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D E C I S I O N
of 11 April 2002

Case Number: T 0961/99 - 3.3.3

Application Number: 89120781.3

Publication Number: 0374458

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Language of the proceedings: EN

Title of invention:
High performance polymer flocculating agents

Patentee:
CYTEC TECHNOLOGY CORP.

Opponent:
Allied Colloids Limited
S.N.F. S.A.

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 123(2)

Keyword:
"Amendments - added subject-matter (no)"
"Novelty - implicit features (no)"
"Inventive step (yes)"

Decisions cited:
G 0010/91

Catchword:
-

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Case Number: T 0961/99 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 11 April 2002

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Decision under appeal: Decision of the Opposition Division of the European Patent Office posted 5 August 1999 rejecting the opposition filed against European patent No. 0 374 458 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: R. Young
Members: P. Kitzmantel
J. H. Van Moer

Summary of Facts and Submissions

I. Mention of the grant of European patent No. 0 374 458 in respect of European patent application No. 89 120 781.3 in the name of Cytec Technology Corp. (original Applicant: American Cyanamid Company), which had been filed on 9 November 1989 claiming two US priorities both of 19 December 1988, was announced on 8 February 1995 on the basis of 18 claims. Claim 1 read as follows:

"1. An unsheared, water-soluble, branched polymeric flocculant having a branching agent content of from 4 to 80 molar parts per million based on initial monomer content and which,

(a) when cationic, has a solution viscosity of at least 1.8 mPa.s as measured in a Brookfield viscometer with a UL adapter at 25°C on a 0.1 percent, by weight, polymer solution in 1M NaCl at 60 rpm, and a solubility quotient of greater than 30 percent, or

(b) when nonionic, comprises at least one ethylenically unsaturated non-ionic monomer and has a solution viscosity of at least 1.9 mPa.s measured as specified above, or

(c) when anionic, has a solution viscosity of at least 3.0 mPa.s measured as specified above."

The granted set of claims, furthermore, contained an independent Claim 7 directed to a process for the preparation of an unsheared water-soluble, branched, polymeric flocculant, an independent Claim 13 directed to a method of releasing water from a dispersion of suspended solids, and an independent Claim 17 directed

to a method of flocculating a dispersion of suspended solids. The further Claims 2 to 6, 8 to 12, 14 to 16 and 18 were dependent, respectively, on Claims 1, 7, 13 and 17.

II. Notices of Opposition requesting revocation of the patent in its entirety were filed on 7 November 1995 by Allied Colloids Limited (Opponent 1) on the grounds of Articles 100(a) and (b) EPC and on 8 November 1995 by S.N.F. (Opponent 2) on the grounds of Article 100(a) EPC.

By its submission dated 27 December 1995 Opponent 1 withdrew its opposition.

The oppositions were *inter alia* based on documents

D1: EP-A-0 202 780,

D2: EP-A-0 201 237, and

D3: GB-A-2 083 053.

III. By its decision announced orally on 19 July 1999 and issued in writing on 5 August 1999, the Opposition Division rejected the opposition.

The decision under appeal held that the claimed subject-matter was novel over D1, because the Opponent had failed to prove that D1 unambiguously disclosed branched polymeric flocculants whose water solubility was within the respective definition of Claim 1.

In the Opposition Division's view, the claimed subject-matter was also inventive, because it could not be considered as an obvious selection over the disclosure of D1 and/or D2; nor could the involvement of an inventive step be denied with the argument that Claim 1

was too broad because it contained inoperable embodiments and failed to comprise all essential features, since the latter was a wrong conclusion based on misconstrued results.

IV. On 5 October 1999 Opponent 2 (Appellant) lodged an appeal against the decision of the Opposition Division and paid the appeal fee on the same day. The Statement of Grounds of Appeal was submitted on 3 December 1999.

