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DECISION
of 30 March 2004

Case Number:	T 0594/01 - 3.3.1
Application Number:	95907004.6
Publication Number:	0741683
IPC:	C07C 29/10
Language of the proceedings:	EN

Title of invention:
Process for the preparation of alkylene glycols

Patentee:
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

Opponent:
THE DOW CHEMICAL COMPANY

Headword:
Alkylene glycols/SHELL

Relevant legal provisions:
EPC Art. 54, 56, 123(3)

Keyword:
"Main request, first to third auxiliary request: novelty (no) - upper end of a range value overlapping the margin of uncertainty inherently associated with a prior disclosed experimental value"
"Fourth and fifth auxiliary request: inventive step (no) obvious solution"

Decisions cited:
-

Catchword:

An experimental value in quantitative analytical chemistry cannot be dissociated from the margin of uncertainty attached to the measurement. When a specific experimental value is disclosed in an example of the prior art, seeking to distinguish the claimed subject-matter therefrom only in terms of an upper limit required to be "lower than" the experimental value must fail as the claimed subject-matter is still not distinguishable from the prior art within the margin of experimental error.

Case Number: T 0594/01 - 3.3.1

DECISION
of the Technical Board of Appeal 3.3.1
of 30 March 2004

Appellant: (Proprietor of the patent)	SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V. Carel van Bylandtlaan 30 NL-2596 HR Den Haag (NL)
Representative:	-
Respondent: (Opponent)	THE DOW CHEMICAL COMPANY 2030 Abbott Road Dow Center Midland, Michigan 46840 (US)
Representative:	Ottevangers, Sietse Ulbe Vereenigde Postbus 87930 NL-2508 DH Den Haag (NL)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted 28 March 2001 revoking European patent No. 0741683 pursuant to Article 102(1) EPC.**

Composition of the Board:

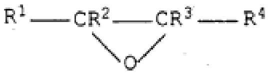
Chairman:	A. J. Nuss
Members:	P. F. Ranguis
	J. H. Van Moer

Summary of Facts and Submissions

I. The present appeal lies from the Opposition Division's decision to revoke the European patent No. 0 741 683 (European patent application No. 95 907 004.6) pursuant to Article 102(1) EPC on the ground that the subject-matter of the then pending requests (main request, first and second auxiliary requests) did not involve an inventive step.

II. Claim 1 of the main request before the Opposition Division read as follows:

"A process for the preparation of ethylene glycols by reacting an alkylene oxide of the formula



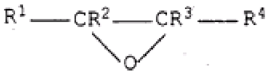
wherein R^1, R^2, R^3 and R^4 all represent hydrogen atoms, with water in the presence of a catalyst composition comprising
a solid material having one or more electropositive sites, which are coordinated with
one or more anions chosen from the group of bicarbonate, bisulphite, and the carboxylates having from 1-20 carbon atoms,
with the proviso that
when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate
the process is performed with less than 0.1 wt% of carbon dioxide".

Claim 1 of the first auxiliary request read as follows:

"A process for the preparation of alkylene glycols by reacting an alkylene oxide with water in the presence of a catalyst composition comprising
a solid material having one or more electropositive sites, which are coordinated with
one or more anions chosen from the group of bicarbonate, bisulphite, and the carboxylates having from 1-20 carbon atoms,
with the proviso that
when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate
the process is performed with less than 0.01 wt% of carbon dioxide in the reaction mixture".

Claim 1 of the second auxiliary request read as follows:

"A process for the preparation of ethylene glycols by reacting an alkylene oxide of the formula



wherein R^1, R^2, R^3 and R^4 all represent hydrogen atoms, with water in the presence of a catalyst composition comprising
a solid material having one or more electropositive sites, which are coordinated with
one or more anions chosen from the group of bicarbonate, bisulphite, and the carboxylates having from 1-20 carbon atoms,
with the proviso that

when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate
the process is performed with less than 0.01 wt% of carbon dioxide in the reaction mixture".

