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Datasheet for the decision of 19 February 2013

Case Number: T 1737/10 - 3.3.06

Application Number: 03748986.1

Publication Number: 1543092

IPC: C10G 9/16, C10G 75/04

Language of the proceedings: EN

Title of invention:
Inhibition of viscosity increase and fouling N hydrocarbon streams including unsaturation

Patent Proprietor:
GE Betz, Inc.

Opponent:
Nalco Company

Headword:
Quinone methides/GE BETZ

Relevant legal provisions (EPC 1973):
EPC Art. 56, 84

Keyword:
"Admissibility of new documents and evidence cited during appeal (yes)"
"Clarity of claims (not be to discussed) - alleged unclarities not arising from the amendments to granted claim 1"
"Inventive step (yes): not obvious to choose with expectation of success"

Decisions cited:
T 0611/04, T 1188/00

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1737/10 - 3.3.06

D E C I S I O N
of the Technical Board of Appeal 3.3.06
of 19 February 2013

Appellant: (Opponent)	Nalco Company 1601 W. Diehl Road Naperville IL 60563—1198 (US)
Representative:	Wilson, Gary Harrison Goddard Foote Delta House 50 West Nile Street Glasgow G1 2NP (GB)
Respondent: (Patent Proprietor)	GE Betz, Inc. 4636 Somerton Road Trevose, PA 19053—6783 (US)
Representative:	Szary, Anne Catherine London Patent Operation GE International Inc. 15 John Adam Street London WC2N 6LU (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted 9 June 2010 concerning maintenance of European patent No. 1543092 in amended form.**

Composition of the Board:

Chairman: P.-P. Bracke
Members: L. Li Voti
J. Geschwind

Summary of Facts and Submissions

I. The present appeal is from the decision of the Opposition Division to maintain in amended form the European patent no. 1 543 092, concerning a method of inhibiting fouling and viscosity increase in hydrocarbon streams.

II. In its notice of opposition the Opponent sought the revocation of the patent on the grounds of Article 100(a) EPC 1973, because of lack of novelty and inventive step of the claimed subject-matter.

The following documents were cited *inter alia* in support of the opposition:

(1): EP-B-737660;
(2): US-A-4003800;
(4): US-A-5985940 and
(5): "Reduce olefin plant fouling" by J.F. Martin, Hydrocarbon Processing, November 1988, pages 63 to 67.

III. The Opposition Division found in its decision, in particular, that the claims according to the main request filed with the letter dated 8 May 2009 were novel and involved an inventive step.

IV. An appeal was filed against this decision by the Opponent (Appellant). The Appellant submitted the following additional documents:

(6): US-A-6143205;
(7): US-A-7470734;
(8): US-A-5616774;

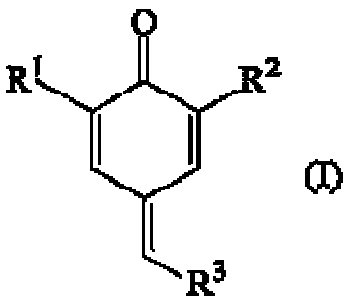
(9): ABB Lummus Styrene Conference 2000;
(10): Statutory declaration from V. Lewis, Ph.D.;
(11): Statutory declaration from B. Manek, Ph.D.;
(12): Statutory declaration from V. J. Masere, Ph.D.;
(13): US-A-5824829.

The Respondent (Patent Proprietor) submitted with letter of 24 February 2011 an auxiliary request.

Oral proceedings were held before the Board on 19 February 2013.

V. The independent claim 1 of the set of claims according to the Respondent's main request, which corresponds with the set of claims found by the Opposition Division to comply with all the requirements of the EPC, reads as follows:

"1. A method of inhibiting fouling and viscosity increase in hydrocarbon streams including ethylenically unsaturated monomers comprising the step of adding to said hydrocarbon stream during ethylene production an effective amount of one or more quinone methides of the formula:



(I)

wherein R^1, R^2, and R^3 are independently selected from the group consisting of H,-OH,-SH,-NH_2, alkyl, cycloalkyl, heterocyclo, and aryl."

