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D E C I S I O N
of 10 October 2002

Case Number: T 0033/00 - 3.3.3

Application Number: 91121778.4

Publication Number: 0516885

IPC: C08F 212/08

Language of the proceedings: EN

Title of invention:

Styrene/acrylic-type polymers for use as surface sizing agents

Patentee:

Bayer Corporation

Opponent:

- (01) BK Giulini Chemie GmbH & Co. OHG
(02) THE DOW CHEMICAL COMPANY

Headword:

-

Relevant legal provisions:

EPC Art. 83

Keyword:

"Disclosure - sufficiency (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0033/00 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 10 October 2002

Appellant I:
(Opponent 02) THE DOW CHEMICAL COMPANY
2030 Abbott Road
Dow Center
Midland, Michigan 48640 (US)

Representative: Raynor, John
W.H. Beck, Greener & Co
7 Stone Buildings
Lincoln's Inn
London WC2A 3SZ (GB)

Appellant II:
(Proprietor of the patent) Bayer Corporation
100 Bayer Road
Pittsburg, PA 15205-9741 (US)

Representative: Allam, Peter Clerk
Lloyd Wise
Commonwealth House
1-19 New Oxford Street
London WC1A 1LW (GB)

**Respondent/
Other party:**
(Opponent 01) BK Giulini Chemie GmbH & Co. OHG
Postfach 15 04 80
D-67029 Ludwigshafen (DE)

Representative: -

Decision under appeal: Interlocutory decision of the Opposition Division
of the European Patent Office posted 10 November
1999 concerning maintenance of European patent
No. 0 516 885 in amended form.

Composition of the Board:

Chairman: R. Young
Members: W. Sieber
J. Van Moer

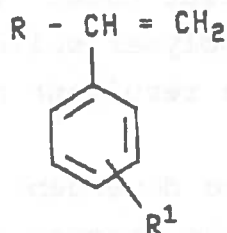
Summary of Facts and Submissions

I. The mention of the grant of European patent No. 0 516 885, with 10 claims, in respect of European patent application no. 91 121 778.4, filed on 19 December 1991 and claiming a US priority of 2 June 1991 (US 651 168) was published on 20 March 1996 (Bulletin 1996/12). Claim 1 read as follows:

"1. A process for the production of a polymer which comprises:

1) forming a homogeneous solution of:

(i) a monomer having the formula:



wherein R is hydrogen or C_1 - C_4 alkyl and R^1 is hydrogen, halo or C_1 - C_4 alkyl;

(ii) acrylic acid or methacrylic acid and
(iii) optionally, a hydrophobic monomer different from that represented by said formula, the mole ratio of (i) to (ii) ranging from 1.4:1 to 1:1.4, the amount of (iii) being such as to replace up to 10%, by weight, based on the total monomer weight, of (i) and/or (ii) and the solvent for said solution comprising a mixture of water and an unsubstituted hydrocarbon non-tertiary alcohol which can be separated from said water, the weight ratio of alcohol to water being 1:1 to 4:1;

2) heating said homogeneous solution to reflux in the substantial absence of oxygen and in the presence of

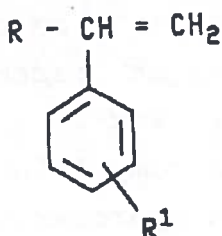
from 1 to 3%, by weight, based on the weight of said monomers, of a water-soluble catalyst which generates sufficient free-radicals during the polymerization, until the weight average molecular weight of the resultant polymer is at least 30,000 as determined by HPSEC (high performance size exclusion chromatography), said catalyst being added to said solution portion-wise such that the first portion is sufficient to only initiate polymerization of said monomers and the remaining portions are added over the course of said heating;

- 3) neutralizing a sufficient amount of the polymerized acid moieties of the resultant polymer so as to render the polymer water-soluble while substantially simultaneously separating the alcohol/water mixture;
- 4) adding sufficient water, if necessary, to produce no more than a 25% polymer solids solution and
- 5) recovering the resultant polymer solution."

Claims 2 to 4 were dependent claims directed to elaborations of the process according to Claim 1.