III. The opposition sought revocation of the patent in suit, in particular, on the grounds that its subject-matter lacked novelty and did not involve an inventive step. In support of lack of novelty or inventive step several documents were cited including

(1) RU-A-2 002 726

(2) RU-A-2 001 901

(3) JP-A-57 139 026

IV. Regarding novelty, the Opposition Division held that neither document (1), nor document (2) disclosed unequivocally the subject-matter of Claim 1 of each request since, in those documents, there was no generic disclosure concerning carbon dioxide ranges. Furthermore, the specific examples disclosed therein could not be combined to form a generic disclosure. As for document (3), the Opponent (now Respondent) had not shown that at the lowest levels of carbon dioxide disclosed in that document, bicarbonate resins were formed in detectable amounts.

Regarding inventive step, the Opposition Division held that in view of document (1) as the closest prior art, the technical problem to be solved was to be seen in the provision of a process for converting alkylene oxides to the corresponding glycols with good conversion and selectivity.

With respect to the subject-matter of Claim 1 of the main request and second auxiliary request relating to a process for preparing ethylene glycol only, Example No. 2 of document (1) disclosed a process for preparing propylene glycol from propylene oxide using a mixture having a concentration of carbon dioxide of 0.01 wt% in conjunction with a quaternary ammonium bicarbonate exchange resin. There was no inventive step to apply the same conditions to ethylene oxide. Furthermore, no effect was demonstrated with respect to a lower than 0.01 wt% carbon dioxide concentration. With respect to the subject-matter of Claim 1 of the first auxiliary request, the Proprietor of the patent (now Appellant) had provided no evidence showing that a minimal reduction in carbon dioxide content as disclosed in Example No. 2 of document (1) would lead to an improved yield.

V. In a communication sent by fax on 24 March 2004, the Board informed the parties that for the assessment of novelty of the claims of the pending requests in view of documents (1) or (2), document

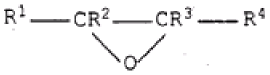
(10) Massanalyse, G. Schulze und J. Simon, 15. Auflage 1989 (1. Auflage 1935), pages 45 to 47 ("Fehlerbetrachtung")

reflecting common general knowledge concerning uncertainty of any experimental measure would be discussed at the oral proceedings.

VI. At the oral proceedings which took place on 30 March 2004, six sets of claims as main request and first to fifth auxiliary request were before the Board:

Claim 1 of the main request read as follows:

"A process for the preparation of ethylene glycols by reacting an alkylene oxide of the formula



wherein R^1, R^2, R^3 and R^4 all represent hydrogen atoms, with water in the presence of a catalyst composition comprising
a solid material having one or more electropositive sites, which are coordinated with
one or more anions chosen from the group of bicarbonate, bisulphite, and the carboxylates having from 1-20 carbon atoms,
with the proviso that
when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate
the process is performed with less than 0.1 wt% of carbon dioxide in the reaction mixture."

Claim 1 of the first auxiliary request differed from Claim 1 of the main request in that the expression "when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate" was replaced by "when the solid material is a quaternary ammonium containing anion exchange resin and the anion is bicarbonate or formate".

Claim 1 of the second auxiliary was identical to Claim 1 of the first auxiliary request before the Opposition Division (cf. point II above).

Claim 1 of the third auxiliary request differed from Claim 1 of the second auxiliary request in that the expression "when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate" was replaced by "when the solid material is a quaternary ammonium containing anion exchange resin and the anion is bicarbonate or formate".

Claim 1 of the fourth auxiliary request was identical to Claim 1 of the second auxiliary request before the Opposition Division (cf. point II above).

Claim 1 of the fifth auxiliary request differed from Claim 1 of the fourth auxiliary request in that the expression "when the solid material is an anionic exchange resin of the quaternary ammonium type and the anion is bicarbonate" was replaced by "when the solid material is a quaternary ammonium containing anion exchange resin and the anion is bicarbonate or formate".