Dependent claims 2 to 9 relate to particular embodiments of the method of claim 1.

VI. The Appellant submitted in essence that

- documents (6) to (13) had been cited as a reply to the arguments of the decision under appeal with regard to the importance of table 5 of the patent in suit for showing an improved effect; therefore, they were admissible;

- claim 1 did not comply with the requirements of Article 84 EPC 1973;

- the comparative tests contained in the patent in suit were not apt to show the superiority of quinone methides with respect to other known polymerization inhibitors since the conditions selected for the tests were not those encountered in the upper section of a primary fractionator (quench oil tower) in an ethylene plant; moreover, whilst claim 1 was not limited to the use of quinone methides in the quench oil tower, the tests of the patent in suit intended to simulate only conditions occurring in such a tower;

- since the viscosity increase at the bottom of the oil quench tower was rather due to the presence of deposited tar or asphaltenes which agglomerated with paraffins and not to the polymerisation of monomers present in the pyrolisis gas oil (called py-gas oil),

which occurred already in the upper section of the quench oil tower, the tests could not show that this specific problem was effectively solved;

- therefore, the technical problem underlying the invention concerned only the provision of alternative polymerisation inhibitors for use in an ethylene plant; since quinone methides were known as polymerisation inhibitors for styrene and other vinyl monomers, which were known to be present in the py-gas oil during ethylene production, the claimed subject-matter thus lacked an inventive step in the light of the combination of document (5) with documents (1) and/or (2).

VII. The Respondent submitted in writing and orally *inter alia* that

- at least documents (6) to (8) were late filed and had not to be admitted;

- the comparative tests contained in the patent in suit had been carried out under extreme conditions and were relevant; they showed that the quinone methides were better than other polymerisation inhibitors in inhibiting fouling and viscosity increase during ethylene production;

- in the light of the teaching of the prior art the skilled person would not have selected the quinone methides, which had been used mainly in styrene plants, among the many known polymerization inhibitors with the expectation of inhibiting effectively fouling and viscosity increase in an ethylene plant; in fact, as

explained in document (13), not all known polymerization inhibitors were able to inhibit viscosity increase in an ethylene plant;

- the claimed subject-matter thus involved an inventive step.

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

IX. The Respondent requests that the appeal be dismissed or, in the alternative, that the patent be maintained on the basis of the auxiliary request submitted with the letter of 24 February 2011.

Reasons for the Decision

1. *Admissibility of documents (6) to (13)*

1.1 The Appellant submitted with the statement of the grounds of appeal documents (6) to (12).

All these documents were cited in order to contest the finding of the Opposition Division that the comparative tests contained in the patent in suit showed that the quinone methides used according to the patent in suit were superior to other anti-fouling agents of the prior art.

Therefore, the Board finds that all these documents, having been submitted with the statement of the grounds of appeal as a reply to an argument upon which the decision under appeal was based, are admissible.

1.2 Document (13), which is cited as background art in paragraph 5 of the patent in suit, was mentioned first by the Respondent in its letter of 29 September 2011 and it was introduced formally into the proceedings by the Appellant with its letter of 19 January 2013.

Since this document was used by both parties for supporting their respective arguments it is also admissible.

2. Respondent's main request

2.1 *Clarity*

The Appellant raised with its letter of 18 January 2013 some objections under Article 84 EPC 1973 against claim 1.

However, it was not disputed during oral proceedings that Article 84 EPC 1973 is not a ground of opposition and that the objections had not been caused by the only amendment to the granted claim 1, which consisted in the limitation of the claimed method to ethylene production.

Therefore, these Appellant's objections have not to be considered (see Case Law of the Boards of Appeal of the EPO, 6th edition, 2010, VII.D.4.2, page 807, first full paragraph).

2.2 *Inventive step*

2.2.1 The invention of the patent in suit relates to a method for inhibiting fouling and viscosity increase in a hydrocarbon stream during ethylene production.

