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D E C I S I O N
of 27 November 1997

Case Number: T 0062/95 - 3.3.3

Application Number: 86201205.1

Publication Number: 0212700

IPC: C08F 212/04

Language of the proceedings: EN

Title of invention:
Styrenic polymer resins having improved flow characteristics

Patentee:
The Dow Chemical Company

Opponent:
BASF Aktiengesellschaft, Ludwigshafen

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 114(2)

Keyword:
"Novelty - (yes) - balance of probabilities"
"Inventive step - (yes) - documents not concerned with the
existing problem"
"Late submission - (yes) - agreement of adverse party"

Decisions cited:
T 0219/83, T 0495/91

Catchword:
-



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Boards of Appeal

Chambres de recours

Case Number: T 0062/95 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 27 November 1997

Appellant:
(Opponent)

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-Patentabteilung - C6-
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Representative:

-

Respondent:
(Proprietor of the patent)

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Decision under appeal:

Interlocutory decision of the Opposition Division
of the European Patent Office posted 17 November
1994 concerning maintenance of the European
patent No. 0 212 700 in amended form.

Composition of the Board:

Chairman: C. Gérardin
Members: P. Kitzmantel
J. A. Stephens-Ofner

Summary of Facts and Submissions

I. European patent application No. 86 201 205.1 in the name of THE DOW CHEMICAL COMPANY which had been filed on 7 July 1986, claiming priority from a NL application filed on 8 July 1985, resulted in the grant of European patent No. 212 700 on 7 November 1990, on the basis of 6 claims, independent Claims 1 and 5 reading as follows:

"1. A thermoplastic styrene polymer moulding resin consisting in polymerized form of styrene, optionally one or more ethylenically unsaturated nitrile monomers and from 0.1 to 15 weight percent, based on the total weight of monomers, of an ester of acrylic acid with an alcohol having 2-8 carbon atoms."

"5. A method for preparing a thermoplastic styrene polymer moulding resin having improved flow properties consisting of polymerizing styrene, optionally one or more ethylenically unsaturated nitrile monomers, and from 0.1 to 15 weight percent, based on the total weight of monomers, of an ester of acrylic acid with an alcohol having 2-8 carbon atoms."

Claims 2 to 4 were dependent on Claim 1; Claim 6 was dependent on Claim 5.

II. Notice of Opposition requesting revocation of the patent in its entirety on the grounds of Article 100(a) EPC was filed by BASF AG on 6 August 1991.

The opposition was based on document

D1: DE-C-669 793.

III. By its interlocutory decision of 26 October 1994, issued in writing on 17 November 1994, the Opposition Division held that the grounds of opposition did not prejudice the maintenance of the patent in amended form.

1. The decision was based on the following set of claims:

"1. A thermoplastic styrene polymer moulding resin consisting in polymerized form of styrene and 0.1 to 10 wt.% of an ester of acrylic acid with an alcohol having 2-8 carbon atoms.

2. A thermoplastic styrene polymer moulding resin consisting in polymerized form of styrene, one or more ethylenically unsaturated nitrile monomers and 0.1 to 15 wt.% of an ester of acrylic acid with an alcohol having 2-8 carbon atoms.

3. The styrene polymer resin of claims 1 or 2, wherein the acrylic acid ester is ethylacrylate, isopropylacrylate, n-propylacrylate, n-butylacrylate, sec-butylacrylate, octylacrylate or 2-ethylhexylacrylate.

4. The styrene polymer resin of claim 3, wherein the acrylic acid ester is n-butylacrylate.

5. The styrene polymer resin of claims 1-4, wherein the amount of acrylic ester, in polymerized form, is from 0.5 to 10 wt.%.