Claim 5, an independent claim, read as follows:

"5. A non-alternating, block-free, substantially homogeneous polymer of 1) a monomer having the formula:



wherein R is hydrogen or [sic] C_1 - C_4 alkyl and R^1 is hydrogen, halo or C_1 - C_4 alkyl, 2) acrylic or methacrylic acid and 3) optionally, a hydrophobic monomer different from that represented by said formula, the monomer units thereof being incorporated therein as if the

monomers from which said units are derived had 1) reactivity ratios nearly equal and 2) a multiplication product of their reactivity ratios approaching unity, said polymer being obtainable by the process of Claim 1."

Claim 7, an independent claim, was directed to a method of surface sizing paper which comprises adding to an alkaline-formed paper sheet the polymer of Claim 5.

Claim 9, an independent claim, was directed to a paper surface-sized with the product of Claim 5.

Claim 6, 8 and 10 were dependent claims directed to elaborations of the corresponding independent claims.

II. Notices of Opposition were filed by BK Giulini Chemie GmbH & Co. OHG (opponent 01) on 11 December 1996, and by The Dow Chemical Corporation (opponent 02) on 19 December 1996, respectively, both parties requesting revocation of the patent in its entirety. The oppositions were based on the grounds of Article 100(a) EPC, ie lack of novelty and lack of inventive step (opponents 01 and 02), and on the grounds of Article 100(b) EPC, ie insufficiency of disclosure (opponent 02).

The oppositions were supported *inter alia* by the following documents:

D1: EP-B-0 320 609;

D3: GB-A-1 107 249;

D9: Affidavits of T. Arakawa dated 19 December 1996 and J. Eiffler dated 20 May 1997;

D11: Principles of Polymerization, 2nd Edition, George Odian, John Wiley & Sons, pages 440 to 441;

D17: D. R. Montgomery and. C. E. Fry, Calculation of relative reactivity ratios from composition-conversion data through use of a computer;

D26: Organic Chemistry of Synthetic High Polymers, Robert W. Lenz, Interscience Publishers, 1967, pages 282 to 283;

D27: Memorandum on Reactivity Ratios;

D29: US-A-4 030 970;

D33: Spreadsheet calculation based on patent data and equation of D17;

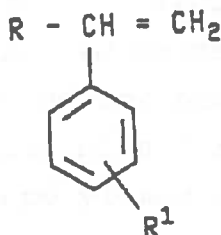
D34: Spreadsheet calculation based on best fit for patent data and equation of D17; and

D36: Data presented by Dr. J. Mallon during oral proceedings held on 14 October 1999 (not admitted by the opposition division).

III. By an interlocutory decision which was announced orally on 14 October 1999 and issued in writing on 10 November 1999, the opposition division held the opposition of opponent 02 admissible, refused the proprietor's main request (claims as granted) and both its first and second auxiliary request and decided that the patent could be maintained in amended form according to the third auxiliary request.

(i) The claims of the first auxiliary request differed from the claims as granted only in Claim 5 which was amended to read as follows:

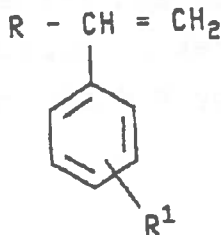
"5. A non-alternating, block-free, substantially homogeneous polymer of 1) a monomer having the formula:



wherein R is hydrogen or C₁-C₄ alkyl and R¹ is hydrogen, halo or C₁-C₄ alkyl, 2) acrylic or methacrylic acid and 3) optionally, a hydrophobic monomer different from that represented by said formula, the monomer units thereof being incorporated therein: (a) in a mole ratio of (1) to (2) ranging from 1.4:1 to 1:1.4, the amount of (3) if any being such as to replace up to 10% by weight, based on the total weight of monomer units (1) and/or (2), and (b) as if the monomers from which said units are derived had 1) reactivity ratios nearly equal and 2) a multiplication product of their reactivity ratios approaching unity; and a sufficient amount of the polymerized acid moieties being neutralized to render said polymer water-soluble; said polymer being obtainable by the process of Claim 1."

