁₋₄ alcohols and C₆₋₂₀ carboxylic acids."

Claims 2 to 5 were dependent claims directed to elaborations of the process according to Claim 1.

Claim 6, an independent claim, was worded as follows:

"A process for producing articles based on polymer of unsaturated hydrocarbon, characterized by the fact that a composition obtained according to the process of any of claims 1-5 is subjected to a shaping treatment with the use of heat."

Claim 7, an independent claim, was worded as follows:

"Articles obtained with the use of the process according to claim 6".

II. According to the decision, the subject-matter of Claims 1 to 7 of both sets did not involve an inventive step having regard to the following documents:

- D1: US-A-4 016 117;
- D2: US-A-4 863 655; and
- D3: "Starch: Chemistry and Technology", Roy Whistler (Ed), Academic Press 1984, pages 346 to 348.

In this connection, the subject-matter of Claim 1 differed from D1, which was the closest prior art and disclosed a biodegradable composition comprising a synthetic resin such as polyethylene, a biodegradable natural filler such as starch, and a fatty material, such as a mixture of ethyl oleate and oleic acid, only in that an etherified starch was used instead of starch itself. Since, however, no particular advantage deriving from this difference had been shown, the objective problem was simply to provide a further biodegradable composition based on a polymer of an unsaturated hydrocarbon monomer having good mechanical properties. A biodegradable packaging material made from a modified high-amylose starch, such as hydroxypropyl starch was, furthermore, known from D2, in which an expanded cellular product of such a modified starch had better mechanical properties than the corresponding unmodified starch. Such a result was also to be expected from the mechanical properties of starch ethers as described in D3. Consequently, there was an incentive to replace the starch in D1 by such a starch ether and the claimed subject-matter did not involve an inventive step.

III. On 15 November 1994, a Notice of Appeal against the above decision was filed, together with payment of the prescribed fee.

In the Statement of Grounds of Appeal filed on 27 February 1995, the Appellant argued in substance as follows:

- (a) The technical problem arising from D1 was to provide a composition based on a polymer derived from an unsaturated hydrocarbon monomer to which one or more additives have been added in order to provide for a significant biodegradability and improved properties of strength and elongation.

The starch ether which was added, according to the application in suit, instead of starch, to provide the solution of this problem did not, contrary to D1, function as a particulate filler, but rather led to a "mutual solution" of hydrocarbon polymer in which the ester functioning as a compatibilizer between the polymer and the starch derivative. This in turn led to improved properties of strength and elongation.

- (b) The aim of D2, which started from the prejudice that attempts to make plastics materials biodegradable by blending them with biodegradable additives had not been overly successful (column 1, lines 27 to 29), was to make a packaging material exclusively of a biodegradable substance. It was therefore concerned with the problem of improving the mechanical properties of starch. Consequently, it would not be taken into account by the skilled person starting from D1.
- (c) The disclosure of D3, which merely described the effects of hydroxypropylation of starch, did not refer to the use of the starch as a packaging material. It would therefore not be taken into account by the skilled person.

Thus, the claimed subject-matter did not arise in an obvious way from the teachings of D1 and D2 or D1 and D3.

The Statement of Grounds of Appeal was accompanied by comparative data relating to tensile strength and elongation at break, to demonstrate the improved results obtained with the compositions according to the application in suit.

Two new sets of claims delimited from D1, as well as adapted pages of description were also filed with the Statement of Grounds of Appeal.

IV. Following the issue, on 25 June 1998, of a communication by the Board, in which certain objections were raised, in particular under Article 123(2) EPC to the revised claims, the Appellant filed, on 19 August 1998, two further sets of Claims 1 to 7, viz. for all Designated states except ES and for the Designated state ES respectively, as well as a revised description (pages 1 to 4).

The claims of the first set are identical with those of the corresponding set underlying the decision under appeal (section I., above), except that the phrase "characterized by the fact that", in Claim 1 has been replaced by "wherein", and the same phrase in Claims 2 to 6, by "characterized in that".

The claims of the second set (Designated state ES) are identical with those of the corresponding set underlying the decision under appeal (Section I, above), except that the phrase "characterized by using as said compatibilizing agent one or more esters of C₁₋₄ alcohols and C₆₋₂₀ carboxylic acids", in Claim 1, has been replaced by, "wherein one or more esters of C₁₋₄ alcohols and C₆₋₂₀ carboxylic acids are used as said compatibilizing agent", and the phrase "characterized by the fact that" in Claims 2 to 6 has been replaced by "characterised in that".