V. The arguments presented by the Appellant in the Statement of Grounds of Appeal and during the oral proceedings held on 11 April 2002 may be summarized as follows:

(i) Claim 1 of the Respondent's main request (cf. point VI below) contravened the requirements of Article 123(2) EPC in that its feature (ii) "has a solution viscosity of at least 2.4 mPa.s" ..." was disclosed only in combination with a solubility quotient of greater than about 40 percent and a branching agent content of about 8 to 20 mppm (molar parts per million) based on initial monomer content.

(ii) The claimed subject-matter was anticipated by D1, because this document disclosed unsheared branched cationic polymeric flocculants which were compositionally very similar to those according to present Claim 1 and which, therefore, must have identical physico-chemical features including solution viscosity and solubility quotient. In this respect, the Appellant especially emphasised that D1 comprised

water-soluble flocculants and recommended amounts of crosslinking agent and of chain-transfer agent meeting the amounts to be used according to the alleged invention.

(iii) Furthermore, the claimed subject-matter was also obvious over D1 which implicitly taught that the use of chain-transfer agents together with crosslinking agents provided better water-solubility, because determining the optimum amounts of these agents was a matter of routine for the skilled person being aware from D2 and D3 that water-solubility was a property associated with an improved flocculation performance.

VI. The Respondent's defence was based (i) as main request, on an amended set of eight claims comprising Claim 1 filed with the submission dated 28 February 2002 and Claims 2 to 8 filed with the submission dated 8 June 2000, (ii) on Claims 1 to 18 as granted (first auxiliary request), and (iii) on Claims 4 to 8 of the afore-mentioned main request (second auxiliary request).

The Claims of the main request read as follows:

"1. An unsheared, water-soluble, branched polymeric flocculant having a branching agent content of 4 to 80 molar parts per million based on initial monomer content and which:

(i) is cationic,

(ii) has a solution viscosity of at least 2.4 mPa.s as measured in a Brookfield viscometer with a UL adapter at 25°C on a 0.1 percent, by weight, polymer solution in 1M NaCl at 60 rpm, and

(iii) has a solubility quotient of greater than 30 percent.

2. The polymeric flocculant as defined in Claim 1 wherein said cationic polymeric flocculant is a polymer formed from one or more ethylenically unsaturated monomers selected from acrylamide; methylacrylamides; N,N-dialkylacrylamides; N-alkyl acrylamides; N-vinyl methylacetamide; N-vinyl methyl formamide; vinyl acetate; N-vinyl pyrrolidone; N,N-dialkylaminoalkyl acrylates and methacrylates and their quaternary or acid salts; N,N-dialkylaminoalkylacrylamides and methacrylamides and their quaternary or acid salts or diallyl dimethylammonium salts.

3. The polymeric flocculant as defined in Claim 1 wherein said cationic polymeric flocculant is a polymer formed from acrylamide in combination with at least one cationic monomer.

4. A process for the preparation of an unsheared water-soluble, branched, cationic polymeric flocculant, said process comprising polymerizing one or more cationic water-soluble, ethylenically unsaturated monomers with at least one branching agent in an amount from 4 to 80 molar parts per million based on initial monomer content, in the presence of at least one chain transfer agent, whereby the cationic polymeric flocculant has a solution viscosity of at least 2.4 mPa.s measured in a Brookfield viscometer with a UL adapter at 25°C on a 0.1 percent, by weight, polymer solution in 1M NaCl at 60 rpm and the chain-transfer agent is present in an amount at least sufficient to provide said branched cationic flocculant with a solubility quotient of greater than 30 percent.

5. The process as defined in Claim 4 wherein when said cationic polymeric flocculant is a polymer formed from one or more ethylenically unsaturated monomers selected from acrylamide; methacrylamide; N-alkyl acrylamide; N,N-dialkylacrylamides; N-vinyl methylacetamide; N-vinyl methyl formamide; vinyl acetate; N-vinyl pyrrolidine; N,N-dialkylaminoalkylacrylates or methacrylates and their quaternary or acid salts; N,N-dialkylaminoalkyl-acrylamides and methacrylamides and their quaternary or acids salts or diallyl dimethylammonium acid salts.