6. The styrene polymer resin of claims 2-5, wherein the unsaturated nitrile is acrylonitrile.

7. A method for preparing a thermoplastic styrenic polymer moulding resin according to claim 2 having improved flow properties consisting of polymerizing styrene, one or more ethylenically unsaturated nitrile monomers, and from 0.1 to 15 weight percent, based on the total weight of monomers, of an ester of acrylic acid with an alcohol having 2-8 carbon atoms.
8. A method for preparing a thermoplastic styrenic polymer moulding resin according to claim 1 having improved flow properties consisting of polymerizing styrene and from 0.1 to 10 weight percent, based on the total weight of monomers, of an ester of acrylic acid with an alcohol having 2-8 carbon atoms.
9. The method of claim 7 or 8, wherein mass polymerization techniques are employed to polymerize the monomers.
10. Use of 0.1 to 15 weight percent of units of an ester of acrylic acid with an alcohol having 2-8 carbon atoms in a thermoplastic polymer moulding resin, said thermoplastic polymer moulding resin consisting in polymerized form of styrene, optionally one or more ethylenically unsaturated nitrile monomers and of said [of] ester of acrylic acid, to improve flow properties of said resin.
11. Use according to claim 10, wherein said alcohol is n-butanol."
2. That decision held that the subject-matter of the afore-mentioned claims met the provisions of Articles 123(2) and (3) EPC as well as those of Articles 54 and 56 EPC.

Novelty of the subject-matter of Claim 1 was acknowledged over the teaching of D1, in particular over the copolymer prepared according to Example 5, because, in view of the reactivity ratios of the polymer chain propagation by styrene and n-butylacrylate disclosed in

D2: POLYMER HANDBOOK (J. Brandrup and E.H. Immergut, John Wiley & Sons, 3rd ed., 1989, pages II/153 and II/159),

this copolymer comprised more than 10 wt.% n-butylacrylate. The subject-matter of Claim 2 was also held to be new, because D1 did not disclose styrene-based terpolymers comprising units of ethylenically unsaturated nitrile.

The acknowledgement of inventive step for the subject-matter of Claim 1 was based on the non-obviousness, vis-à-vis the disclosure of

US-A-3 100 195 (document D5 in the appeal, acknowledged on page 2, lines 15 to 28 of the patent in suit),

of the claimed solution for the problem of providing styrenic polymers having improved flow properties while maintaining good physical properties. An analogous conclusion was drawn for the subject-matter of Claim 2, but on the basis of the evidence provided in Comparative Experiment C of the patent in suit. The subject-matter of use Claim 10 was also considered to be new and non-obvious, because it was not suggested in the available prior art to improve the flow properties of styrenic compositions by incorporation of acrylic ester units.

- IV. On 23 January 1995 the Opponent (Appellant) lodged an appeal against the interlocutory decision of the Opposition Division and paid the appeal fee on the same day. The Statement of Grounds of Appeal was submitted on 6 March 1995. Further written submissions of the Appellant dated from 4 April 1995, 20 November 1997 and 25 November 1997.
- V. The Respondent (Patentee) defended his case in submissions dated 8 September 1995 and 21 November 1997.
- VI. In a communication issued in preparation of the oral proceedings to be held on 27 November 1997 the parties were invited to submit further information as to the meaning of the reactivity ratios for styrene and n-butylacrylate mentioned in documents D1 and D2 (cf. points VII (i), (ii) and VIII (i) to (iii) below).
- VII. The Appellant's written and oral submissions may be summarized as follows:
- (i) In view of the more recent information contained in
- D3: A.S. Brar et al. Polym. Journal, Vol. 24,
No. 9, 1992, pages 879 to 887,
- the reactivity ratios disclosed in D2 for the polymer chain propagation by styrene and n-butylacrylate could no longer be regarded as correct. According to the reactivity ratios disclosed in D3, and contrary to what was set out in D2, styrene reacted more quickly than n-

butylacrylate. Thus, the Respondent's assumption that the polymer formed by the reaction of Example 5 of D1 would comprise more than 10 wt.-% n-butylacrylate was not in agreement with the facts.

(ii) However, in his view, these considerations were not decisive, because

(1) on the one hand, a person skilled in the art would take it for granted that the polymerization reaction according to Example 5 of D1 was carried out to 100% completion, with the consequence that the resulting copolymer contained the same amount of n-butylacrylate as the monomer feed, i.e. 10 wt.%, and

