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D E C I S I O N
of 23 March 1994

Case Number: T 0030/91 - 3.3.3

Application Number: 82850200.5

Publication Number: 0106004

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Language of the proceedings: EN

Title of invention:
Method of forming a hydrophilic coating on a substrate

Patentee:
Astra Tech Aktiebolag

Opponent:
Kudo, Fumio

Headword:
-

Relevant legal norms:
EPC Art. 54(3), 56

Keyword:
"Novelty (affirmed)"
"Inventive step (affirmed)"

Decisions cited:
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Catchword:
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Case Number: T 0030/91 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 23 March 1994

Appellant: (Opponent)
Kudo, Fumio
5-51, 2-chome
Sugeinadazutsumi
Tama-ku
Kawasaki-shi
Kanagawa-ken (JP)

Representative:
Rees, David Christopher
Kilburn & Strode
30 John Street
London WC1N 2DD (GB)

Respondent: (Proprietor of the patent)
Astra Tech Aktiebolag
Box 14
S-431 21 Mölndal (SE)

Representative:
Linderoth, Margareta
AB Astra
Patent Department
S-151 85 Södertälje (SE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office dated 5 November 1990 rejecting the opposition filed against European patent No. 0 106 004 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: C.R.J. Gérardin
Members: P. Kitzmantel
G. Davies

Summary of Facts and Submissions

I. The mention of the grant of patent No. 0 106 004 in respect of European patent application No. 82 850 200.5, filed on 14 October 1982, was published on 7 January 1988 on the basis of 21 claims.

Independent Claim 1 reads as follows:

"A method of forming a hydrophilic coating on a substrate intended for use in biomedical applications, characterized in:

applying a coating from a solvent solution comprised of a polyisocyanate to the surface of said substrate to form a coupling coating with unreacted isocyanates;

applying a solvent solution comprised of a hydrophilic copolymer made from monomers selected from a group consisting of vinylpyrrolidone, vinyl methyl ether or vinyl pyridine and a monomer containing active hydrogen, which will react with isocyanate to form a covalent bond between said coupling coating and hydrophilic copolymer;

evaporating the solvent and reacting said isocyanates."

Claims 2 to 18 are directed to preferred embodiments of the method according to Claim 1.

Independent Claim 19 reads as follows:

"A biomedical product having a hydrophilic coating on a substrate characterized in that it comprises:

a hydrophilic copolymer coating made from monomers selected from a group consisting of vinylpyrrolidone,

vinyl methyl ether or vinyl pyridine and a monomer containing active hydrogen;

coating retention means for retaining said hydrophilic coating on said substrate by a covalent bond, said copolymer having an average of at least two or more sites capable of covalently bonding to a polyisocyanate coupling coating."

Claims 20 and 21 are dependent on Claim 19.

II. Notice of opposition was filed by FUMIO KUDO by facsimile on 6 October 1988, requesting revocation of the patent in its entirety, on the ground of lack of inventive step, having regard to, among others, the following documents:

D2: US-A-4 100 309,
D3: US-A-4 119 094,
D5: US-A-3 198 692,
D7: EP-A-0 065 884, filed 27 May 1982, published 1 December 1982,
D9: Technical Bulletin 7487-011 Rev 1 of GANTREZ AN,
D10: JP-A-53/74554.

III. By its decision date-stamped 5 November 1990, the Opposition Division rejected the opposition holding that the subject-matter of the opposed patent met the requirements of inventive step. In particular, none of the cited documents could suggest to the skilled person that the adhesion between a polyvinylpyrrolidone (PVP) coating layer and the polyisocyanate-treated surface of a biomedical article, as disclosed in D2 or D3, could be enhanced by copolymerizing the PVP with an active hydrogen-containing monomer.

IV. By facsimile dated 2 January 1991, the Appellant (Opponent) lodged an appeal against the rejection of the opposition and paid the appeal fee. Grounds of Appeal were submitted by facsimile on 14 March 1991.

V. Oral proceedings were held on 23 March 1994 during which the parties first dealt with a novelty objection in regard to D7, raised in the Board's previous communication dated 6 October 1993, and then emphasized their previous arguments regarding the issue of inventive step.

