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D E C I S I O N
of 18 May 1998

Case Number: T 0548/94 - 3.3.5

Application Number: 85309272.4

Publication Number: 0186446

IPC: C10G 11/05

Language of the proceedings: EN

Title of invention:

Catalytic cracking with a mixture of faujasite-type zeolites
and zeolite beta

Patentee:

MOBIL OIL CORPORATION

Opponent:

Grace GmbH

Headword:

Catalytic cracking/MOBIL OIL

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (no), obvious combination"

Decisions cited:

-

Catchword:



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Boards of Appeal

Chambres de recours

Case Number: T 0548/94 - 3.3.5

D E C I S I O N
of the Technical Board of Appeal 3.3.5
of 18 May 1998

Appellant: MOBIL OIL CORPORATION
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Respondent: Grace GmbH
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Representative: von Kameke, Allard, Dr.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 3 May 1994 revoking
European patent No. 0 186 446 pursuant to
Article 102(1) EPC.

Composition of the Board:

Chairman: R. K. Spangenberg
Members: G. Dischinger-Höppler
J. H. van Moer

Summary of Facts and Submissions

I. The appeal is from the Opposition Division's decision revoking European Patent No. 0 186 446. The decision under appeal was based on the claims as granted as main request and on amended claims as auxiliary requests 1-3. Granted Claim 1 reads as follows:

"1. A process for cracking a hydrocarbon feed which comprises contacting said feed at a temperature of 449 to 566°C in the absence of added hydrogen with a catalyst comprising zeolite beta and a zeolite having the structure of faujasite, the weight ratio of faujasite to beta being from 1:25 to 20:1."

II. The stated ground for revocation was lack of inventive step. It was held that the subject-matter of all requests differed from the teaching of

D1: US-A-4 486 296

only in that the process was conducted in the "absence of added hydrogen" or, in other words, that D1 concerned a hydrocracking process while the patent in suit referred to catalytic cracking. However, it was held to be obvious to try the known combination of zeolite X or Y and zeolite beta in a cracking process without added hydrogen because it was known that the mechanism of hydrocracking was that of catalytic cracking with hydrogenation superimposed.

III. During the appeal proceedings the Appellant (Proprietor) filed amended claims and an amended text of the description as an auxiliary request with letters dated 8 April and 12 May 1998.

Oral proceedings were held on 18 May 1998 in the absence of the Respondent (Opponent), who had in advance informed the Board of his intention not to attend the hearing. '

IV. The Appellant's written and oral submissions can be summarized as follows:

The patent in suit was concerned with the technical field of catalytic cracking and the problem of increasing the octane number while maintaining a high yield of gasoline + alkylate. This problem was solved by using a catalyst comprising zeolite beta and a zeolite having the structure of faujasite in the weight ratio specified in Claim 1.

- D1 did not address this problem but was concerned with the pour point and viscosity of the liquid product which was obtained by hydrocracking heavy carbon oils. Moreover, hydrocracking and catalytic cracking were different not only with respect to the reaction mechanisms involved but also to the products obtained. In particular, hydrocracking did not provide olefines and aromatics in an amount sufficient to provide the desired octane number. The teaching of D1 was therefore remote from that of the patent in suit. The same applied to

D2: US-A-4 419 220 and

D3: US-A-4 481 104.

- According to D2, it was intended to dewax the hydrocarbon streams by isomerization without substantial cracking. This was opposite to the results of increased yield of C3/C4-olefines (alkylates) obtained by the process of the patent

in suit, which was important for potential alkylation to produce higher quality alkylates.

- Also, the teaching of D3 led away from the claimed subject-matter in that it aimed at an increase of distillate yield and hence to a lowering of the gasoline yield by using a particularly treated zeolite.

According to the Appellant, the closest prior art was represented by any conventional cracking process using a commercial catalyst comprising a faujasite-type zeolite. The cited prior art did not suggest that any improvements could be obtained in such a process by the admixture of zeolite beta to the catalyst composition, let alone that the problem underlying the invention could be solved. However, from Tables 4 and 12, as well as Figures 10 and 11 of the patent in suit, the problem-solving technical effect was clearly derivable.