(2) on the other hand, in consequence of the depletion of the reaction mixture of the faster reacting monomer (be it n-butylacrylate or styrene) - whose proportion in the initially formed polymer chains was therefore higher than in the monomer feed - a state must be reached, where the feed concentration of the faster reacting monomer had become so low that the polymer chains formed thereafter comprised the faster reacting monomer in an amount below the original feed concentration. This fact was demonstrated for the reaction rates $r_1 = 0.19$ and $r_2 = 0.84$ by the differential curves $pd1_1$ and $pd2_1$ in the computer plots filed with the Appellant's submission of 25 November 1997. From that it resulted that the polymer formed according to Example 5 of D1 must, in considerable amount, comprise molecules having a content of 10 wt.-% or less n-

butylacrylate. It followed that the subject-matter of the patent in suit was deprived of novelty, because Claim 1 was not restricted to resins consisting **exclusively** of polymer molecules comprising units of styrene and n-butylacrylate in the specified amounts.

- (iii) In his written submissions the Appellant argued that the novelty of the subject-matter of the patent in suit was also destroyed by the disclosure of document EP-A-29 174, not previously cited. However, in the oral proceedings he did not maintain this objection.
- (iv) Concerning the issue of inventive step, the Appellant's view was that the alleged improvement of the melt flow rate was not based on the presence of n-butylacrylate units, but on the lower molecular weight of the produced styrene copolymers. This was also shown by the low softening points of the copolymers described in the patent in suit. When starting from D1, the real problem was thus the provision of further transparent styrene/acrylic ester copolymers having improved impact strength and elasticity. Since it was known from D1 that by incorporation of acrylic ester units into styrene polymers these properties could be improved, the provision of such copolymers did not involve an inventive step.
- (v) Moreover, even if an improvement of the melt flow rate was recognized as the problem underlying the patent in suit, the claimed solution was obvious, because it was known from D1 that the presence of acrylate ester units led to lower softening points, a behaviour that implied enhanced melt flow.

- (vi) Furthermore, an inventive step could also not be founded on the selected range of amounts of acrylate ester units in the styrene copolymer, because the determination of the most favourable composition was mainly governed by the different prices of the monomers. Since n-butylacrylate was much more expensive than styrene, it was evident that its amount should be minimized.

VIII. The Respondent's written and oral submissions may be summarized as follows:

- (i) All reactivity rates r_1 and r_2 for the copolymerization of styrene and n-butylacrylate, which were disclosed in D2, led to the same result, namely that the content of n-butylacrylate units of a copolymer prepared by copolymerization of 90 wt.-% styrene and 10 wt.-% n-butylacrylate was necessarily above 10 wt.-%. Only at a theoretical conversion of 100% the n-butylacrylate amount would reach 10%, but this was impossible even with today's technology, and thus out of question in the year 1931, when document D1 was patented. The disclosure of Example 5 of D1 was therefore not novelty destroying for the subject-matter of Claim 1 of the patent in suit.
- (ii) The evidential weight of document D3 was inferior to that of document D2 because the authors of D3 were unknown in the technical field concerned. The reaction rates disclosed in D3 ($r_1 = 0.17$ and $r_2 = 1.21$) could therefore not be relied upon.
- (iii) The Appellant's argument that a portion of the styrene/n-butylacrylate copolymer produced according to Example 5 of D1 must comprise 10% or less of n-butylacrylate units and that this

portion destroyed the novelty of the subject-matter of present claim 1 was inconclusive, because what was to be considered in the assessment of novelty was the average n-butylacrylate content of the total copolymer produced. It was evident from the computer plots filed with the Appellant's submission of 25 November 1997 that this average n-butylacrylate content was above 10 wt.-% at any time during the copolymerization reaction, except in the purely theoretical event of 100% conversion (cf. the integral curves $pi1_1$ and $pi2_1$ for the reaction rates $r_1 = 0.19$ and $r_2 = 0.84$ in the above-mentioned computer plots).

- (iv) Concerning the issue of inventive step, the Respondent agreed to the conclusions drawn in the appealed decision. In particular the problem to be solved by the invention was the provision of a styrenic polymer having improved melt flow properties while maintaining the good physical properties inherent to such polymers and avoiding the drawbacks associated with an excessive use of plasticizers/flow improvers.