(ii) In the second auxiliary request comprising eight claims, Claims 1 to 4 corresponded to Claims 1 to 4 as granted and Claims 5 to 8 read as follows:

"5. A method of surface sizing paper which comprises adding to the alkaline-formed paper sheet a non-alternating, block-free, substantially homogeneous polymer of 1) a monomer having the formula:

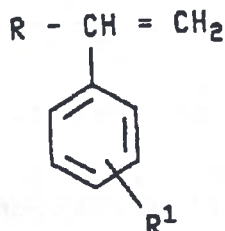


wherein R is hydrogen or [sic] C₁-C₄ alkyl and R¹ is hydrogen, halo or C₁-C₄ alkyl, 2) acrylic or methacrylic acid and 3) optionally, a hydrophobic monomer different from that represented by said formula, the monomer units thereof being incorporated therein as if the monomers from which said units are derived had 1) reactivity ratios nearly equal and 2) a multiplication product of their reactivity ratios approaching unity, said polymer being obtainable by the process of Claim 1.

6. A method according to Claim 5 wherein both R and R¹ are hydrogen and no monomer 3) is present.

7. A method according to Claim 6, wherein (2) is methacrylic acid.

8. Paper surface-sized with a non-alternating, block-free, substantially homogeneous polymer of (1) a monomer having the formula:



wherein R is hydrogen or C₁-C₄ alkyl and R¹ is hydrogen, halo or C₁-C₄ alkyl, 2) acrylic or methacrylic acid and 3) optionally, a hydrophobic monomer different from that represented by said formula, the monomer units thereof being incorporated therein as if the monomers from which said units are derived had (1) reactivity ratios nearly equal and (2) a multiplication product of their reactivity ratios approaching unity, said polymer being obtainable by the process of Claim 1."

(iii) In the third auxiliary request comprising six claims, Claims 1 to 4 corresponded to Claims 1 to 4 as granted and Claims 5 and 6 read as follows:

"5. A method of surface sizing paper which comprises adding to an alkaline-formed paper sheet a polymer which has been produced by a process according to any preceding claim.

6. Paper surface-sized by a method according to Claim 5."

According to the decision, the ground of opposition raised by opponent 02 under Article 100(a) EPC (based on D3 to D6 and public prior use) was not sufficiently substantiated according to Rule 55(c) EPC.

Nevertheless, the opposition of opponent 02 was held admissible because the patent had been correctly opposed in accordance with Rule 55(c) EPC on the ground listed in Article 100(b) EPC.

As to sufficiency of disclosure, it was decided that a person skilled in the art was not able to derive from the information in the patent in suit a method by which the required reactivity ratios could be determined in a reliable manner. When following the claimed process, a non-alternating, block-free, substantially homogeneous product as defined by reactivity ratios 1) and 2) could not be achieved. Thus, the main request, first and second auxiliary requests, all containing at least one claim with a reference to the reactivity ratios, did not meet the requirements of Article 83 EPC.

However, the third auxiliary request did meet the requirements of the EPC. In particular, the objection relating to "reactivity ratio" did not apply equally to the claims of this request as none of these claims made reference to the reactivity ratios. Also the molecular

weight determination by HPSEC (high performance size exclusion chromatography), was sufficiently disclosed for a skilled person taking into account the common general knowledge and the information given in the patent in suit. The claims were held to be both novel and inventive over the cited prior art. As to inventive step, the closest prior art was considered to be D1 (opponent 01) or D29 (opponent 02). The technical problem with respect to D1 and D29 was to provide a modified process for producing a styrene/acrylic type polymer resulting in a more effective incorporation of the monomers into the polymer product which functioned as sizing agent for alkaline paper more effectively than those made in accordance with the procedures of the prior art, especially as regards ink penetration. The solution, ie the process steps of Claim 1, was considered not obvious from the available prior art.

IV. Notices of Appeal against the above decision were filed by opponent 02 (appellant I) on 7 January 2000 and by the proprietor (appellant II) on 20 January 2000, the prescribed fees being recorded as paid on the same, respective dates.

(i) In the Statement of Grounds of Appeal, filed on 10 March 2000, opponent 02 (appellant I) argued in substance as follows:

(a) The objection under Article 100(b) EPC relating to reactivity ratio applied equally to Claim 1 of the third auxiliary request because Claim 1 had at its heart the production of polymers which were alleged to be more random than those of the prior art. There was, however, insufficient information in the patent to enable the skilled person to produce by the process of Claim 1 polymers which had an increased randomness of monomer incorporation.

As regards the molecular weight determination by HPSEC, the patent in suit contained insufficient information to enable the HPSEC test of Claim 1 to be carried out.