VII. The arguments of the Appellant submitted in the course of the written proceedings and during the oral proceedings may be summarised as follows:

The differences between the expressions "the solid material is an anionic exchange resin of the quaternary ammonium type" and "the solid material is a quaternary ammonium containing anion exchange resin" was only linguistic and, therefore, the latter did not extend the protection conferred by the patent as granted in which the expression "the solid material is an anionic exchange resin of the quaternary ammonium type" was recited. Claim 1 of the first, third and fifth auxiliary requests did not contravene the requirements of Article 123(3) EPC.

Regarding novelty of Claim 1 of the main request and first to third auxiliary requests, Example No. 2 of document (1) disclosed a process for preparing propylene glycol using an amount of carbon dioxide of 0.01 wt% in conjunction with a quaternary ammonium bicarbonate exchange resin and propylene oxide. Example No. 4 of document (1) and Example No. 1 of document (2) disclosed a process for preparing ethylene glycol using an amount of carbon dioxide of 0.1 wt% in conjunction with a quaternary ammonium bicarbonate exchange resin and ethylene oxide. Those figures were the sole explicit disclosure that could be drawn from those documents. Any measurements around them would have brought ambiguity to those disclosures. Those documents gave no information as to how the amounts of carbon dioxide were measured and given there was no indication of the purity of the alkylene oxide, those figures were a minimum. Furthermore, specific examples could not be combined to generate a generic disclosure, in particular since propylene oxide and ethylene oxide were different entities.

Regarding inventive step of the fourth and fifth auxiliary requests, the technical problem to be solved in view of document (1) was to be seen in the provision of a process for converting ethylene oxide to ethylene glycol with an improved conversion and selectivity. Such a technical effect was demonstrated by the comparison of runs 2.4 and 2.5 of Example No. 2 of the patent in suit and the experiments submitted with the statement of grounds of appeal. When contemplating the hydrolysis of ethylene oxide, in the absence of any other teaching to lower carbon dioxide concentrations than that derivable from the examples of document (1), the person skilled in the art would not have considered applying an amount of carbon dioxide lower than indicated in those examples to solve the technical problem. Document (3) disclosing a process for preparing alkylene glycols involving a chloride resin was not relevant in that respect.

VIII. The arguments of the Respondent submitted in the course of the written proceedings and during the oral proceedings may be summarised as follows:

The subject-matter of Claim 1 of the first, third and fifth auxiliary requests extended beyond the protection conferred by the patent as granted since the feature "the solid material is a quaternary ammonium containing anion exchange resin" encompassed resins where a few amount of quaternary ammonium cations might be present, whereas the patent in suit related only to an "anionic exchange resin of the quaternary ammonium type" which implied that the resin contained only quaternary ammonium cations.

The subject-matter of Claim 1 of each request was not new in view of the disclosure of documents (1) or (3).

Document (1) disclosed the preparation of monoalkylene glycols by hydration of alkylene oxides in the presence of an anionic exchange resin of the quaternary ammonium type and carbon dioxide. This document disclosed, therefore, carbon dioxide concentrations ranging from more than 0 wt% to any upper value. In view of this generic disclosure and the specific examples disclosed therein, the person skilled in the art would have seriously contemplated carbon dioxide concentrations overlapping with the range defined in any of Claims 1. Furthermore, the specific carbon dioxide concentration values disclosed in Examples No. 2 or 4, i.e. 0.01 wt% or 0.1 wt% respectively, was to be understood by the person skilled in the art as approximated values, the last digit being not significant and being uncertain. Document (3) disclosed a solid material where at least some of the positive sites were converted to the bicarbonate form. Since the amount of carbon dioxide per mole of alkylene oxide could be as low as 0.00001 mole, the claimed subject-matter of each request lacked novelty in view of document (3).

Regarding inventive step, none of the examples provided by the Appellant supported an improved effect. If the claimed subject-matter of any of the requests was held new, it nevertheless lacked inventive step in view of documents (1) and (3).