- (v) Document D1 contained no pointer towards the solution of this problem. The fact that D2 disclosed that by admixture of acrylic esters the softening point could be reduced could not suggest that by the same token the melt flow properties would also be improved. First, there was no such relationship between the softening behaviour and the melt flow and, secondly, the large difference between the Vicat softening temperatures of the copolymers tested according to Table I of the patent in suit, which were between 70°C and 93°C, and the temperature of the melt flow measurement of about 200°C, showed

clearly that a change of the softening temperature could have little, if any, influence on the melt flow behaviour.

(vi) Likewise, the Appellant's contention that the melt flow improvement was due to a lower molecular weight of the copolymers of the patent in suit was unfounded. All copolymers tested according to Table I of the patent in suit, although exhibiting diverging melt flow rates, had approximately the same solution viscosity and thus about the same molecular weight. That this contention of the Appellant was wrong was also shown by the concurrence of the molecular weights and tensile data of Experiment 7 and Comparative Experiment B in Table II of the patent in suit.

(vii) In reaction to the Board's objection that, in contravention of the provisions of Rule 57a EPC, Claims 4, 5 and 11 of the set of claims submitted during the first instance proceedings had not been occasioned by grounds of opposition, the Appellant during the oral proceedings filed a set of 8 claims from which these claims were omitted and in which previous Claims 6 to 10 were renumbered 4 to 8, with consequential adjustment of the claim references in new Claim 4 (now: "The styrene polymer resin of claims 2 or 3 ... ") and new Claim 7 (now: "The method of claim 5 of 6 ...").

IX. The Appellant requested that the decision under appeal be set aside and that the European patent No. 212 700 be revoked.

The Respondent requested that the decision under appeal be set aside and that the patent be maintained on the basis of the claims submitted during the oral proceedings.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 114(2) EPC*

2.1 The late cited EP-A-29 174 is not relevant to the claimed subject-matter and is therefore not admitted into the appeal (see also Section VII (iii) supra).

2.2 The Appellant's facsimile submission dated 25 November 1997, 16:30, reached the Board and the Respondent only in the morning before the oral proceedings. Its admission into the appeal was, however, not only not objected to by the Respondent, but even considered by him to be of help in establishing his case. Despite the extremely late submission, it was therefore admitted by way of exception to the general practice of the Boards.

3. *Article 123(2) and (3)*

No objection arises under Articles 123(2) and (3) EPC (see point 3 of the Reasons of the appealed decision).

4. *Rule 57a EPC*

After deletion of Claims 4, 5 and 11 from the set of claims underlying the appealed decision (see Sections III.1 and VIII (viii) supra) the Board is

satisfied that the remaining amendments, with regard to the granted version, comprised by the now operative claims are all occasioned by the grounds of opposition.

In particular, the splitting of granted Claims 1 and 5 into separate claims for non-nitrile-modified and nitrile-modified styrene polymer compositions and the introduction of a use claim (Claim 8 of operative set) were occasioned by the novelty situation vis-à-vis document D1.

5. *Article 54 EPC*

- 5.1 The issue of novelty hinges on the question whether the styrene/n-butylacrylate copolymers disclosed in Example 5 of document D1 comprise 10 % by weight (or less) of n-butylacrylate.
- 5.2 D1 is concerned with the provision of substitute materials for celluloid, a mixture of nitrocellulose and camphor, which materials, while maintaining the beneficial physical properties of celluloid, should remedy its major drawbacks, i.e. its easy inflammability and the need of solvents for its processing. This object was achieved by copolymers of acrylic acid esters with vinyl chloride, acrylic acid nitrile, acrylic acid or styrene (page 1, lines 1 to 26; Claim). According to Example 5 a product, made by polymerization at 120° of a mixture of 90 parts styrene and 10 parts acrylic acid butyl ester, was extruded to tubes and further thermoformed under the action of vapour or hot air to hollow bodies of good hardness and strength.
- 5.3 For the assessment of novelty it is therefore important to decide whether the weight ratio of styrene units to n-butylacrylate units in the

copolymer resulting from the polymerization carried out according to Example 5 of D1 was the same as in the monomer feed, i.e. was also 90 : 10 (or possibly less) (during the first instance opposition proceedings agreement was reached among the parties that "parts" in Example 5 meant "parts by weight" and "acrylic acid butyl ester" meant "n-butylacrylate"; this interpretation was not an issue in the appeal). If this were the case than there would be an overlap between the subject-matter of present Claim 1 and the disclosure of said Example 5.