(b) The third auxiliary request was not permissible because the opposition division did not take due regard of the fact that, according to T 150/82, T 219/83 and T 205/83, a "product-by-process" claim was allowable only if the product was demonstrated to be novel. In the present case, neither the patent itself, nor any document filed subsequently demonstrated the novelty of the product *per se*. On the contrary, all of the experimental evidence supplied by opponent 02 during the course of the opposition proceedings pointed to the conclusion that the product of Claim 1 was not different in any measurable respect from materials produced by prior art processes, in particular those of D3 to D6.

(c) The process of Claims 1 to 4 did not involve an inventive step in view of D3 and D29 and in view of the demonstrated prior sales of the material "Polymaron 1308S". The modifications, which distinguished the process of Claim 1 from the prior art, were mere obvious alternatives with no demonstrated advantages, in particular as regards an increase in randomness of the copolymer obtainable by the process of Claim 1.

(ii) In the Statement of Grounds of Appeal, filed on 15 March 2000, the proprietor (appellant II) argued in substance as follows:

(a) The opposition division and the opponent had misunderstood the requirement of Claim 5 because the formation of a random copolymer was, as

apparent from the patent in suit, equated with an equal rate of monomer consumption (eg patent specification page 4, lines 13 to 17; page 4, lines 50 to 56; page 5, lines 6 to 9). Consequently, no actual measurement of reactivity ratios had to be made at all.

(b) Even if the determination of actual reactivity ratios were required a skilled person could calculate the ratios from the monomer consumption values from a single polymerization as described in D17 and shown in D36 (not admitted by the opposition division).

V. Both the proprietor (appellant II) and opponent 02 (appellant I) presented observations on the Statement of Grounds of Appeal of the other party in their letters dated 18 September 2000 and 24 November 2000, respectively.

VI. In a communication accompanying a summons to oral proceedings, a salient issue was identified by the board as being the allowability of amended Claims 5 and 6 of the third auxiliary request with regard to Article 123(3) EPC.

VII. By letter received on 6 September 2002, the proprietor (appellant II) amended the third auxiliary request by the deletion of Claims 5 and 6 in order to meet the Article 123(3) EPC objection. The proprietor was of the opinion that no consequential amendments to the body of the specification were needed by this change to the claims of the third auxiliary request. Nevertheless, an unamended specification, ie pages 2 to 12 of the patent as granted, was refiled. In the same letter, the proprietor (appellant II) withdrew its request for oral proceedings, and informed the board that it would not

be represented at the oral proceedings. Thus, it was requested to issue a decision on the basis of the written submissions and evidence.

- VIII. In preparation for the oral proceedings, opponent 02 (appellant I) summarized its position with regard to the significance of reactivity ratios and their determination (letter received on 6 September 2002).
- IX. In view of the proprietor's withdrawal of its request for oral proceedings, opponent 01 (respondent/party as of right) requested the board, in a letter received on 19 September 2002, to cancel the oral proceedings, informed the board that no representative for the respondent/party as of right would be present at the oral proceedings, and asked for a decision on the basis of the written submissions and evidence.
- X. On 10 October 2002, oral proceedings were held before the board at which opponent 02 (appellant I), but not the proprietor (appellant II) or opponent 01 (respondent/party as of right), was represented. Because the latter two parties had been duly summoned, however, the oral proceedings were continued in their absence in accordance with Rule 71(2) EPC. In the discussion, the representative of opponent 02 (appellant I) elucidated the written submissions with regard to sufficiency of disclosure and lack of inventive step.
- XI. Opponent 02 (appellant I) requested that the interlocutory decision under appeal allowing the third auxiliary request be set aside and the patent be revoked.

The proprietor (appellant II) requested that opponent's 02 appeal be dismissed, that the interlocutory decision under appeal be set aside and that the patent be maintained:

- as granted (main request), or
- on the basis of Claims 1 to 10 according to the first auxiliary request underlying the decision under appeal (first auxiliary request), or
- on the basis of Claims 1 to 8 according to the second auxiliary request underlying the decision under appeal (second auxiliary request), or
- on the basis of Claims 1 to 4 and pages 2 to 12 of the patent specification filed on 6 September 2002 (third auxiliary request).