IX. The Appellant requested that the decision under appeal be set aside and that the patent be maintained on the basis of the main request submitted at the oral proceedings or, in the alternative, on the basis of the first, third or fifth auxiliary request submitted at the oral proceedings or of the second or fourth auxiliary request filed on 27 February 2004.

The Respondent requested that the appeal be dismissed.

X. At the end of the oral proceedings the decision of the Board was announced.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC - Amendments*

2.1 Main request, first to fifth auxiliary requests

The Respondent did not raise any objections under Article 123(2) EPC. The Board also considers that Claim 1 of each request does not contain subject-matter which extends beyond the content of the application as filed. Indeed, the amendments are supported by the application as filed (cf. page 4, lines 2 to 5 and page 6, lines 27 to 29).

3. *Article 123(3) EPC - Amendments*

3.1 First, third and fifth auxiliary requests

3.1.1 The Respondent submitted that the subject-matter of Claim 1 of the first, third and fifth auxiliary requests extends beyond the protection conferred by the patent as granted since the feature "the solid material is a quaternary ammonium containing anion exchange resin" encompasses resins where a small amount of quaternary ammonium cations might be present, whereas Claim 1 of the patent in suit related only to an "anionic exchange resin of the quaternary ammonium type" which implied that the resin contained only quaternary ammonium cations.

3.1.2 However, it arises from the patent in suit that both expressions are used in the same context to define the same resin so that there is *a priori* no reason to consider that the difference in wording is of any relevance (cf. page 3, lines 5 to 6 and line 55). In the absence of any evidence to the contrary, no strong presumption liable to reverse the burden of proof to the Appellant exists.

3.1.3 For these reasons, the requirements of Article 123(3) EPC are met.

4. *Article 54(1)(2) EPC - Novelty*

4.1 Main and first auxiliary request

4.1.1 Document (1) discloses a method for producing alkylene glycols by catalytic hydration of alkylene oxides in the presence of anionic exchange resin, namely a polystyrene cross-linked with divinylbenzene having quaternary ammonium groups in the bicarbonate form (Anionites AV-17 and AV-17-T), and carbon dioxide (cf. page 2, third and fourth paragraph).

Example No. 4 discloses a method of preparation of ethylene glycol from a mixture comprising water (43.4 wt%), ethylene oxide (20.5 wt%), ethylene glycol

(36.0 wt%), carbon dioxide (0. 1 wt%) fed to a tubular flow reactor packed with anionite AV-17-T in the bicarbonate form. The conversion of ethylene oxide is 99.8% and the yield of ethylene glycol is 96.1% (selectivity 96.3%).

4.1.2 It is not disputed that the sole issue to be decided is whether there is an overlap between the carbon dioxide concentration ranges defined in any of the requests at issue and the carbon dioxide concentration values disclosed in document (1).

4.1.3 The Appellant argued that for preparing ethylene glycol the carbon dioxide concentration of 0.1 wt% was the sole unambiguous disclosure which emerged from Example No. 4 of document (1), this value being a minimum, given that carbon dioxide was probably also present with the ethylene oxide feed.

4.1.4 The Board observes, first, that the concentration of carbon dioxide is given in respect of the whole fed mixture. It derives therefrom that this concentration value takes into account any carbon dioxide amount wherever it originates. Therefore, the argument of the Appellant that the carbon concentration value is a minimum is at variance with the facts.

4.1.5 Furthermore, although the Board concurs with the Appellant that only an unambiguous disclosure may be considered in assessing novelty, it remains the case that any technical information is addressed to a skilled reader. In that context, it must be pointed out that it is common general knowledge, as shown by document (10) on page 46, that every experimental measurement in quantitative analytical chemistry as well as any result of any physical measurement cannot be dissociated from the margin of uncertainty attached to the measurement. Normally, the uncertainty of a measured experimental value is irrelevant for the assessment of novelty. However, when a specific experimental value is disclosed in an example of the prior art, seeking to distinguish the claimed subject-matter therefrom only in terms of an upper limit required to be "lower than" the experimental value must fail as the claimed subject-matter is still not distinguishable from the prior art within the margin of experimental error.