5.3.1 In the Board's judgment and for the following reasons, the polymerization reaction in Example 5 of D1 was not carried out to 100% completion, with the consequence that there was no automatic identity of the styrene/n-butylacrylate weight ratio in the monomer feed and in the final polymer.

According to Experiment 1 of the patent in suit "essentially complete polymerization" was achieved by (i) heating in an oil bath for 72 hours at 140°C in an oxygen-free sealed ampoule a mixture of 97.5 weight parts of styrene and 2.5 weight parts of n-butylacrylate, followed by (ii) heating for 6 hours at 220°C in an air circulating oven at 220°C.

This complex and lengthy polymerization process, necessary to achieve "essentially complete polymerization", contrasts with the simple statement in Example 5 of D1, which apart from the (lower) temperature of 120° does not specify any of the further conditions of the polymerization reaction.

Since the authors of the patent in suit would not have used a process as elaborate as the one according to Experiment 1, if they could have attained complete polymerization at less severe conditions, and since

the meagre information in D1 does not allow any conclusion as to the use in the process of Example 5 of similarly stringent conditions, it cannot be reasonably assumed that according to this example "essentially complete polymerization" was achieved. The Appellant's allegations to the contrary have not been backed by evidence and, in view of the above, must be dismissed.

- 5.3.2 The issue of novelty therefore boils down to the question, whether a copolymer resulting from the incomplete polymerization of 90 parts styrene and 10 parts n-butylacrylate contains 10 wt.-% (or less) of the latter monomer in polymerized form.
- 5.3.2.1 In deciding the afore-mentioned question, the reactivity ratios for the polymer chain propagation by styrene (r_1) and n-butylacrylate (r_2) were considered important by the parties. It was argued by the Respondent that, in view of the respective reactivity ratios disclosed in D2, page II-251, the formed polymer comprised more n-butylacrylate than the 10 wt.-% contained in the monomer feed. According to document D3, adduced as evidence by the Appellant, the reverse was true.
- 5.3.2.2 The conclusions drawn in the preceding paragraph are only valid for the initial stage of the polymerization, because, as the reaction proceeds, the monomer feed is depleted of the faster reacting monomer (be it styrene or n-butylacrylate), leading to a point ("azeotropic point") where the monomer distribution in the then formed polymer molecules is exactly that of the original feed composition. From that point onwards the formed polymer molecules must contain less of the faster reacting monomer than the amount which was contained in the original feed. This fact is illustrated by the differential curves pdl_1 and

pd₂, in the computer plots attached to the Appellant's submission dated 25 November 1997 (see upper graphs on pages 3 and 4). Nevertheless, the average content of the faster reacting monomer in the **total** formed polymer is always above its proportion in the original feed composition (see integral curves pi₁ and pi₂, in the same graphs) and it remains therefore decisive for the present issue of novelty which one of the two monomers, styrene or n-butylacrylate, is the faster reacting monomer.

5.3.2.3 On page II-159 document D2, being a passage from the textbook "Polymer Handbook", discloses 8 pairs of reactivity rates for the copolymerization of styrene and n-butylacrylate, coming from different literature sources. It was argued by the Respondent, and this was not contested by the Appellant, that all of these rates (except for those having a negative value, which seem to be unrealistic, because such a value points to **depolymerization** rather than polymerization), when applied to the feed composition of Example 5 of D1, lead to copolymers whose average content of n-butylacrylate units is over 10 wt.-%. This is illustrated for the reactivity ratios $r_1 = 0.19$ and $r_2 = 0.84$ by the upper graph on page 4 of Appellant's submission of 25 November 1997 (curve pi₁).

5.3.2.4 Document D3, a paper originating from a national institute of technology, is concerned with the copolymerization of styrene and n-butylacrylate, including the determination of the reactivity ratios of these monomers (see Abstract). In the paragraph bridging pages 880 and 881 D3 indicates that according to the authors' investigations the ratios r_s and r_b for styrene and n-butylacrylate, respectively, were 1.21 ± 0.21 and 0.17 ± 0.07 . As illustrated in the upper graph on page 3 of the Appellant's submission of 25 November 1997, when applied to the feed composition

of Example 5 of D1, these ratios would lead to copolymers whose average content of n-butylacrylate is below 10 wt.-%, thus meeting the respective requirement of Claim 1 of the patent in suit.