6. The process as defined in Claim 4 wherein when said cationic polymeric flocculant is a polymer formed from acrylamide in combination with at least one cationic monomer.

7. A method of releasing water from a dispersion of suspended solids which comprises (a) adding to the dispersion from 0.1 to 50,000 parts per million of dispersion solids of an unsheared, branched water-soluble cationic flocculant as claimed in Claim 1 or Claim 2, and (b) dewatering the mixture of the suspended solids and the polymeric flocculant.

8. The method as defined in Claim 7 wherein said dispersion comprises biologically treated sludge."

VII. The arguments presented by the Respondent in their written submissions dated 8 June 2000 and 28 February 2002 as well as during the oral proceedings may be summarized as follows:

(i) The definition of the cationic flocculant of Claim 1 of the main request did not contravene the requirements of Article 123(2) EPC because it was evident from the information contained in Table 1 of the patent specification that for the

achievement of a solution viscosity of greater than 2.4 mPa.s it was not required to use the branching agent in amounts of from 8 to 20 mppm.

(ii) The claimed subject-matter was novel over D1 because this document failed to disclose high molecular weight, unsheared, **branched** polymeric flocculants having the required solubility quotient. Contrastingly, the solubility quotient of the flocculants of Examples 2A* and 2B* of Table 1 of the patent specification, which used crosslinking and branching agents in amounts according to D1, was below the 30% minimum of present Claim 1.

(iii) Nor was the present solution of the existing technical problem, ie the provision of flocculants whose performance met better than conventional linear flocculants the modern environmental concerns and led to higher cake solids, obvious over the available citations. This conclusion resulted from the facts that (i) D1 was explicitly directed towards flocculants which, predominantly, were water-insoluble, (ii) D2 required for a good flocculation performance that the flocculant composition be sheared, and (iii) D3 was only concerned with an enhancement of the water solubility of a non-crosslinked acrylamide polymer by the use of a purified monomer.

(iv) The superiority of the flocculants of the patent in suit over those of D1 was apparent from a comparison of Examples 13A, 13B and 13C (Table 4) of the specification: "inventive" Example 13A provided higher cake solids at smaller dose levels than "comparative" Examples 13B and 13C.

VIII. The Appellant requested that the decision under appeal be set aside and that the European patent No. 374 458 be revoked.

The Respondent requested that the appeal be dismissed and that the patent be maintained on the basis of, as main request, Claim 1 filed with the submission dated 28 February 2002 and Claims 2 to 8 filed with the submission dated 8 June 2000, as first auxiliary request with the claims of the patent as granted and as second auxiliary request on the basis of the Claims 4 to 8 of the main request.

Reasons for the Decision

1. The appeal is admissible.

Main request

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

2.1 Claims 1 and 4 are based on their original versions and on the statement on page 5, lines 25 to 33 of the original application: "Preferably, the cationic polymeric flocculants possess a solubility quotient of greater than 40 percent, the branching agent comprises from about 8 to about 20 molar parts per million based on original monomer content and exhibit a solution viscosity of at least 2.4 mPa.s ..." (corresponding to Claims 1 and 7, respectively, and page 3, lines 34 to 38 of patent specification).

2.2 The combination in Claims 1 and 4 of the limit of the solution viscosity of at least 2.4 mPa.s with a branching agent content of 4 to 80 mppm and a solubility quotient of greater than 30 percent does not

contravene the requirements of Article 123(2) EPC because, in the light of the specification as a whole, the afore-mentioned statement must be interpreted to mean that each one of the three requirements is separate from the others.