VI. Regarding the issue of novelty over D7 the Appellant merely confirmed the Board's concerns. In regard to inventive step, it argued that, when starting from D2 or D3, it was obvious to substitute the active hydrogen-containing materials known from D5, D9 or D10 for the PVP of D2 or D3. Especially D9 would not only relate to hydrophilic methyl vinyl ether/maleic **anhydride** copolymers, which may be rendered insoluble by reaction with isocyanates, but also to their active hydrogen-containing **partial esters** which lend themselves to film forming and may be used for "enteric and sustained-release coatings". Furthermore, the high reactivity of active hydrogen-containing compounds with isocyanates was well known, as was the possibility of copolymerising PVP with active hydrogen-containing acrylic monomers.

With its letter of 9 March 1994 (less than two weeks before the oral proceedings) the Appellant filed the following new documents:

D12: "Technical Bulletin GANTREZ ES" (1967),
D13: pages 448-462 of Vol. 8 of the Enc. Pol. Sci. & Eng. (1987) and

D14: pages 45-51 of Vol. 12 of Kirk-Othmer's Enc. Chem. Technol., 2nd ed. (1967).

VII. The Respondent (Patentee) essentially argued as follows:

The novelty objection was not well-founded, since the Art. 54(3) document D7 would not disclose unambiguously either all process steps or the combination of starting materials of present Claim 1. In particular, the methyl ether of polyvinyl alcohol disclosed on page 21, lines 5 and 6 was not necessarily a hydroxyl compound for process (4), and the process conditions set out on pages 25 to 27, which were silent about a hydrolysis step, did not relate to method (F), and thus also not to process (4). Concerning the product Claim 19, the polyisocyanate reactant of D7 could not establish "coating retention means" towards the substrate. With regard to inventive step the Respondent stressed that neither the food wrapping materials according to D5, nor the hydrophilic compositions according to D10 made use of a hydrophilic material as defined in the opposed patent. The GANTREZ AN material of D9 did not lend itself to a combination with D2/D3, since it was different from the PVP used in D2/D3 and there was no suggestion either in D9 to use GANTREZ AN for biomedical articles.

Moreover, none of the prior art documents identified the technical problem underlying the patent in suit.

VIII. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent requested dismissal of the appeal and maintenance of the patent as granted.

At the conclusion of the oral proceedings the decision of the Board to dismiss the appeal was announced.

Reasons for the Decision

1. *Admissibility*

The appeal is admissible.

2. *Late-filed documents*

In the Board's opinion, the disclosure of D12 is not relevant to the outcome of the present appeal and, having been filed more then five years after the end of the opposition period, is not admitted into the proceedings pursuant to Article 114(2) EPC.

D13 and D14, two excerpts from standard textbooks, are admitted for consideration as illustrating of the common general knowledge.

3. *Novelty*

The Respondent's arguments concerning the novelty of the subject-matter of Claims 1 and 19 over D7 are accepted.

D7 is state of the art under Art.54(3) EPC for the overlapping Contracting States DE and FR. It relates to an urethral catheter, to whose wall(s) an antimicrobial substance is chemically bonded via the ionic groups of a layer substance, which may be prepared *inter alia* according to process (4) of method (F) (cf. page 12, lines 14 to 20; page 18, lines 3 to 5 and 25 to page 19, line 3), comprising reacting a compound (A) having hydroxyl groups with a compound (B) having a plurality

of isocyanate groups (page 22, lines 20 to 23). Compound (A) is also used in reaction (5) together with a compound having a plurality of acid chloride groups and may be selected from a multitude of compounds (p.20/19 to p. 21/20), among which the methyl ether of polyvinyl alcohol comes under the definition of the hydrophilic copolymer of the patent in suit. Compounds (A) and (B) may be brought into contact with the catheter wall by dipping of the catheter into a solution (page 26, line 17) of said compounds, which solution may be prepared by blending separate solutions of (A) and (B) (page 25, lines 18 to 20). The solvent is removed thereafter by drying and the catheter is then heated (page 26, line 21 to page 27, line 3).