5.3.2.5 While, at first sight, the conclusions drawn from in the preceding paragraph seem to be at variance with those drawn in point 5.3.2.3 on the basis of document D2, this is in fact not the case, since the information contained in D3 does not refer to the copolymerization of styrene with 10 wt.-% or less of n-butylacrylate. This can i.a. be inferred from Table I on page 880, according to which the minimum mol fraction of n-butylacrylate in the feed was 0.20, amounting to a content of about 23.5 wt.-% n-butylacrylate in the monomer feed.

5.3.2.6 On the balance of probabilities, it is therefore decided that the reactivity ratios disclosed in D2, which refer to eight different literature sources, are more likely to be applicable to the copolymerization reaction set out in Example 5 of D1 than those disclosed in D3, relying on a single investigation. This was not denied by the Appellant during the oral proceedings. This conclusion is also in line with the jurisprudence of the boards of appeal for the case that they are not able to establish on its own motion with certainty which one of two contrary assertions is true, since in such a case the Appellant/Opponent has not discharged his burden of proof to the necessary level he is obliged to in opposition proceedings (cf. T 219/83 OJ EPO 86, 211, corr. OJ EPO 86, 328).

It follows that Example 5 of document D5 does not disclose copolymers of styrene and n-butylacrylate, where the content of n-butylacrylate units is 10 wt.-% or less.

5.3.2.7 During the oral proceedings the Appellant did not entertain any more the above-discussed line of argumentation, but wanted to rely on the new argument that, independent of the fact which one of the two monomers, styrene or n-butylacrylate, is the faster reacting one, the copolymer produced according to Example 5 of D1 must contain a portion of polymer molecules which comprised 10 wt.-% (or less) of n-butylacrylate units. This portion, the Appellant contended, deprived the subject-matter of Claim 1 of novelty as long as this claim was not restricted to resins consisting **exclusively** of polymer molecules comprising units of styrene and n-butylacrylate in the specified amounts.

This conclusion is, however, not in agreement with the requirement of Article 54(2) EPC that for something to become state of the art it must have been made available to the public. Unidentified and non-isolated parts of polymers, which by their very nature are practically always mixtures of different polymer molecules, cannot be regarded as having been made available to the public. What has been made available to the public in a case like the one according to Example 5 of D1, where no post-treatment, polymer separation or other modification/isolation techniques were applied, is the direct result of the polymerization reaction, i.e. the copolymer, whose composition is defined by its **average** contents of styrene and n-butylacrylate units. However, the average content of n-butylacrylate units in the copolymer resulting from the incomplete polymerization carried out according to Example 5 of D1 is in any event higher than 10 wt.-% (cf. point 5.3.2.3 supra).

Thus, this argument of the Appellant fails and the conclusion drawn in point 5.3.2.6, second paragraph remains valid.

5.4 It is therefore decided that the disclosure of document D1, particularly its Example 5, does not deprive of novelty the subject-matter of Claim 1 of the patent in suit.

The same conclusion applies to the subject-matter of independent Claim 6, which relates to a method of preparation of the resin according to Claim 1.

5.5 The subject-matter of independent Claims 2 and 5 is also novel over D1, because the disclosure of this document does not comprise terpolymers from styrene, esters of acrylic acid and ethylenically unsaturated nitrile monomers.

5.6 Furthermore, the subject-matter of independent Claim 8 is also novel over D1, because this document does not disclose that the flow properties of a thermoplastic styrene polymer moulding resin may be improved by the incorporation of units derived from an ester of acrylic acid.

6. *Article 56 EPC*

6.1 According to the patent in suit (page 2, lines 42 to 44 and 15 to 28) the problem underlying the present subject-matter was to provide a styrenic polymer resin having improved flow characteristics, while avoiding the drawbacks of the known addition of plasticizers/flow promoters which may cause haziness and mold sweating.

6.2 The Board is satisfied of the objective nature of the afore-mentioned problem vis-à-vis the closest prior art, i.e. document D5.

For the reasons given in paragraph 6.6 below D1 does not qualify as relevant prior art for the assessment of inventive step.