As explained in the patent in suit, one of the products of cracking during ethylene production is the py-gas oil, which is refluxed in the upper section of the oil quench tower and its counter current flow cools cracked gases. However, as the py-gas oil is subjected to heat, it increases in viscosity and the heavier components drop to the bottom section of the oil quench tower, leading to an increase in the viscosity of the hydrocarbon present in the bottom section of the tower and fouling. This is possibly a result of polymerization of the unsaturated hydrocarbon components (see paragraphs 2 and 3).

The prior art attempted to reduce viscosity in the bottom section of the oil quench tower, for example, by adding chemical agents. However, compositions that inhibit the polymerization of a particular monomer do not necessarily prevent a viscosity increase in an oil quench tower during ethylene production. One reason for this observation is that the hydrocarbons present in the bottom of the oil quench tower are a mixture of a variety of different unsaturated aromatic monomers such as styrene, methyl styrene, divinylbenzene, and indene (paragraphs 5 and 7).

Therefore, the technical problem underlying the invention is formulated in the patent in suit as the

provision of another adequate method of inhibiting fouling and viscosity increase in an ethylene plant.

2.2.2 Both parties chose document (5) as suitable starting point for the evaluation of inventive step.

In fact, document (5), addresses the technical problem of inhibiting fouling due to polymerization of vinyl monomers like styrene, indene and divinylbenzene in an ethylene plant, and especially in the quench oil tower (see passage bridging pages 63 and 64).

Therefore, the Board also chooses document (5) as the most suitable starting point for the evaluation of inventive step.

2.2.3 The technical problem underlying the invention was formulated in the decision under appeal, starting from document (5), as the provision of a method which further improves the inhibition of fouling in ethylene plants (see page 6, second full paragraph). The Respondent maintained also this formulation of the technical problem. This formulation differs from that of the patent in suit which referred only to the provision of another adequate method for inhibiting fouling and viscosity increase.

The Board remarks also that document (5) had already provided a solution to the problem of fouling in an ethylene plant (see page 64, paragraph entitled "Remedy") by means of a proprietary blend of polymer chain-stopper, metal deactivator, detergent and dispersant (see page 64, right column, lines 11 to 13). All comparative tests contained in the patent in suit

were instead carried out with respect to individual polymerization inhibitors, in particular various phenylene diamines (PDAs) and a piperidinyloxy free radical (OH-Tempo). The tested inhibitors thus do not correspond to the blend of compounds used in document (5). Furthermore, the patent in suit does not mention that the quinone methides used as inhibitors according to the invention perform better than a blend of the type used in document (5).

It is in this respect established jurisprudence of the Boards of appeal of the EPO that the burden of proof for a new undisclosed effect which is not mentioned in the application as filed or in the patent lies on the party alleging this new effect (see Case Law of the Boards of Appeal of the EPO, 6th edition, 2010, I.D.9.9, page 222, first paragraph as well as T 611/04, points 2.2.2 to 2.2.4 of the reasons and T 1188/00, catchword). Since the patent in suit does not contain any comparison with the closest prior art nor it has stated in the patent in suit that the used quinone methides perform better than the mixture of compounds used in document (5) in order to prevent fouling and viscosity increase, the Board concludes that no improvement of the inhibition of fouling in ethylene plants with respect to the closest prior art has been demonstrated and that this alleged effect has to be disregarded in the formulation of the technical problem.

The Board thus finds that the technical problem underlying the invention can only be defined as formulated in the patent in suit as the provision of alternative antifouling agents which can adequately

inhibit fouling and viscosity increase in an ethylene plant.

The Board agrees with the Appellant that the temperatures used in the comparative examples of the patent in suit do not necessarily correspond to those found in the upper section of an oil quench tower and the used operative conditions of shut-in for several hours do not correspond to those used in an industrial process; however, the used conditions are certainly more severe than those found actually in an ethylene plant. Consequently, the Board finds that, if quinone methides are shown to be able to inhibit polymerization and viscosity increase under such conditions, they are certainly able to inhibit fouling and viscosity increase in an ethylene plant under normal processing conditions. The fact that the effect shown in the examples might not correspond to a very substantial inhibition is in this respect irrelevant, since claim 1 is only directed to the achievement of a generic not quantified inhibitory effect and there is no reason to assume that the inhibition shown in the comparative examples would not be adequate in a real process.