While D7 unambiguously discloses a process (process 4) satisfying all procedural requirements of present Claim 1, it is doubtful whether the disclosure of D7 implies the use of the methyl ether of polyvinyl alcohol in process (4), because the list of the possible hydroxyl group-containing starting materials (compounds A) is introduced by the words "Examples of the compounds having hydroxyl groups used for the above described reactions (4) and (5) include ..." (cf. page 20, lines 19 and 20). As a consequence, and because of the different chemical reactivities involved with regard to the different reaction partners of the OH-compounds in reactions (4) and (5) (NCO groups and acid chloride groups, respectively), not all of the compounds listed can be regarded as equally applicable to both processes (4) and (5). In view of this uncertainty as regards the disclosure, the Respondent is to be given the benefit of the doubt and the novelty of the subject-matter of independent Claims 1 and 19 must be recognized.

4. *Closest prior art*

D2 and D3, the latter being based on a divisional application of D2, are equally pertinent. In the following, only D2 is referred to.

Like the patent in suit, D2 relates to the deposition of a hydrophilic coating on a biomedical substrate. This coating is obtained by first applying to the substrate a solution of a polyisocyanate, and usually of a polyurethane, and then, after evaporation of the solvent, applying a solution of PVP, thereby forming a PVP-polyurethane interpolymer (Claim 1). The coating so obtained has a very low friction when wetted with a water base liquid or a lower aliphatic alcohol and yet is much less slippery when dry; the thickness of the coating is not limited to a few molecular monolayers (as in the case of grafted layers) and it is non-reactive with respect to living tissue and non-thrombogenic when in contact with blood (column 1, lines 30 to 48). However, the coating stability does not meet the degree required for many applications, particularly biomedical drains, catheters, and blood evasive devices.

5. *Problem to be solved and its solution*

In view of the insufficient stability of the hydrophilic coatings according to D2, the technical problem underlying the patent in suit may be seen in the provision of biomedical articles having better adhering hydrophilic coatings, without otherwise impairing the advantageous properties obtained according to D2.

According to the present Claim 1, a solution to this problem has been achieved by using a hydrophilic copolymer made from monomers selected from a group

consisting of vinylpyrrolidone, vinyl methyl ether or vinyl pyridine and a monomer containing active hydrogen.

That thereby the underlying technical problem has been solved effectively is credibly demonstrated by Example 2 and the Comparative Example in the present description.

6. *Inventive step*

The issue of inventive step turns on whether there was an incentive for the skilled person in the documents relied upon by the Appellant to enhance the adhesion of a hydrophilic coating made from PVP towards a polyisocyanate-treated surface of a biomedical article, as known from D2, by incorporation into the PVP of comonomers having H-active sites.

6.1 The Board cannot follow the Respondent's argumentation presented during oral proceedings that the inventiveness of the claimed subject-matter was based on the discovery of the present adhesion problem because this deficiency in the state of the art could not have escaped the notice of a skilled person experimenting with the PVP-coated catheters disclosed in D2. To pose the problem to be solved must be regarded as the consequence of this deficiency, which logically leads to a search for a solution to eliminate such deficiency. Hence this problem must be regarded as having been obvious and is not able to contribute towards the inventive merits of its solution (cf. T 109/82, "Hearing aid/BOSCH", OJ EPO 1984, 473, particularly Reasons 5.1).

6.2 While the ability of the formation of covalent bonds by the reaction of NCO-groups with active hydrogen-containing groups, as evidenced in D13 and D14, was undoubtedly within the general common-knowledge of the skilled man, there was no reason why the skilled

man, starting from the PVP coating of D2, should have selected - from the multitude of options which were at his disposal - the one chosen by the present inventor, namely the introduction of H-active sites into PVP by copolymerization thereof with hydroxyl group-containing monomers. Rather this appears to be a conclusion based on hindsight not justified by the facts.