6.2.1 Document D5 relates to the preparation of polymers of styrene and, possibly, ethylenically unsaturated monomers, e.g. aliphatic esters of acrylic acid, which have increased mold flowability. This object, according to D5, is achieved by the incorporation during the bulk polymerization of the monomers of certain amounts of (i) unsaturated fatty acids having 12 to 20 carbon atoms and (ii) mineral oil of a viscosity of 40 to 250 centipoises (Claim 1; column 1, lines 28 to 64).

6.2.2 Document D5 is, thus, concerned with the same "main" problem as the present invention, i.e. the improvement of the melt flow of styrenic polymers and is, thus, an appropriate starting point for the assessment of inventive step.

6.3 According to the patent in suit, the solution to the existing technical problem resides in the incorporation into a styrenic resin of certain amounts of an ester of acrylic acid with an alcohol having 2 to 8 carbon atoms.

6.4 On the basis of the information contained in the patent in suit the Board is satisfied that the above mentioned problem has effectively been solved by the measures taken according to the preceding point.

6.4.1 Table I on page 4 of the patent in suit demonstrates that by the incorporation of increasing amounts of n-butylacrylate into a styrenic resin the melt flow rate is concomitantly enhanced (Experiments 1 to 6). The same effect is established by Experiment 8/Comparative Experiment C (page 5, line 55 to page 6, line 10) for

styrenic resins comprising acrylonitrile units. Table II on page 5 shows that this improvement is not achieved at the expense of the tensile strength because the latter is identical for polymer compositions with and without n-butylacrylate (compare Experiment 7 and Comparative Experiment B). Because the presence of external flow improvers (e.g. mineral oil) is avoided or reduced it can also be accepted that the resins according to the patent in suit are transparent and do not suffer from mold sweating (cf. page 2, lines 59 to 64 of the patent in suit).

6.4.2 The Appellant's argument that the improved melt flow was not caused by the incorporation of acrylic ester units but by a lower molecular weight, with the consequence that this effect would be unable to endorse the inventivity of the claimed solution, is dismissed.

First, the Appellant has not submitted any evidence in support of this allegation and, secondly, the evidence in the patent in suit (Table II) shows that at similar molecular weights of the polymers (with acrylate: 250000; without acrylate: 240000) a substantial improvement of the melt flow is achieved by the incorporation of n-butylacrylate (from 10.6 g/10 min to 16 g/10 min). Similarly, the improvement of the melt flow exhibited in Table I is not linked to a lowering of the molecular weight, as evidenced by the small variations of the solution viscosity of the polymers (e.g. 23.6 mPas for Comparative Experiment A [styrene homopolymer]; 23.8 mPas for Experiment 6 [copolymer with 15 wt.-% n-butylacrylate]).

Appellant's further argument that the lowering of the softening temperature accompanying the enhancement of the melt flow would make the claimed resins of limited use, thus questioning the practical importance of the

claimed technical solution, was not based on any evidence. In the absence thereof the Board sees no reason to doubt that the properties of the claimed resin represent indeed a valuable contribution to the prior art.

- 6.5 Since D5 does not contain any suggestion that the melt flow of styrenic polymers may be improved, in the absence of saturated fatty acids and substantial amounts of mineral oil, by the mere presence of acrylic acid ester units, the solution set out in Claim 1 of the patent in suit is non-obvious over the disclosure of this document.

Although the same non-obviousness conclusion was one of the important grounds for the Opposition Division's decision of maintaining the opposed patent, the Appellant, during the appeal, did not comment thereupon, but, in his obviousness argumentation, relied only on document D1 (see paragraph 6.6 below).

- 6.5.1 In the Board's judgment, the same conclusion also applies to the subject-matter of Claim 2, because document D5 too is an appropriate starting point for the assessment of inventive step of styrenic resins comprising ethylenically unsaturated nitrile units. Although styrene/nitrile copolymers are not exemplified in D5, acrylonitrile is among the possible comonomers enumerated in this document (column 1, lines 56 to 60 and column 2, lines 54 to 58). Since there is no reason to assume that copolymers of styrene and acrylonitrile have a peculiar melt flow behaviour, one skilled in the art will consider that the respective problems described in D5 for styrenic polymers extend as well to copolymers of styrene and acrylonitrile.