2.3 This conclusion, which excludes the interpretation advanced by the Appellant, namely that this statement related to flocculants meeting all of the three mentioned requirements, is supported by experimental data contained in Table 1 (original application and patent specification) which demonstrate that a solution viscosity of at least 2.4 mPa.s is not conditional on a branching agent content of 8 to 20 mppm. Rather Examples 3A, 3B, 4A, 4B, 5A, 5B, 6B, 6E, 8A and 9B show that a solution viscosity above 2.4 mPa.s may also be obtained when the branching agent content is beyond the range of 8 to 20 mppm and Examples 3D, 4D and 7A show that a branching agent content within that range does not necessarily cause the solution viscosity to be above 2.4 mPa.s.

2.4 It is thus manifest from the worked Examples, which normally must be deemed to represent the most authentic disclosure of an invention, that the statement quoted in point 2.1 supra does not relate to a flocculant having a branching agent content in the range of 8 to 20 mppm **and** a solution viscosity above 2.4 mPa.s.

2.5 It follows that this statement refers in a condensed manner to preferred ranges of the solution viscosity and of the branching agent content, as well as, in the interest of logical symmetry, of the solubility quotient which ranges may, therefore, independently from one another, be embodied in "inventive" flocculants.

2.6 This interpretation is not affected by the statement on page 6, lines 19 to 28 of the original application (page 3, lines 50 to 54 of the patent specification): "Preferably, such a process calls for the addition of from about 8 to about 20 molar parts per million ... of branching agent. The branched cationic polymeric flocculant has a solubility quotient of greater than about 40 percent and has a solution viscosity of at least 2.4 mPa.s ..., when prepared using said preferred amount of branching agent."

This judgment results from the fact that the above-quoted statement does not support the conclusion that it was necessary for obtaining a solution viscosity ≥ 2.4 mPa.s that the flocculant comprises 8 to 20 mppm branching agent and has a solubility quotient > 40 percent but states only that a flocculant which comprises 8 to 20 mppm branching agent will have a solubility quotient > 40 percent and a solution viscosity ≥ 2.4 mPa.s. Moreover, as set out above, Examples 3D, 4D and 7A of Table 1 even show that a branching agent content within that range does not necessarily cause the solution viscosity to be above 2.4 mPa.s.

2.7 Claims 2, 3, 5, 6 and 7 of the main request are based on their original versions (corresponding to granted Claims 2, 3, 8, 9 and 13); Claim 8 is based on original Claim 14 (corresponding to granted Claim 18).

2.8 Thus, all claims comply with the requirements of Article 123(2) EPC, and, since the scope of the independent claims of the main request is narrower than of the version of the Claims as granted, also with those of Article 123(3) EPC.

3. *Meaning of the term "solubility quotient"*

3.1 Page 5, lines 37 to 45 of the patent in suit reads:

"In the case of cationic polymers, the optimum concentration of chain-transfer agent, can be determined by measuring the solubility quotient. For purposes of this invention, solubility quotient is defined as the total mole % cationicity in the polymer as determined by an anion binding technique (CEQ), eg colloid titration, divided by the total cationicity as determined by an analytical technique which does not depend on anion binding, using, eg, nuclear magnetic resonance, infra red spectroscopy or chemical analysis, the quotient of which is multiplied by 100. The cationicity is determined by measuring the CEQ as described in Volume 62, Number 7 of the Journal of Chemical Education dated July 1985 at pages 627 to 629, [hereinafter document D7], which comprises measuring the cationicity of a solution using colloid titration to determine the solubility in water. Use of a chain-transfer agent in concentrations such that the solubility quotient is less than 30 percent provides products that are not soluble."

3.2 Colloid titration is a technique that determines the positive charges of a polyelectrolyte in aqueous solution which are accessible to the negatively charged titrant used (cf. D7, page 627, left hand column, first and second paragraphs). It cannot determine charges which are not accessible to the titrant (potassium poly(vinyl)sulphate (PVSK): cf. D7, page 627, right hand column, last paragraph), eg for steric reasons (cf. D7, page 628, left hand column, third paragraph).