V. The Appellant requested the grant of a patent on the basis of the text constituted by the documents filed on 19 August 1998 (Section IV., above).

Reasons for the Decision

1. The appeal is admissible.
2. *Text*

The text of the application in suit on which the present decision is based, in accordance with the request of the Appellant, is as follows:

Claims: Claims 1 to 7 (DE, GB, FR, IT, NL, SE, CH/LI, BE, AT, LU, DK), filed on 19 August 1998, with letter of same date;

Claims 1 to 7 (ES), filed on 19 August 1998, with letter of same date;

Description: Pages 1 to 4, filed on 19 August 1998, with letter of same date.

3. *Amendments*
 - 3.1 The claims of both sets correspond to the claims as originally filed, subject to minor clarifying amendments to meet objections raised by the Examining Division under Article 84 EPC, in the communications issued on 16 April 1993 (point 5A) and on 19 November 1993 (point 4). No objection was raised by the Examining Division to these amendments under Article 123(2) EPC, and the Board sees no reason to raise any objection of its own. Consequently, both sets of claims are held to meet the requirements of Article 123(2) EPC.

3.2 The description corresponds to the description as originally filed, subject to amendments to adapt the latter to the revised claims, and to acknowledge the background art pursuant to Rule 27(1)(b) EPC. These amendments are not such as to contravene the requirements of Article 123(2) EPC.

3.3 Consequently, the requirements of Article 123(2) EPC are met.

4. *The application in suit; the technical problem*

The application in suit is concerned with a composition which contains a polymer derived from an unsaturated hydrocarbon monomer and an additive for improving biodegradability. Such a composition is, however, known from D1, which by common consent represents the closest state of the art.

4.1 According to D1, there is provided a biodegradable synthetic polymer composition consisting essentially of a polymer having carbon to carbon linkages, for instance a polyvinyl chloride, polyethylene or polypropylene resin, and, dispersed therein, from 5 to 50% by weight particles of a biodegradable substance, and up to 5.5% by weight of an auto-oxidisable substance containing at least one double bond which, when in contact with a transition metal salt, auto-oxidises to generate a peroxide or a hydroperoxide. The auto-oxidisable substance is selected from a fatty acid, a fatty acid ester, and mixtures thereof, such as ethyl oleate/oleic acid (Claim 1 in conjunction with column 2, lines 33 to 40; Example I). The particles of biodegradable substance may be lactose sugar granules (Claim 6), but are preferably natural starch granules, and in particular, a multi-occupation starch such as rice or maize starch, which has a granule of polyhedral

form. To optimise the starch concentration, a mixture of two starches each having a different grain size is preferred. The greater the starch concentration, the greater the biodegradability (column 2, lines 41 to 62).

The starch granules are normally added to prepare the raw polymer for processing at elevated temperatures, which are survived by the starch granules. If, however, the polymerisation takes place under conditions such that the starch is not altered chemically or physically, then the starch granules can be added to the monomer (column 3, lines 3 to 11).

The compositions have, at least to some extent, the physical characteristics of paper, i.e. the ability to hold a crease and to receive a printed impression. Treatment with hot water to gelatinize or dissolve surface starch granules renders the composition more paper-like (column 3, lines 19 to 39).

According to Example I, a blown film was prepared by extruding a blend, with unfilled low density polyethylene (density 0.916; melt flow index 1), of a masterbatch made by compounding, in a two-roll mill at 140°C, 200g pre-dried maize starch (moisture content 0.5%), 39g ethyl oleate, 1g oleic acid and 160 g low density polyethylene film (density 0.920; melt flow index 1), so as to give 8% starch in the final composition. The blown film had a tensile strength in the machine direction of 7.59 units, and in the transverse direction of 6.9 units, compared with a corresponding film made without the starch etc., of 8.28 units in the machine direction, and 5.52 units in the transverse direction.