6.5.2 The same considerations also apply to the subject-matter of Claims 5 and 6, which relate to methods for preparing the styrenic resins according to, respectively, Claims 1 and 2, and to that of use Claim 8.

The patentability of the subject-matter of, on the one hand Claims 3 and 4 and, on the other hand Claim 7 arises from their dependency upon the independent Claims 1 and/or 2, respectively, 5 or 6.

6.6 When determining the problem to be solved by the claimed invention it is standard practice of the boards of appeal to start from the problem described in the contested patent. Only if that problem has not been solved, or if inappropriate prior art was used to define the problem it is necessary to investigate which other problem objectively existed (cf. e.g. T 495/91, Reasons 4.1 and 4.2). As set out above, in the present case there is no need to depart from the problem as formulated in the patent in suit.

6.6.1 Document D1 (cf. point 5.2 supra) nowhere mentions the melt flow of styrenic resins. Insofar this document does not appear relevant to the present issue of inventive step. D1 does however disclose that by the incorporation of acrylic esters the softening point of the polymers may be reduced (cf. sentence bridging pages 1 and 2 of D1) and it was argued by the Appellant that this property was equivalent to the melt flow in the sense that the enhancement of the melt flow was a corollary of the lowering of the softening point.

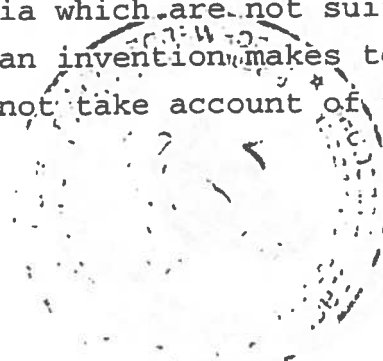
6.6.2 In the Board's judgment, the above reasoning of the Appellant is, however, not convincing, since the temperature difference between the softening points of the claimed resins (e.g. Table I: 70° to 93°C) and the

temperature of the determination of the melt flow (according to the Respondent and uncontested by the Appellant: at least about 200°C) is so important that an influence of the softening behaviour on the melt flow behaviour can essentially be ruled out.

The description of the softening behaviour of the copolymers according to D1 can therefore not be equated with their melt flow behaviour, and insofar D1 is not a relevant prior art for the assessment of an inventive step of the subject-matter of the patent in suit.

6.6.3 No different conclusion can be reached when considering the information in D1 concerning the possible improvement of the impact flexural strength ("Schlagbiegefestigkeit") and elasticity by the incorporation of acrylic esters into the polymer, because there is no evidence available, on the basis of which one could conclude that these properties are related to the melt flow behaviour.

6.6.4 The alternative reasoning of the Appellant that, irrespective of the existing technical problem as defined in point 6.1 supra, it was obvious to modify the polymer compositions disclosed in D1 in the way suggested by the patent in suit, because it was evident that by that one would arrive at valuable tough, elastic and transparent styrenic polymers, is not supported by any evidence and defies the well established problem-solution method for assessing inventive step. This way of thinking relies on purely subjective criteria which are not suitable to assess the contribution an invention makes to the state of the art and does not take account of the fact that, in



order to make a technical solution obvious, it is necessary for the skilled person to have a definite and reasonable expectation of success for the solution of a specific technical problem.

6.6.5 By the same token the further argument of the Appellant must be dismissed, namely that, when starting from Example 5 of D1, it would be obvious to reduce the amount of n-butylacrylate thereby arriving at the claimed subject-matter, because, as compared to styrene, n-butylacrylate was a relatively expensive monomer. Commercial considerations of this kind are only secondary indicia in determining inventive step and cannot replace a proper technically skilled assessment of the invention vis-à-vis the closest prior art.


7. In summary the Appellant has failed to prove his case on both novelty and inventive step.

Order

For these reasons it is decided that:

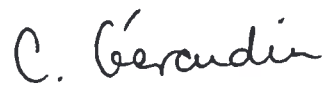
1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent on the basis of the claims submitted during oral proceedings and after any consequential amendments of the description.

The Registrar:


E. Gorgmaier



The Chairman:


C. Gérardin