Reasons for the Decision

1. The appeal is admissible.

Sufficiency of disclosure

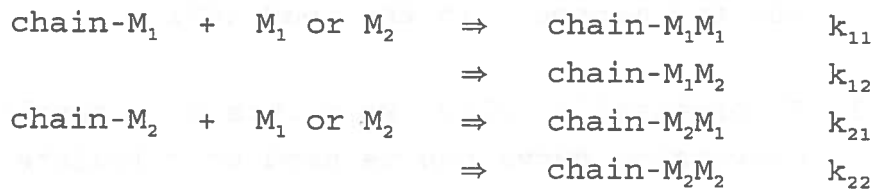
2. *Main request*

- 2.1 The opposed patent is concerned with styrene-acrylic acid type copolymers and their use as surface sizing agents for paper. As is explained in the opposed patent, particularly at page 2, lines 5 to 33, the characterizing technical feature of these copolymers lies in their high degree of randomness, their chemical composition in terms of starting monomers being quite conventional in paper sizing art. Because it is the very essence of "randomness" that it is not possible to

define this characteristic of the copolymers in terms of their composition, the patent in suit relies on the concept of reactivity ratios.

2.2 The concept of reactivity ratios can be summarized as set out in the memorandum D27, which was filed by the proprietor (appellant II) (letter dated 10 August 1999) and the contents of which were agreed to by opponent 02 (appellant I) in general terms (letter dated 6 September 2002, 2nd paragraph).

2.2.1 According to D27, during a copolymerization, polymer chains are built up from the respective comonomers by the sequential addition of comonomers. At any given time during the copolymerization of two monomers M_1 and M_2 , the polymer solution will contain two types of active polymer chains that are in the process of adding new monomer units. These active chains will have either an M_1 unit or an M_2 unit on the end, wherein the chains having a M_1 unit on the end are called " M_1 -chains" and the chains which have a M_2 unit on the end are called " M_2 -chains". Both M_1 - and M_2 -chains are active and are capable of adding additional comonomers of either M_1 or M_2 . Since there are two kinds of chains and two kinds of monomers, there are four different ways that the next comonomer unit can add:



In general, the four different possibilities occur at four different rates (having rate constants k_{11} , k_{12} , k_{21} and k_{22} as shown above). "Reactivity ratios" are the ratios of the rate constants to one another. By

convention, the reactivity ratio "r₁" refers to M₁-chains, and is defined as k₁₁/k₁₂. Similarly, the reactivity ratio "r₂" refers to M₂-chains, and is defined as k₂₂/k₂₁.

Copolymerization reactions of two monomers may be classified empirically into several different types according to the relative values of the two reactivity ratios to each other and to unity (D26). In the one type where r₁ ≈ r₂ ≈ 1.0, little or no selectivity is exhibited by a polymer radical for either monomer, and monomer insertion into the copolymer chain is random.

- 2.2.2 The classical methods for determining r₁ and r₂ involve polymerization of several initial monomer compositions to low conversion, recovery and purification of the polymer formed, compositional analysis, and fitting of the data to the differential form of the copolymerization equation

$$\frac{d[M_1]}{d[M_2]} = \frac{[M_1] (r_1 [M_1] + [M_2])}{[M_2] ([M_1] + r_2 [M_2])}$$

by one of several techniques, whereby d[M₁]/d[M₂], is the molar ratio of the two monomer units in the copolymer and [M₁] and [M₂] are the concentrations of the two monomers in the feed (D11).

- 2.2.3 Theoretically, also two points of a single composition-conversion curve can be used to calculate r₁ and r₂ (D17).

- 2.3 Thus, it was well known in the art before the priority date to attribute presence (or absence) of a random structure in polymers by reference to reactivity ratios, and the proprietor has characterized the random structure of the copolymers in granted Claim 5 in

accordance with the concept of reactivity ratios: the monomer units of the copolymer should be incorporated therein as if the monomers from which said units are derived had 1) reactivity ratios nearly equal and 2) a multiplication product of their reactivity ratios approaching unity.

2.4 The patent in suit purports to demonstrate that the improvement in randomness has been achieved, by making measurements of residual monomer in a styrene/methacrylic acid reaction system (Example 3), and performing some unspecified calculation on these data, in order to ascertain therefrom reactivity ratios for styrene and methacrylic acid of $r_1 = 1.11$ and $r_2 = 1.13$, respectively (page 4, lines 55 to 56). Taking this information into account, a skilled person carrying out the invention would inevitably try to calculate the actual reactivity ratios of a polymerization in order to verify whether the desired degree of randomness was achieved.