While it can be assumed that the charged positions of strictly linear polyelectrolytes are accessible to a colloid titrant, this is not the case, because of

steric hindrance, for all of the charged positions of a non-linear, eg crosslinked or chain-branched polymer structure.

3.3 The discrepancy between the charges which can be determined by colloid titration (CEQ) and the totality of the charges of the polymer molecule ("total cationicity") is reflected by the quotient CEQ % = [CEQ/total cationicity] x 100. Since the non-linearity of a polymer is associated with its inferior solubility, a higher quotient CEQ % also indicates a better water-solubility.

3.4 The Appellant criticised that the definition of the solubility quotient CEQ % was defective insofar as the disclosure of the patent failed to sufficiently disclose the method of determination of the "total cationicity". Apart from the fact that this observation relates to a new, and therefore non-admissible, ground of opposition of Article 100(b) EPC of the Appellant (G 10/91, OJ EPO 1993, 420), it is also unfounded because the reference in the specification to the standard methods nuclear magnetic resonance (NMR), infra red spectroscopy or chemical analysis is sufficient guidance to the skilled person to determine the "total cationicity" and, thus, the subsequent CEQ %. This also applies to the NMR technique which, contrary to the Appellant's allegations, allows a self-sufficient determination of the structural elements of a molecule.

3.5 As set out in the patent specification (e.g. page 5, lines 43 to 45) and as reaffirmed by the Respondent at the oral proceedings, polymeric flocculants whose solubility quotient is above the value of 30% are water-soluble, while those having a solubility quotient below this value are water-insoluble.

4. *Citations*

4.1 Document D1

Claim 1 of this document relates to a process in which an aqueous solids suspension is flocculated by adding a synthetic polymeric material which, at the time of addition to the suspension, has a specific viscosity above 10 and comprises polymeric particles having a dry size of below 10 µm and in which the flocculated solids are subjected to shear substantially without increasing the amount of suspended solids in the aqueous medium.

This invention is based on the discovery that the shear stability of the flocs can be increased by initiating, and usually completing, flocculation while some or all of the polymeric material is in the form of small particles rather than a true solution (column 4, lines 44 to 49).

The polymer particles of the flocculant may be soluble and in that case they must be added to the suspension before they dissolve (column 8, lines 26 to 29) but, preferably, the polymeric material comprises particulate polymer which is insoluble due to the inclusion of insolubilising monomers or due to the provision of a controlled degree of non-linearity, eg by crosslinking, in an otherwise soluble polymer (column 5, lines 13 to 18; column 9, lines 13 to 27). In this case, the amount of dissolved polymer is usually from 0 to 50% by weight of total polymer (column 9, lines 1 to 4).

According to a third embodiment the polymer particles may even be wholly insoluble (column 9, lines 5 to 12). If the polymer particles are too highly crosslinked

then sufficient shear may be applied to restore a desired degree of crosslinking (column 12, lines 31 to 44).

In general terms D1 also discloses the possible addition to the polymerisation mixture of a chain-transfer agent (eg isopropanol in amounts of 1000 to 5000 ppm based on monomer: column 10, lines 36 to 41) in combination with a crosslinking agent in order to control the degree of non-linearity and promote chain branching rather than crosslinking (column 10, lines 31 to 35). There is no concrete example of this alternative.

Example 1 describes a linear copolymer AC and a branched copolymer BC, both prepared from 58% acrylamide and 42% dimethylaminoethylacrylate quaternized with methyl chloride (DMAEA.MeCl), the branched copolymer BC additionally comprising 10 ppm MBA (methylenebisacrylamide).

4.2 Document D2

Claim 1 of this document relates to a process in which a stable, homogeneous aqueous composition of a high molecular weight, cross-linked, water swellable polymeric material formed from water-soluble monomers is used to flocculate an aqueous solids suspension.