- 4.2 The products according to D1, although combining the desirable properties of plastics with significant biodegradability, show less than desired strength and elongation properties.
- 4.3 Thus, the technical problem arising from this disclosure is to provide such a composition having improved strength and elongation properties.
- 4.4 The solution proposed according to Claim 1 of the application in suit is to replace the granular starch filler by a C₁₋₄ alkyl or hydroxyalkyl starch ether having a degree of substitution of at least 0.25.
- 4.5 A direct comparison of the properties of the claimed compositions with those of D1 is neither possible (i) in relation to tensile strength, because the dimensions of the blown films exemplified in D1 are not identical with those of the extruded films exemplified in the application in suit, nor (ii) as regards elongation at break, since D1 makes no reference to this property. Furthermore, the amount of starch incorporated into the composition according to Example I of D1, at 8%, is lower than that exemplified in the application in suit, at 30 or 40%.

A relevant comparison is, however available, in the experimental report filed with Statement of Grounds of Appeal, which shows pressure moulded Compositions X and Y, X being according to the application in suit, and Y falling within the disclosure of D1, respectively, comprising:

	Composition X	Composition Y
	wt%	wt%
extrusion cooked starch.....		50
hydroxypropyl starch.....	50	
linear low density polyethylene..	45	45
ethyl oleate.....	5	5

Whereas the moulded product of Composition X has a tensile strength of 5 MPa, that of Composition Y is 4 MPa. Thus Composition X is capable of giving a product having a higher tensile strength than that of Composition Y.

Furthermore, as regards extensibility, the product of Composition X has an elongation at break of 420%, compared with 5% for that of Composition Y. Hence, Composition X is capable of giving a product of far higher elongation at break than that of Composition Y.

4.6 Composition X, however, differs from Composition Y only by the replacement of the starch component by hydroxypropyl starch, none of the other parameters being changed. It therefore represents a closer comparison than the specific disclosure of D1.

4.7 In this connection, an Applicant or Patentee may discharge his onus of proof by voluntarily submitting comparative tests with newly prepared variants of the closest state of the art making identical the features common with the invention in order to have a variant lying closer to the invention so that the advantageous effect attributable to the distinguishing feature is thereby more clearly demonstrated (T 35/85 of 16 December 1986, not published in OJ EPO, Reasons for the decision, point 4, supplementing T 181/82 "Spiro-compounds", OJ EPO 1984, 401).

4.8 In view of the above, it is credible that the claimed measures provide an effective solution of the stated problem.

5. *Novelty*

The decision under appeal explicitly recognised a distinction in the claimed subject-matter over the closest state of the art, namely the use of an etherified starch instead of starch, a view with which the Board fully concurs (decision under appeal; Reasons for the decision, point 2, second paragraph). The remaining documents are more remote. Consequently, the subject-matter claimed in the application in suit is novel.

6. *Inventive step*

In order to assess the question of-inventive step, it has to be considered whether the skilled person, starting from D1, would have expected to be able to improve the tensile strength and stretchability of the products, by replacing the starch by a C₁₋₄ alkyl or hydroxyalkyl starch ether having a degree of substitution of at least 0.25.

6.1 Whilst the preferred embodiment of the biodegradable additive in D1 is starch, the only alternative proposed being lactose, the additive must in any case be present as particles (Claim 1). With regard to the preferred particles, which are starch granules, furthermore, it is made clear that these will survive even severe polymer processing at elevated temperatures. Thus, the addition of the granules to the monomer prior to polymerisation is only permitted under conditions in which the starch is not altered chemically or physically (column 3, lines 3 to 14). This is in

contrast to the application in suit in which, according to the submission of the Appellant, which the Board has no reason to doubt, the starch derivative leads to a "mutual solution" of hydrocarbon polymer and starch derivative (section III.(a), above). Consequently, there is no hint in D1 to the solution of the technical problem.

- 6.2 According to D2, an expanded, biodegradable, low-density packaging material having a closed cell structure with good resilience and compressibility properties, is prepared by extruding starch containing at least 45% by weight amylose content in the presence of a total moisture content of 21% or less by weight and at a temperature of from about 150° to 250°C (Claim 1; column 2, lines 32 to 60). The starch may be unmodified or modified, in the latter case by forming a derivative, e.g. by esterification, etherification, oxidation, acid hydrolysis, cross-linking or enzyme conversion (column 3, lines 55 to 61). One advantageous modification is the etherification with alkylene oxides, propylene oxide being especially preferred, generally in an amount of up to 15% by weight based on the weight of the starch, extruded starches modified in this manner showing improved expansion, uniformity and resiliency (column 4, lines 9 to 21). Additive compounds may be combined or blended with the starch starting material to improve properties such as strength, flexibility, water resistance, etc., compounds such as polyvinyl alcohol, monoglyceride and polyethylene vinyl acetate being suitable. Typically, up to about 50% by weight of such additives, and preferably up to 10% by weight, may be used (column 4, lines 22 to 33). When etherified starch is used, the extrusion temperature is preferably 160° to 210°C (column 5, lines 17 to 59).