- V. The Respondent's written submissions may be summarized as follows:

The reactions taking place in hydrocracking and in catalytic cracking processes were almost the same. The difference was only that hydrocracking additionally included hydrogenations. Of particular interest was that the process of both, D1 and the patent in suit, included the element of dewaxing in addition to the cracking or hydrocracking, respectively. It was further known that zeolites used as cracking catalysts may, by the incorporation of suitable hydrogenation components, be adapted for hydrocracking. Consequently, the skilled person would have expected more or less the same advantages when using the zeolite catalyst of D1 in a cracking process without added hydrogen, so that it was

obvious to try. In addition, the presence of any unexpected effect provided by the claimed process was disputed.

- VI. The Appellant requested that the decision under appeal be set aside and that the patent be maintained as granted (main request) or, auxiliarily, with the amendments to the claims and description as submitted with the letters of 8 April 1998 and 12 May 1998.

The Respondent requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.
2. *Main Request*
 - 2.1 The only question to be answered in respect of this request is whether the claimed subject-matter is based on an inventive step.
 - 2.2 The Respondent as well as the Opposition Division considered D1 as closest prior art. It is, however, undisputed that the process conditions in a hydrocracking process as described in D1 are substantially different to those of catalytic cracking as presently claimed, not only because hydrocracking requires the addition of hydrogen but also because it usually performs at higher pressures and lower temperatures than catalytic cracking (see in D1, in particular column 9, lines 9 to 18, and the patent specification, page 2, lines 43/44). In agreement with the Appellant, the Board considers, therefore, that the closest prior art is represented by a conventional catalytic cracking process as described in the

- specification (see page 2, lines 28-30) wherein the catalyst employed contains a faujasite-type zeolite such as zeolite X or Y.
- 2.3 Such a process is disclosed eg in D3, Table 2, where a commercial rare earth exchanged zeolite Y having a preference for gasoline production is used for comparison (see example 12, column 5, lines 51 to 61 and column 7, lines 56 to 60). The process in this example is conducted in the absence of added hydrogen at a temperature of 505°C and a pressure of 1 atm, ie under the process conditions according to the claimed process. Hence, the subject-matter of Claim 1 differs therefrom only in that the catalyst additionally contains zeolite beta in an amount such that the weight ratio of faujasite to beta is from 1:25 to 20:1.
- 2.4 The patent in suit says that the object attained in view of such prior art consists in increased octane numbers and gasoline plus alkylate yields (see page 2, line 57 to page 3, line 1). As pointed out by the Appellant, the amount of gasoline plus alkylate corresponds to the sum of C_5^+ gasoline + C_3^- + C_4^- + i- C_4 . During the oral proceedings the Appellant explained that the improvement objectively obtained by the claimed process was a maximum gain in octane number (ΔO) in relation to loss of gasoline yield (ΔY), as was shown in Figures 10 and 11 of the patent in suit, graphically representing the results listed in Table 12 of the patent specification.
- 2.5 However, the Board is not convinced that this technical problem has been credibly solved by the process defined in Claim 1.

2.5.1 In examples 4 and 21 to 24, referred to by the Appellant and represented in Tables 4 and 12 of the patent specification, it is shown that the admixture of zeolite beta provides an increase in the octane number and in C₃/C₄-yields (alkylates) at equal or comparable conversion rates, but at the expense of the C₅⁺ gasoline yield. According to example 4 the loss of gasoline even leads to a decreased yield of gasoline + alkylate (see table 4).

2.5.2 In addition, the Board observes that in example 4 (table 4) the corresponding yields and rates are given in weight %, while in all other examples the yields are indicated in volume %. Moreover, as admitted by the Appellant, the densities of the fractions obtained in the various examples differ from each other due to the different compositions of hydrocarbons contained. Since the opposed patent specification does not indicate any density values for the different fractions of hydrocarbons obtained, it is not possible to convert the yields from volume % into weight % or to compare the results obtained in the different examples. This means, however, that any advantages expressed in volume % do not necessarily translate into advantages when expressed in weight % or vice versa, so that the evidential weight of the results presented in most of the examples is questionable.