Before or during flocculation the aqueous composition of the polymeric material is subjected to shear.

According to page 10, lines 20 to 31 it is one of the principal advantages of this invention that it permits the conversion of a cross-linked polymer, that would at least provide very poor flocculation properties into an effective flocculant.

4.3 Document D3

Claim 1 of this document relates to a process for producing an acrylamide-type cationic high molecular weight polymeric flocculant by polymerizing acrylamide which is substantially free from N-acroyl acrylamide. These cationic flocculants exhibit a considerably improved water solubility as compared with cationic polymers prepared from acrylamide comprising N-acroyl acrylamide.

5. *Novelty*

5.1 The subject-matter of Claim 1 is novel over each one of the documents D1, D2 and D3; *inter alia* because none of these documents discloses the feature that the solubility quotient of the polymeric flocculant be greater than 30 percent.

5.2 The argument of the Appellant that D1 anticipated the subject-matter of present Claim 1 because it disclosed the preparation of cationic high molecular weight polymeric flocculants comprising the same moieties, and including the use of crosslinking agents, eg methylenebisacrylamide, in amounts of 0.1 to 100 ppm and of chain-transfer agents, e.g. isopropanol in amounts of 1000 to 5000 ppm, is not conclusive because D1 fails to disclose polymeric flocculants having a solubility quotient above 30 percent, nor does it disclose the use of a crosslinking agent together with a chain-transfer agent in such amounts as to inevitably cause the formation of such flocculants.

5.3 That D1 does not disclose flocculants which are within the scope of present Claim 1 is particularly apparent from Examples 2A* and 2B* in Table 1 of the patent specification (page 8) which use amounts of chain-transfer agent (IPA = isopropanol) and crosslinking

agent (MBA = methylenebisacrylamide) which are fully within the afore-mentioned ranges of D1 and which Examples **do not meet** the requirements of present Claim 1 for the features solution viscosity (S.V.) and solubility quotient (CEQ %):

Example	acrylamide [mole%]	Q-9# [mole%]	IPA [%]	MBA [wppm]	S.V.	CEQ %
2A*	60	40	0.125	20	1.49	13.7
2B*	60	40	0.25	20	1.78	29.5

acryloxyethyl trimethylammoniumchlorid

This evidence emphasises the critical importance of the ranges of amounts of the crosslinking and branching agents for the attainment of the claimed properties solution viscosity and solubility quotient.

5.4 Nor is the Appellant's argument convincing that the use of 0.5% IPA (5000 ppm) together with 5 to 15 wppm MBA according to the "inventive" Examples 3A, 3B and 3C, ie of amounts of IPA and MBA which were also within the disclosure of D1, demonstrated the anticipatory character of this document, because D1 does not disclose this, nor any other **combination of amounts** of chain-transfer agent and crosslinking agent as specified in present Claim 1.

5.5 The afore-mentioned unsubstantiated allegations of the Appellant are thus unable to discharge the burden of proof which according to the well established principle in opposition proceedings before the EPO rests on an opponent/appellant.

5.6 The conclusion of novelty drawn in point 5.1 supra applies for the same reasons to the subject-matter of independent Claims 4 and 7 which comprise, separately

or by reference to Claim 1, the same distinguishing features, and *a fortiori* also to the dependent Claims 2, 3, 5, 6 and 8.

6. *Closest prior art*

The nearest prior art is represented by D1, which essentially differs from the subject-matter of the present invention by the missing indication of a solubility quotient and by any information as to the impact of the possible presence of a branching agent on that parameter.

7. *Problem and solution*

7.1 According to the patent in suit (page 2, lines 18 to 21; page 3, lines 7 to 9 and 14 to 15) the problem underlying the present subject-matter resides in the provision of polymeric flocculants which can be prepared without the use of high level shear and which, when used for the treatment of waste sludges, produce higher levels of cake solids at lower dose levels.