2.5 In the course of the present opposition and appeal procedures, the objection under Article 100(b) EPC, raised by opponent 02 (appellant I) has, to a large extent, been based on questions about the determination of the reactivity ratios mentioned in Claim 5 and the reproducibility of the data given in the patent in suit with respect to reactivity ratios.

2.6 As explained above, several different methods were available at the priority date for determining reactivity ratios of a polymerization reaction. Claim 5 does not, however, explain how the actual reactivity values quoted in the claim should be determined. Nor does the specification of the patent in suit provide any further details in this respect. The only example dealing with reactivity ratios that could provide further guidance to the skilled person is Example 3.

This example shows in Table I the rate of consumption of the monomers styrene and methacrylic acid whereby it is stated on page 6, lines 38 to 39 that "the rate of consumption of both monomers is essentially identical, indicating that a random copolymer is formed."

Furthermore, page 4, lines 55 to 56 states: "Using the data generated by the reaction described in Example 3, reactivity ratios for the styrene monomer (r_1) and the methacrylic acid monomer (r_2) are calculated as follows: $r_1 = 1.11$ and $r_2 = 1.13$." The method of calculation is, however, not indicated.

- 2.6.1 At no stage during the opposition appeal proceedings has the proprietor (appellant II) given any detailed explanation of the method by which the reactivity ratios had to be calculated, and in particular, how the quoted values for r_1 and r_2 from the data of Example 3 were in fact obtained. On the contrary, the only information given was a reference to an unidentified computer program which was no longer available.
- 2.6.2 It is not surprising that the proprietor's first approach based on D11 did not succeed because the classical methods described in D11 involve the polymerization of several initial monomer compositions to low conversion whereas Example 3 is a single polymerization run to substantial completion. But also its second approach based on the Montgomery method (D17) did not provide reactivity ratios as reported in Example 3 of the patent in suit. On the contrary, opponent 02 (appellant I) demonstrated with the calculations D33 and D34, based on the equation of D17, using the data of Example 3 of the patent in suit, that it was not possible to arrive at the quoted values.
- 2.6.3 In summary, it is quite impossible to determine from the data presented in the patent in suit what the reactivity ratios of styrene and methacrylic acid were

in the method of Example 3. No method suggested by the proprietor (appellant II) can be used to calculate reactivity ratios of $r_1 = 1.11$ and $r_2 = 1.13$ from the data presented, nor has the proprietor indicated at any point, let alone in the patent itself, how the reactivity ratios which it claims to have obtained can be calculated from the data in the patent in suit.

- 2.6.4 In its written submissions of 13 March 2000, the proprietor (appellant II) referred to D36 which was a calculation purporting to show a possible method by which the reactivity ratio values quoted in the patent in suit might be arrived at. The opposition division refused to admit D36 into the proceedings because it was filed too late. In fact, D36 was only filed at the day of the oral proceedings held before the opposition division on 14 October 1999.

The board sees no reason to depart in this matter from the decision under appeal, in particular because it is *prima facie* not evident from that document that the calculated reactivity ratio values resemble those quoted in the patent in suit, nor that a skilled person would be aware of the assumptions which had to be made when performing these calculations.

- 2.6.5 The above discussion shows that the decision under appeal and opponent 02 (appellant I) did not overstate the difficulties of obtaining sufficiently reliable values of reactivity ratios, as argued by the proprietor (appellant II). Indeed, it is not clear according to which method the reactivity ratios have to be calculated in order to verify the randomness criteria mentioned in Claim 5.

- 2.7 The further argument of the proprietor (appellant II) that there was in any case no need to calculate r_1 and r_2 was based on a number of passages of the

description of the patent in suit to which reference was made. In particular, reference was made to page 4, lines 50 to 54: "A strong indication of the high degree of randomness present in the products of the instant invention is that measurement of the monomer incorporation (by direct measure of residual monomer) during the reaction progress indicates that the monomers are incorporated into the polymer uniformly throughout the polymerization", and to page 5, lines 6 to 9: "However, as the experimental data in Table I clearly illustrates, using the instant process both the styrene monomer and the (meth)acrylic acid monomer are consumed at nearly identical rates, thereby providing a polymer composition having monomer units incorporated therein as if the monomers from which said units are derived had 1) reactivity ratios nearly equal and 2) a multiplication product of their reactivity ratios approaching unity." According to the proprietor, these passages teach that, for the purpose of the invention, the formation of a random copolymer is equated with nearly identical rates of monomer consumption; thus, no actual measurements of reactivity ratios has to be made at all.