2.5.3 Furthermore, the Board is unable to agree with the Appellant's submission that the problem-solving effect was derivable from Figures 10 and 11 of the specification, and the corresponding examples 21 to 24. It is certainly true that Fig. 10 shows a non-linear dependency between octane number or, respectively, gasoline yield and percentage of zeolite beta in the catalyst mixture (see also Table 12). It is also true that Fig. 11, which presents the efficiency of gaining

octane number (ΔO) over a catalyst containing only a faujasite-type zeolite in relation to the loss of gasoline yield (ΔY) as a function of the zeolite beta content in the zeolite catalyst, shows that this efficiency, expressed as the ratio $\Delta O/\Delta Y$, has a maximum for the zeolite Y : beta ratio of 1:1. In the Board's judgment, however, this is not sufficient to demonstrate that the technical problem relied upon by the Appellant has been credibly solved within the whole claimed range of ratios of zeolite Y to zeolite beta, not only because a different result is likely to be obtained if the ratios of products were expressed in weight % rather than in volume %, but, more importantly, because the graphs are based on only three pairs of data for ΔO and ΔY , which are derived from examples wherein the zeolite Y : beta ratios are 1:0, 2:1, 1:1 and 0:1. This is not enough to substantiate the presence of the effect in the whole very broad range of zeolite Y : beta ratios indicated in Claim 1, particularly since in the patent specification it is said that this particular maximum "is only a coincidence" and further that it is "a function of the conversion level and the two zeolites' relative activities" (see page 20, line 58 to page 21, line 1). The Board infers therefrom that any maximum efficiency of gaining octane number expressed by the ratio $\Delta O/\Delta Y$ is further dependent on parameters such as conversion rate and catalyst activity. Such a dependency is not reflected by present Claim 1. It is therefore not credible that the effect shown in Table 11 is actually attained by a process defined solely by the features of Claim 1.

2.5.4 In addition, the Board notes that the examples referred to by the Appellant (see Tables 4 and 12) show that by using zeolite beta in admixture with faujasite considerably more bottoms are left than with faujasite

alone. This is evidently disadvantageous with respect to the available yield of valuable products such as gasoline, alkylate and distillate. The Board concludes that what is shown in the examples is, at best, a positive effect concerning increased octane numbers and possibly alkylate yields versus a negative effect concerning decreased gasoline yield and/or conversion rate. Such a balancing of advantages and disadvantages is, however, rather a commercial than a technical problem and is no indication for the presence of an inventive step.

- 2.6 Since, for the reasons set out above, the technical problem relied upon by the Appellant cannot be taken into account as a basis for deciding the question of inventive step, the Board has to examine which other technical problem can serve as such a basis.
- 2.6.1 The patent specification contains a statement that the claimed process includes the elements of cracking and dewaxing (see page 2, lines 49 to 54). The Board therefore considers that a further object of the process according to the patent in suit consists in providing a process for conversion of a hydrocarbon feedstock wherein the elements of cracking and dewaxing are combined.
- 2.6.2 The problem of dewaxing is addressed in D2 and D1. D2 discloses the specific suitability of zeolite beta for dewaxing a hydrocarbon feed at a temperature of 250 to 500°C in the absence or presence of added hydrogen. More particularly, it is disclosed therein that zeolite beta performs as a catalyst for isomerization of the waxy n-paraffins to the less waxy branched chain iso-paraffins (see in D2, column 2, lines 8 to 13). D1 makes use of this property of zeolite beta in a catalyst for hydrocracking which further contains

zeolite Y and a hydrogenation component (see column 1, line 65 to column 2, line 19 in combination with column 3, lines 30 to 38).