According to a typical example, a high amylose starch (70% amylose) modified with propylene oxide (5%) with the addition of polyvinyl alcohol (2.40% by weight) gave good expanded products (Example III).

- 6.2.1 Whilst other materials may be present together with the hydroxypropyl starch, contrary to the argument of the Appellant in the Statement of Grounds of Appeal (section III.(b), above), it is evident that D2 is concerned exclusively with an expanded product, i.e. packaging material having the character of a foam, of which the relevant physical properties are bulk density, resiliency and compressibility (D2; column 6, line 58 to column 7, line 55). These qualities are, however, irrelevant to the aims set out in the technical problem, the latter two even being diametrically opposed to the relevant qualities aimed at, namely increased tensile strength and elongation. Consequently, the disclosure of D2 cannot be regarded as giving any information useful to the skilled person for solving the stated problem.
- 6.2.2 In any case, it has not been alleged, let alone demonstrated in the decision under appeal, that the level of reactant disclosed in D2 (up to 15%) would result in a degree of conversion of the starch of 0.25 (25% conversion) or more, required by the solution of the technical problem.
- 6.2.3 In summary, the skilled person starting from D1 and faced with the technical problem would not regard the disclosure of D2 as relevant to his purpose, and even if, in spite of this, he endeavoured to make use of its teaching, the result has not been shown to correspond to the solution of the problem as stated.

- 6.3 According to D3, film prepared from hydroxypropyl-high-amylose corn starch (71% apparent amylose; 1.11% hydroxypropyl) is water-soluble, transparent, and impermeable to oxygen at 25° over a wide range of humidities. Hydroxypropylation reduces tensile strength of the film but increases elongation and burst strength and maintains folding endurance. Plasticisation with 5% glycerol is not beneficial (page 347, third complete paragraph).
- 6.3.1 The information contained in D3 is, in the Board's view, even less relevant to the technical problem than that in D2, since it is neither concerned with packaging, nor the behaviour of the starch derivative when blended with other materials.
- 6.3.2 To the extent that the skilled person could derive any relevant information from such a general text, it would evidently be concluded that elongation is improved at the expense of tensile strength. It is a requirement of the solution of the technical problem, however, that both elongation and tensile strength are improved simultaneously (sections 4.3, 4.4., above). Consequently, D3 would not offer the skilled person a solution of the technical problem. The situation is no different, even if D3 is viewed in the light of D2, since there is no discernable relationship between the parameters dealt with in D2 and those referred to in D3.
- 6.4 In other words, the solution of the technical problem does not arise in an obvious way from the state of the art.
- 6.5 On the contrary, the simultaneous increase in tensile strength **and** elongation at break, brought about by the different and unsuggested role of the third component (the fatty acid ester), which functions as a

compatibiliser to assist the formation of a "mutual solution" of the polymer and the starch ether (section 6.1, above) and furthermore results in the stretchable character of the composition according to the application in suit, rather than the paper-like quality referred to in D1, must be regarded as a surprising result.

6.6 Consequently, the subject-matter of Claim 1, and, by the same token, of dependent Claims 2 to 5 of both sets of claims involves an inventive step. Furthermore, the subject-matter of Claims 6 and 7 of both sets of claims, which are equally limited to applications of compositions according to the relevant Claim 1, also involves an inventive step.

Order

For these reasons it is decided that:

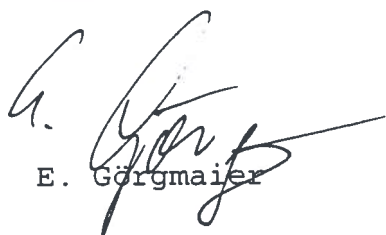
1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division with the order to grant a patent on the basis of the following text:

Claims: Claims 1 to 7 (DE, GB, FR, IT, NL, SE, CH/LI, BE, AT, LU, DK), filed on 19 August 1998, with letter of same date;


Claims 1 to 7 (ES), filed on 19 August 1998, with letter of same date;

Description: Pages 1 to 4, filed on 19 August 1998, with letter of same date.

The Registrar:


E. Görgmaier

The Chairman:


C. Gérardin