2.7.1 First of all, the board is bound to take account of the submissions of opponent 02 (appellant I), repeated at the oral proceedings, that merely measuring the rates of disappearance of two monomers in a polymerization reaction, as was done in Example 3 of the patent in suit, does not unambiguously establish their rates of incorporation in the resulting copolymer, or even that there is necessarily a single identifiable resulting copolymer into which they are incorporated.

2.7.2 Even if it were assumed, in favour of the proprietor, that it was a measure of randomness that the monomers disappear at nearly identical rates, the data of Example 3, which allegedly represents the invention, do

not show identical consumption rates. As can be seen from Table 1, at $t = 40$ min, 18 percent of the original styrene content has reacted but only 7.1 percent of the original methacrylic acid has reacted. The same is true at $t = 133$ and 135 min where 36 to 37 percent of the initial amount of styrene have already reacted, but only about 26 percent of methacrylic acid have reacted. At least up to $t = 198$ min the rate of consumption of styrene and methacrylic acid is not even close to being identical, which means that styrene reacts faster than methacrylic acid. The rates of consumption only begin to approach identity when almost all of the monomers have reacted. Thus, already the data in the patent in suit give rise to reasonable doubt on the proprietor's alleged equation of monomer consumption and formation of a random copolymer.

- 2.7.3 In a further attempt to ascertain whether the process reported in the patent in suit results in more random copolymers, opponent 02 (appellant I) has carried out further experiments (D9) to determine reactivity ratios when the process reported in the opposed patent is followed. The measurements were carried out by repeating the process of Example 3 of the patent in suit (at a styrene/methacrylic weight ratio of 45/55; test SVSH143) and also using essentially the same process, but at monomer ratios of 55/45 and 35/65 (tests SVSH144, and SVSH145, respectively). The two additional tests SVSH144 and SVSH145 were necessary because opponent 02 (appellant I) used the classical approach according to Fineman-Ross for determining r_1 and r_2 , requiring the polymerization of more than one initial monomer composition. These experiments demonstrate that, when the method according to the patent in suit is followed as closely as possible, the reactivity ratios of the styrene and methacrylic monomers in the reaction process are far from being approximately equal to each other, let alone equal to

unity. On the contrary, the styrene is found to have a reactivity ratio of 0.53, and methacrylic acid a reactivity ratio of 0.14. In other words, by following the instructions in the patent in suit, a polymer which fulfils the reactivity ratio requirement of Claim 5 is not obtained. These experiments and their validity have not been challenged by the proprietor.

2.7.4 Thus, the repetition by opponent 02 (appellant I) of Example 3 of the patent in suit not only yields reactivity ratios different from those quoted in the patent, but also does not show a "nearly equal consumption of monomers". On the contrary, as is apparent from the experimental data for test SVSH143 in D9, styrene is consumed substantially more quickly than methacrylic acid, as would be expected according to the conventional state of the art.

2.8 Summing up:

- (i) there exists more than one method for the determination of reactivity ratios, but even after discussing this issue for years, it is still not clear according to which method the reactivity ratios mentioned in Claim 5 should be calculated;
- (ii) the data of Example 3 in the patent in suit cannot provide further guidance to the skilled person because it is not clear how the quoted values for r_1 and r_2 were obtained;
- (iii) the argument that no actual measurement of reactivity ratios has to be made because the formation of a more random copolymer is equated with identical rates of monomer consumption is not supported by the data in the patent in suit;

- (iv) on the contrary, the uncontradicted experiments of opponent 02 (appellant I), including a repetition of Example 3 of the patent in suit and carrying out measurements which allow the determination of reactivity ratios, demonstrate that a polymer which fulfils the reactivity ratio requirement of Claim 5 is not obtained.

Hence, there is insufficient information in the patent in suit to enable a skilled person to prepare a polymer having the requirements of Claim 5, ie having monomer units incorporated "as if the monomers from which said units are derived had 1) reactivity ratios nearly equal and 2) a multiplication product of their reactivity ratios approaching unity". Thus, the requirements of sufficiency (Article 83 EPC) are not met.