Confronted with the adhesion problem, the skilled person looking, at the priority date of the patent in suit, for hydrophilic, biocompatible, coating materials had several possibilities; he could, for instance, (i) strive for coating materials having themselves an improved adhesion to the substrate without the necessity of a "coupling" agent, (ii) concentrate on the quality of the substrate, (iii) elaborate on the properties of the surface of the substrate by physical treatments, (iv) develop better "coupling" agents, (v) try to optimize the bonding methods (temperature, solvent, etc.), (vi) turn to the use of additional adhesives (as recommended in D7, page 27, lines 9 to 22), and finally (vii) think of taking advantage of the NCO/OH reaction for improving the bonding strength; but even in the latter case a variety of stratagems could be thought of, one of which was the use of the cellulosic materials employed in D5 as hydrophilic polymers and another one was the solution eventually arrived at by the present inventor.

This solution of the existing problem was therefore not the result of a "one-way street" situation, where the skilled man, once given the problem, could conceive only of one way of attaining the desired object (cf. T 192/82 "Moulding composition/BAYER", OJ EPO 1984, 415). Rather there was a multiplicity of possibilities and no preference for the present solution could be inferred from common general knowledge. Moreover, the PVP

copolymers required for the present solution of the existing problem have not even been disclosed in any of the cited prior art documents.

6.3 The Appellant's allegation that it would have been obvious to substitute the GANTREZ AN material described in D9 for the PVP of D2, thereby arriving at the subject-matter of the opposed patent, is likewise not convincing.

The poly(methyl vinyl ether/maleic anhydride) GANTREZ AN itself does not comprise active hydrogen sites and does not therefore come under the definition of the vinyl methyl ether copolymer of Claim 1 in suit unless the cyclic anhydride structure is hydrolyzed or alcoholized (cf. reaction schemes on page 5). But apart therefrom there is no conceivable reason which could induce the skilled man aiming at the solution of the problem underlying the present invention to try out GANTREZ AN, for it bears no particular structural similarity to PVP; while it is said to be rendered insoluble by reaction with diisocyanates (cf. page 19, 2nd paragraph), there is no disclosure of the use of polyisocyanates as agents for coupling the GANTREZ AN to extraneous substrates; the suggested use of GANTREZ AN and its half esters "for evaluation in enteric and sustained-release coatings" (cf. page 35, half way down) is ambiguous with regard to its function and does certainly not attach any importance to its adhesive properties; the fact that throughout D9 GANTREZ AN and its half esters are put on a par demonstrates that - contrary to the subject-matter of the patent in suit - the presence of H-active sites is of no particular relevance.

There was therefore no reason for the skilled man faced with the present problem to assume that GANTREZ AN or the products of its hydrolysis/alcoholysis would be

appropriate substituents for the PVP of D2. The Appellant's allegations of obviousness are consequently unfounded.

6.4 Neither D5 nor D10 are relevant to the technical problem of the patent in suit, nor do they disclose a hydrophilic copolymer coming under the definition of present Claim 1. D5 relates to food packaging laminates made from polyolefin and preferably cellulosic materials. Polyisocyanates may be used as "adhesives". Thus the disclosure in D5 does not go beyond the common general knowledge relating to the utilization of the NCO/OH reaction in adhesive formulations and the non-obviousness conclusions drawn in section 6.2 above apply. D10 discloses a composition comprising a polyisocyanate and a vinyl copolymer comprising tertiary amino and carboxylic acid groups which may be used for such diverse applications as medical appliances and ship-bottom coatings. This document is completely unrelated to both the technical problem of the patent in suit and the structure of the hydrophilic copolymer used therein and cannot be of any help to the skilled man in solving that problem.

6.5 In view of the above conclusions, the Boards finds that the subject-matter of Claim 1 cannot be derived from the prior art relied upon by the Appellant, either in isolation or in combination, and, therefore, complies with the requirements of inventive step. Since the structure of the biomedical product of independent Claim 19 is defined by the essential features of the process Claim 1, the same inventive step conclusions apply to the subject-matter of this claim. All other claims are dependent claims.

7. The arguments brought forward in the appeal do not, therefore, prejudice the maintenance of the opposed patent and, consequently, the appeal must be dismissed.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

E.Görgmaier C.Gérardin

24/5/93