4.1.6 Therefore, the carbon dioxide concentration range defined in Claim 1 of each request, i.e. lower than 0.1 wt%, does not distinguish it from the experimental carbon dioxide concentration value, i.e. 0.1 wt%, disclosed in Example No. 4 of document (1).

4.1.7 For these reasons, the subject-matter of Claim 1 of the main and first auxiliary requests lacks novelty in view of document (1).

4.2 Second and third auxiliary requests

4.2.1 Example No. 2 of document (1) discloses a method of preparation of propylene glycol from a mixture of water (40.3 wt%), propylene oxide (35.5 wt%), propylene glycol (24.19 wt%), carbon dioxide (0.01 wt%) fed to a tubular flow reactor packed with anionite AV-17-T in the bicarbonate form. The conversion of propylene oxide is 100% and the yield of propylene glycol is 95%.

4.2.2 The sole difference between the claimed subject-matter of the second auxiliary request and third auxiliary request and the experiment disclosed in Example No. 2 is that the carbon dioxide concentration is less than 0.01 wt% (cf. point VI above).

4.2.3 For the same reasons as set out in point 4.1.5 relating to the assessment of novelty of the main and first auxiliary request, the claimed subject-matter of the present requests lacks novelty in view of Example No. 2 of document (1) since irrespective of how small the margin of uncertainty is, the claimed subject-matter is still not distinguishable from the prior art within the margin of experimental error.

4.3 Fourth and fifth auxiliary request

4.3.1 The Respondent argued that in view of the general disclosure of document (1) relating to a method for producing alkylene glycols by catalytic hydration of alkylene oxides in the presence of anionic exchange resin and carbon dioxide (cf. point 4.1.1 above) and the examples for preparing alkylene glycols disclosing carbon dioxide concentrations ranging from 0.01 to 0.6 wt% depending of the starting alkylene oxide involved, i.e. propylene oxide (0.6 wt%, 0.01 wt% and 0.2 wt%, in Examples Nos. 1, 2 and 3 respectively) and ethylene oxide (0.1 wt% and 0.2 wt%, in Examples Nos. 4 and 5 respectively), the person skilled in the art would have seriously contemplated using carbon dioxide in a concentration close to 0 wt% up to any upper value for preparing ethylene glycol from ethylene oxide.

4.3.2 However, such a statement requires the combination of experiments relating to method of preparation of propylene glycol or ethylene glycol, whereas the claimed subject-matter of the fourth and fifth auxiliary requests defines a method of preparation limited to ethylene glycol. The Board does not contest that it may be possible in some cases to combine various examples relating to the same entity with a general teaching disclosed in the same document. However, what is not permissible for the assessment of novelty is to combine the technical information belonging to different entities, here ethylene glycol and propylene glycol, as such a combination of information leads to a disclosure which does not emerge clearly and unambiguously from the disclosure of document (1).

4.3.3 For the same reasons, document (2), in which the lowest carbon dioxide concentration disclosed is 0.1 wt% in connection with ethylene oxide (Example No. 1) and propylene oxide (Examples Nos. 2 and 8), is also not novelty-destroying with respect to the subject-matter of the fourth and fifth auxiliary requests.