The Board accepts that this problem formulation is applicable to the assessment of inventive step over the disclosure of the closest prior art document D1.

7.2 This problem is to be solved, according to Claim 1, by the provision of unsheared, branched cationic polymeric flocculants having a solution viscosity of at least 2.4 mPa.s and a solubility quotient of greater than 30 percent.

7.3 Examples 13A ("inventive") and 13B ("comparative") of Table 4 (cf. pages 12 and 13 of the patent specification) demonstrate that the existing technical problem has effectively been solved by the flocculants according to present Claim 1:

The flocculants 5B and 1B* used in Examples 13A and 13B both have been prepared from 60 mole% acrylamide, 40 mole% acryloxyethyltrimethylammonium chloride (Q-9) and 7.8 mppm methylenebisacrylamide (MBA). Moreover, 1.5% of the chain-transfer agent isopropanol (IPA) was used during the preparation of flocculant 5B (cf. Table 1 on page 8 in conjunction with page 6, lines 41 to 49).

Table 4 contains the following information:

Table 4 Example	floccu-ulant	CEQ %		cake solids								
	Table 1 Example		dose kg/t	3	3.5	4	4.5	5		8	9	10
13A	5B - inv.	91.6		28.6	30.3	30.6	30.7	29				
13B	1B - comp.	16.0								22.8	25.7	28.8

This evidence shows that the "inventive" flocculants which have been prepared in the presence of the chain-transfer agent isopropanol are able to provide higher levels of cake solids at lower dose levels.

8. *Obviousness*

8.1 Claim 1

This issue turns on the question whether it is obvious the solve the existing technical problem (provision of polymeric flocculants which can be prepared without the use of high level shear and which, when used for the treatment of waste sludges, produce higher levels of cake solids at lower dose levels) by the development of flocculants having a solubility quotient of greater than 30 percent. As set out in the patent specification (eg page 5, lines 43 to 45) and as reaffirmed at the

oral proceedings, polymeric flocculants whose solubility quotient is above this value are water-soluble, those having a solubility quotient below this value are water-insoluble.

8.1.1 Document D1

Since D1 is completely silent on the parameter "solubility quotient", a possible case of non-obviousness starting from D1 as closest prior art would have to rely on information in this document that, in combination with further prior art, would lead to the claimed invention, in particular to polymeric flocculants which at the same time are water-soluble **and** branched.

However, whenever D1 refers to water-solubility it is, directly or indirectly, in connection with **linear** flocculants: column 3, lines 31 to 33 ("... linear, truly dissolved polymers ..."); column 4, lines 5 to 9 ("... linear ... flocculant ... true solution ...") ; column 5, lines 1 to 12 ("Thus, a conventional reverse phase emulsion of soluble polymer ... to form a true solution": the reference a "conventional emulsion" clearly relates to the afore-mentioned prior art, linear polymers); column 8, lines 33 to 38 ("Although ... essential to include non-dissolved particles ... the polymeric material ... may include also dissolved linear polymer"); column 9, lines 13 to 19: "Preferably ... the particles are either soluble ... or, preferably, are crosslinked sufficient that they are insoluble ..."); column 10, lines 3 to 6 ("The polymer may be soluble but is preferably insoluble as a result of the controlled degree of crosslinking"; column 10, lines 48 to 50 ("Instead of insolubilizing the polymer by crosslinking ...").

The Appellant's contention that the reference to a water-soluble polymer in Claim 9 of D1 related to crosslinked/branched polymers is therefore at variance with all relevant passages of the description.

Moreover, it is the very gist of the invention of D1 that the aqueous flocculant composition should comprise undissolved polymer particles instead of a true solution (column 4, lines 44 to 49). This goes so far as to use flocculant compositions of soluble (linear) polymers under conditions that they have not fully dissolved (Claim 9).