Furthermore, even though the viscosity increase inhibition addressed to in the patent in suit regards only the inhibition of the viscosity increase due to the polymerization of vinyl monomers and not the possible agglomeration of deposited tars and asphaltenes with paraffins at the bottom of the oil quench tower, as explained by the Appellant during oral proceedings, it cannot be disputed that monomers still present at the bottom of the oil quench tower will certainly tend to polymerize because of the presence of

high temperature and will contribute to the overall viscosity increase. Therefore, the Board finds that the quinone methides will have necessarily also a positive inhibitory effect against viscosity increase at the bottom of the oil quench tower.

Moreover, since the effects obtained by adding quinone methides to the oil quench tower of an ethylene plant have been convincingly shown, it is reasonable to assume that the same effects will be obtained by adding the quinone methides to other parts of the ethylene plant wherein fouling can occur, which parts have milder operative conditions than the oil quench tower, as admitted by the Appellant during oral proceedings.

The Board thus finds that the technical problem mentioned above has been successfully solved by means of the addition of the quinone methides represented in claim 1.

2.2.4 It is undisputed that the only difference between the disclosure of document (5) and the subject-matter of claim 1 is that the method of document (5) uses a blend of various components and not quinone methides for inhibiting fouling and viscosity increase.

Therefore, it is irrelevant for the evaluation of inventive step whether the quinone methides of the invention are superior or not to other known antifouling agents different from those used in document (5). Hence, there is no need to discuss documents (6), (7) and (9) to (12), which were cited by the Appellant only for contesting the results of the comparative tests of the patent in suit allegedly

showing a superiority of the quinone methides over PDAs and OH-Tempo, i.e. over known antifouling agents different from those used in document (5).

The only issue thus to be replied in the evaluation of inventive step is whether the skilled person, in the light of the teaching of the prior art, would have chosen the quinone methides of claim 1, among all the known antifouling agents available at the priority date of the patent in suit, with an expectation of obtaining an adequate inhibition of fouling and viscosity increase in an ethylene plant.

2.2.5 Quinone methides were known polymerization inhibitors for styrene and other aromatic vinyl monomers or acrylic monomers. In particular, they had been suggested specifically for use during manufacturing processes of such monomers (see documents (1), paragraphs 1, 11 and 39; (2), column 1, lines 6 to 9; column 1, line 61 to column 2, line 27; and (8), column 1, lines 5 to 21; column 2, line 62 to column 3, line 22; column 5, lines 29 to 35), i.e. for use in plants having different operative conditions than an ethylene plant.

Moreover, the Board remarks that the prior art published after document (5) suggested rather the use of other blends not containing quinone methides instead of individual polymerization inhibitors for inhibiting polymerisation of aromatic monomers and viscosity increase in the oil quench tower of an ethylene plant (see document (13), column 1, lines 28 to 34; column 2, lines 7 to 61 and document (4), column 1, lines 7 to 10 and 38 to 57). In particular, document (13) warned also

that known polymerization inhibitors were not able to inhibit the viscosity increase due to polymerization of aromatic vinyl monomers at the bottom of the oil quench tower (column 1, lines 35 to 39 and column 4, lines 39 to 41). This teaching was also acknowledged in paragraph 7 of the patent in suit.

The above mentioned documents (1), (2) and (8) did not contain any indication or suggestion that the quinone methides would behave differently from other known polymerization inhibitors and would be able to inhibit viscosity increase under the conditions encountered in an ethylene plant.

Therefore, even though they were well known polymerisation inhibitors, the prior art did not contain any hint that could have prompted the skilled person, aware of the warning of document (13), to try them instead of the blends disclosed in document (5) with the expectation of obtaining, not only an adequate inhibition of the polymerisation of aromatic monomers with consequent fouling, but also an inhibition of viscosity increase.

The Board thus concludes that the subject-matter of the claims according to the Respondent's main request involves an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Magliano P.-P. Bracke