4.3.4 The Respondent also argued that document (3) was novelty destroying.

4.3.5 Document (3) discloses a method for preparing alkylene glycols by the reaction of an alkylene oxide and water wherein a halogen type anion exchange material is used as a catalyst in the presence of carbon dioxide (cf. page 3, lines 2 to 5). Typical alkylene oxides are *inter alia* ethylene oxide and propylene oxide (cf. page 5, lines 15 to 16). Carbon dioxide is used in the range of 0.00001 to 1 mol for 1 mole of alkylene oxide, preferably 0.0001 to 1 mole (cf. page 7, lines 12 to 14). In Example No. 1 of this document 203 g of deionized water, 30 ml of chlorine type anion exchange resin were poured into an autoclave, then, 33.0 g of liquefied ethylene oxide was force fed with carbon dioxide gas; 91 mol% of ethylene glycol was obtained. Furthermore, a test report submitted by the Respondent in the course of the opposition proceedings showed that reproducing the experimental conditions of Example No. 1 by using a chloride resin having a chlorine content of about 12% led to a resin (catalyst D) having a chlorine content of 8.7%.

4.3.6 The Respondent argued that having proved that at least some of the electropositive sites are converted to the bicarbonate form and given the teaching of document (3) that the amount of carbon dioxide per mole of alkylene oxide can be as low as 0.00001 mole, the novelty objection was well founded.

4.3.7 However, the Board observes that it is not shown in the test report mentioned above (cf. point 4.3.5) that the missing chloride was replaced by bicarbonate. Even though it might be admitted that the resulting resin (catalyst D) carries at least some bicarbonate anions, neither Example No. 1 of document (3) nor the experiment of the test report mentions the content of carbon dioxide involved in the reaction. The conditions of the reaction may involve a carbon dioxide concentration far higher than 0.01 wt%. That implies that it is not proven, as held by the Opposition Division, that at the lowest levels of carbon dioxide, bicarbonate resins are formed. That finding distinguishes the claimed subject-matter of the fourth and fifth auxiliary requests from the disclosure of document (3), so that novelty can be also recognised vis-à-vis that document.

5. *Article 56 EPC - Inventive step of fourth and fifth auxiliary requests*

5.1 Since the subject-matter of the main request and first to third auxiliary requests does not comply with the requirements of Article 54 EPC (cf. points 4.1 and 4.2 above), that issue is restricted to the compliance or not of the subject-matter of the fourth and fifth auxiliary request with the requirements of Article 56 EPC.

5.2 The Board concurs with the parties that document (1) (cf. point 4.1.1 above) is the closest state of the art.

5.3 In the next step, the technical problem which the invention addresses in the light of the closest state of the art is to be determined.

5.3.1 In view of the experimental results shown in the examples of the patent in suit, no improvement can be acknowledged since none of them can exceed the combination of conversion and yield obtained in the experiment disclosed in Example No. 4 of document (1) (cf. point 4.1.1 above). Indeed, although Experiment No. 7 of the patent in suit, the best example of all, yields an ethylene glycol conversion of 99.9% with respect to a conversion of 99.8% obtained in Example No. 4 of document (1), this improvement is seriously counter-balanced by a significant lower selectivity (92.7 versus 95.9%).

The Appellant submitted however that the experiments provided with the statement of grounds of appeal (Examples Nos. 5 and 6 according to the numbering of the Appellant) showed that the best results were achieved when the carbon dioxide concentration was less than 0.01 wt%.

However, as pointed out by the Respondent, the molar ratio water/ethylene oxide used in the said Example No. 5 is 38:1. This molar ratio is so high that it cannot be considered as a fair comparison with Example No. 4 of document (1) wherein a molar ratio of about 5:1 is used. Already for that reason, this experiment is worthless as evidence.

Furthermore, this molar ratio is clearly not in line with the teaching of the patent in suit in which it is stated that:

"it is advantageous to perform the hydrolysis of the alkylene oxides, **without using excessive amounts of water** (emphasis added by the Board). In the process according to the invention, amounts of water in the range of 1 to 15 moles per mole of alkylene oxide are quite suitable, amounts in the range of 1 to 6 on the same basis being preferred" (cf. page 3, lines 23 to 25).

This is so true that the patent in suit itself warns against increasing the relative amount of water in the reaction mixture as improving the selectivity but at the same time involving large energy expenditure and rendering the process economically unattractive (cf. page 2, lines 15 to 20).