2.6.3 The Board agrees with the Appellant's opinion that D2 refers to a process without substantial cracking and is, in this respect, not comparable with the claimed process providing an increased yield of alkylates. However, D2 expressly states that a measure of cracking does take place, and that this measure largely depends upon the amount of heavy ends present in the feedstock, which leads to more cracking, and the reaction conditions (see column 2, lines 59 to 65 and column 8, lines 34 to 42). Hence, the skilled person is made aware of the fact that the process of D2 can be modified in such a manner that substantial cracking occurs. The Appellant's submission that the teaching of D2 as a whole leads away from the presently claimed process, and for this reason would not have been taken into account by the person skilled in the art looking for a process for simultaneous cracking and dewaxing, is therefore not convincing. It also stands in contradiction to the fact that in D1 zeolite beta is considered to have both general activity for cracking several types of hydrocarbons and for selectively dewaxing certain portions of the feed (see in D1, column 1, lines 9 to 13).

2.6.4 As set out above, the Appellant was unable to show any unexpected effects related to the particular weight ratio of faujasite to beta in the range from 1:25 to 20:1. Considering further that this weight ratio embraces the broad range of zeolite mixtures wherein beta is present in an amount of about 5%wt to about 96%wt, the Board holds that this feature embraces all ratios which a skilled person would consider in practice.

The Board therefore comes to the conclusion that it was obvious for a person skilled in the art to combine in a catalytic hydrocarbon cracking process a typical cracking catalyst such as a conventional faujasite with a dewaxing catalyst as disclosed in D2 in a practical ratio, because he or she would have expected that such a combination would provide at the same time substantial cracking and dewaxing.

2.7 For these reasons, the main request must fail.

3. *Auxiliary Request*

3.1 The amendments made to Claim 1 of this request are disclosed in the application as originally filed (see Claims 1, 2, 13, 16, 17, 19 and 20, page 2, last paragraph, page 4, second paragraph and page 13, first full paragraph). Further, the protection conferred by the claims as granted is not extended by the amendments made to Claim 1 of the auxiliary request. The requirements of Article 123(2) and (3) are therefore met.

3.2 The amendments made to Claim 1 of the auxiliary request consist in that (a) the hydrocarbon feed was restricted to gasoil having a boiling range of at least 204.5 to at least 454.5°C, (b) the process conditions were restricted to the working under a pressure of 1 to 7.9 bar and LHSV of 0.1 to 20 in a moving- or fluidized-bed catalytic cracking unit, (c) the ratio of faujasite to beta in the mixture was restricted to 1:2 to 20:1 and (d) the product to be obtained was indicated to comprise an enhanced quantity of gasoline of enhanced octane rating and an enhanced quantity of alkylate. In the Board's judgment this last feature is, however, rather an indication of the desired result than a

technical feature of the claimed process, so that it cannot contribute to the assessment of inventive step.

- 3.3 The Board does not see any reasons why these amendments should lead to a redefinition of the relevant technical problem. On the contrary, since conventional catalytic cracking processes as well as the process according to D2 embrace the amended features (a) and (b) (see in D3, column 4, lines 21 to 52, column 6, lines 12 to 16 and Table 2; in D2, column 7, line 50 to column 8, line 8, column 11, table 8), the Board considers that the considerations set out in points 2.4 and 2.5 above still remain applicable.
- 3.4 The Appellant did not provide any arguments as to the relevance of the above amendments with respect to conventional catalytic cracking processes or to the disclosure of D2. He merely indicated that they delimited the claimed subject-matter over the process of D1, in particular with respect to the pressure and temperature conditions.
- 3.5 The same conclusions as drawn for Claim 1 of the main request in point 2.6 above therefore apply to Claim 1 of the auxiliary request, so that this request must also fail.

Order

For these reasons it is decided that:

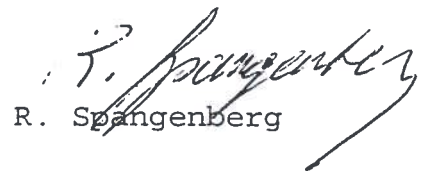
The appeal is dismissed.

The Registrar:



S. Hue

The Chairman:



R. Spangenberg