There is therefore no basis for the Appellant's contention that the passage in column 10, lines 31 to 41, which relates to the promotion of chain branching rather than crosslinking by the conjoint use of chain-transfer and crosslinking agents, suggested the use of a chain-transfer agent in order to prepare water-soluble, **branched** polymeric flocculants.

It follows that D1 does not offer to the skilled person any reason to expect any advantage from the use of aqueous solutions of crosslinked and/or branched polymeric flocculants because this would be contrary to its inventive concept.

Even less does D1 contain any suggestion able to solve the existing technical problem (cf. point supra) by the provision of branched cationic polymeric flocculants having a solubility quotient of above 30 percent.

The subject-matter of present Claim 1 is therefore non-obvious over D1.

8.1.2 Document D2

Nor can this document contribute to the solution of the existing technical problem because it neither refers to the solubility quotient nor does it comprise any information concerning the desirability of chain branching in combination with or independent from crosslinking in order to influence the water-solubility.

Quite contrastingly, D2 teaches that insoluble crosslinked polymeric flocculant which is not dispersible in water can by shearing be converted into a stable homogeneous aqueous composition (Abstract; page 8, lines 10 to 20).

This is inconsistent with the present invention which does not require shearing of the aqueous flocculant composition.

The subject-matter of present Claim 1 is therefore also non-obvious over the disclosure of document D2.

8.1.3 Document D3

This document teaches that the water-solubility of high molecular weight polymeric flocculants having acrylamide units can be enhanced by removing from the acrylamide monomer N-acryloyl acrylamide which is present therein as an impurity. While D3 compares the insolubilising effect of N-acryloyl acrylamide with the crosslinking effect of methylenebisacrylamide (cf. Table 2 on page 6) it contains no information about any means to enhance the solubility of such crosslinked flocculants in order to provide them with a solubility quotient as required by present Claim 1.

8.1.4 Since D1 aims at the provision of aqueous flocculant compositions comprising small undissolved particles, D2 recommends the application of shear in order to convert dispersions of crosslinked polymeric flocculant compositions into solutions, and D3 concentrates on the prevention of any crosslinking in polyamide based polymeric flocculants, these citations do not lend themselves to any combination with respect to the solution of the existing technical problem which essentially resides in the provision of unsheared aqueous solutions of branched cationic polymeric flocculants.

8.2 Claim 4

The subject-matter of Claim 4 which relates to the preparation of an unsheared water-soluble, branched cationic polymeric flocculant whose definition corresponds to that of Claim 1 is also non-obvious.

None of the citations suggests the preparation polymeric flocculants in the presence of a branching agent in order to obtain a branched/crosslinked polymeric flocculant from which aqueous solutions can be prepared without shearing. As set out in Section 8.1.1 supra the purpose to provide unsheared aqueous flocculant solutions is diametrically opposed to the teaching of D1 to use flocculant compositions which comprise undissolved polymer particles.

8.3 Claim 7

The subject-matter of this claim which is directed to the use of the flocculants of Claim 1 to a method for releasing water from a dispersion of suspended solids is likewise non-obvious because, as set out above, neither was the provision of such flocculants suggested by the submitted citations, nor does the available

prior art contain any pointer towards the improved flocculation performance which can be obtained by the use of such flocculants (cf. point 7.3 supra).

8.4 Owing to their appendancies, respectively, to Claims 1, 4 and 7 the subject-matter of the dependent Claims 2, 3, 5, 6 and 8 also complies with the requirement of Article 56 EPC.

9. The grounds of opposition alleged by the Appellant do not, therefore, prevent the maintenance of the patent on the basis of Claims 1 to 8 of the main request.

10. There is therefore no need to examine the auxiliary requests.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the main request ie Claim 1 filed with the submission dated 28 February 2002 and Claims 2 to 8 filed with the submission dated 8 June 2000, after any necessary consequential amendment of the description.

The Registrar

E. Görgmaier

The Chairman:

R. Young