Example No. 5 may show an improvement, but there is no evidence that it is due to the carbon dioxide range rather than the molar ratio water/ethylene oxide.

As for the said Example No. 6, Table 3 shows no improvement since the best result obtained, i.e. carbon dioxide 0%, yields an ethylene glycol conversion of 88.0 wt% and a selectivity of 87.1%, which is significantly lower than the result obtained in the experiments of Example No. 4 of document (1).

5.3.2 In view of the above, the technical problem can only be seen in the provision of a further process for converting ethylene oxide to ethylene glycol with good conversion and yield (selectivity).

5.4 It remains to be decided whether or not the claimed solution as defined in Claim 1 of the fourth and fifth auxiliary requests is obvious in view of the cited prior art.

5.4.1 Looking for a solution to the said technical problem, the person skilled in the art starting from document (1) would have looked at processes in the same technical field.

5.4.2 The Appellant argued in that respect and relying on internal experiments that it was well known that the hydrolysis of propylene oxide proceeded more slowly but with a higher selectivity and thus needed different conditions to the hydrolysis of ethylene oxide. For the person skilled in the art, the teaching related to propylene oxide was, therefore, not relevant to ethylene oxide.

5.4.3 However, that statement is at variance with the technical information contained in the documents available to the person skilled in the art. Indeed, documents (1) and (2) do not distinguish between processes involving ethylene oxide or propylene oxide which are regrouped in the general disclosure by the general term "alkylene oxides" (cf. page 2, third paragraph and first paragraph respectively). Document (3) makes also no distinction in this respect (cf. page 5, last paragraph). There is no indication in the state of the art cited that a skilled person would have a reason not to apply teachings concerning propylene oxide to ethylene oxide.

5.4.4 In the Board's judgment, therefore, the person skilled in the art would have considered without any restriction technical information relating to hydration either of ethylene oxide or propylene oxide.

5.4.5 In comparing the results of the working examples of document (1), grouped in the Table below, the person skilled in the art, having in mind that ethylene oxide (EO) or propylene oxide (PO) are in the context of that process equivalent entities, would have noted as submitted by the Respondent that the carbon dioxide (CO_2) concentration ranged from 0.01 to 0.6%, good to excellent conversion and yield (selectivity) being obtained when lowering the carbon dioxide concentration for propylene oxide as well as for ethylene oxide.

Ex	alkylene glycol	CO_2 concentration	Conversion	yield	Selectivity
1	PO	0.6%	99.9%	93%	93.1
2	PO	0.01%	100%	95%	95
3	PO	0.2%	99.7%	95.7%	96
4	EO	0.1%	99.8%	96.1%	96.3
5	EO	0.2%	99.5%	93.0%	93.5

Selectivity: Yield (%) / Conversion (%) × 100
[molar number of monoalkylene glycol produced] / [molar number of alkylene oxide reacted] × 100

5.4.6 For the person skilled in the art, starting from those results and looking for further processes for converting ethylene oxide to ethylene glycol with good combinations of conversion and yield, i.e. good selectivity, it is merely a matter of routine experimentation, to sweep the carbon dioxide concentration down in order to determine how low the concentration may be, while still providing a good technical effect. In view of the results shown in document (1) a reasonable expectation of success existed that ethylene oxide could be converted to ethylene glycol at carbon dioxide concentration below 0.01 wt% and maintaining both a good conversion and yield.

5.4.7 Nor can this finding be rebutted by document (3) which, apart from the fact that it is not concerned with a bicarbonate resin in the sense of the claimed invention (cf. point 4.3.7 above), teaches that carbon dioxide may be lowered down to a value as low as 0.00001 mole of carbon dioxide per mole of alkylene oxide.

5.4.8 It would, therefore, have been obvious for a person skilled in the art to arrive, without inventive ingenuity, at the subject-matter of Claim 1 of each request. Therefore, the subject-matter of the fourth and fifth auxiliary request lacks inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:	The Chairman:
N. Maslin	A. Nuss