3. *First and second auxiliary requests*

Both of these requests contain at least one claim having a reference to the reactivity ratios objected to, so that the above presented reasons apply equally to these requests. Thus, the first and second auxiliary requests do not meet the requirements of Article 83 EPC.

4. *Third auxiliary request*

4.1 The uncontradicted experiments of opponent 02 (appellant I) in D9, in particular sample SVSH143, demonstrate clearly that, when the method of Claim 1 is carried out, the production of a more random polymer is not achieved (point 2.7.3 above). Therefore, it is necessary for the board to evaluate the process of Claim 1 in view of these findings.

4.2 The proprietor (appellant II) holds that the objection under Article 100(b) EPC relating to reactivity ratio

does not apply to Claim 1, because the words "reactivity ratio" are not used in Claim 1. Moreover, Claim 1 is directed to a process for the production of a polymer which has five steps defining the resulting polymer only by reference to the monomers from which it is made, and there is no requirement that the polymer should exhibit any particular degree of randomness.

4.3 Despite the restriction of the third auxiliary request to process claims, no consequential amendments to the body of the specification were considered necessary by the proprietor (appellant II), although the patent specification clearly links the process of Claim 1 to the production of highly random copolymers as is apparent from the following passages in the patent specification:

- (a) page 2, lines 31 to 33: "It has now been found that substantially uniformly random polymers of such monomers as styrene and methacrylic acid can be produced if a combination of critical process steps and conditions are followed during the polymerization thereof".
- (b) page 4, lines 35 to 36: "The polymers produced by the above-described process have unique structural characteristics by virtue of the dynamics of the process".
- (c) page 4, lines 43 to 45: "The process described in Example 1, below, is specifically designed to produce a polymer from monomers of dissimilar reactivities which has a high degree of randomness in the incorporation of the monomers into the polymerizing polymer backbone".

4.4 Thus, the process of Claim 1, whilst not explicitly limited to the production of polymers which are more

random than those of the prior art, has at its heart, when read in the light of the description, as in the board's view it must be to arrive at a proper construction, the production of such polymers. This is the promise of the disclosure in respect of which a patent has been granted by the EPO.

In this connection, there is no equivocation in the language of the description that the relevant additional degree of randomness is provided by the method claimed. Indeed, the proprietor (appellant II) has insisted that "the characterizing technical feature of the styrene-acrylic type copolymers of the invention lies in their high degree of randomness, their chemical composition in terms of starting monomers being quite conventional in the paper sizing art" (emphasis by the board; Statement of Grounds of Appeal of appellant II, filed on 15 March 2000, paragraph 2.3).

4.5 Since, furthermore, the proprietor (appellant II) has in effect invited the board, in accordance with Article 113(2) EPC, to consider the claims in connection with a specific associated text of the description which repeats the promise, the board has no choice in this particular case but to interpret Claim 1, in the light of the description, as being bound by this promise, and therefore as containing, as an implicit limitation, the provision of the promised result in the form of a copolymer having the relevant additional degree of randomness. In other words, this limitation is inseparable from the invention itself.

4.6 According to Article 100(b) EPC, however, it is a valid ground for opposition that the European patent does not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. In view of the conclusions already

reached (point 2.8 above), however, it is manifestly the case that the patent in suit fails to disclose the invention, ie the production of highly random copolymers, in the manner required. Consequently, Claim 1 of the third auxiliary request does not meet the requirements of Article 83 EPC. Therefore, it follows that the third auxiliary request has to be refused in its entirety.

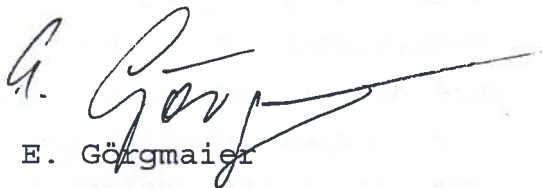
5. In view of the above, any further consideration of other relevant issues is not necessary.

Order

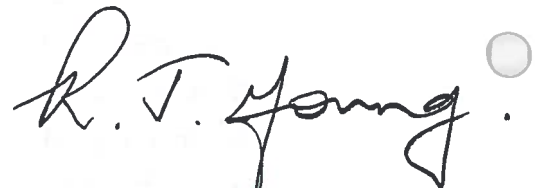
For these reasons it is decided:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:


E. Görgmaier

The Chairman:


R. Young