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**Datasheet for the decision  
of 12 February 2016**

**Case Number:** T 0354/15 - 3.3.06

**Application Number:** 10803648.4

**Publication Number:** 2504414

**IPC:** C10L1/223, C10L1/23

**Language of the proceedings:** EN

**Title of invention:**

HIGH OCTANE NUMBER COMPOSITION USEFUL AS FUEL FOR INTERNAL  
COMBUSTION AND CONTROLLED IGNITION ENGINE

**Applicant:**

Chimec S.p.A.

**Headword:**

Increasing RON using 2,4-dialkyl anilines/CHIMEC

**Relevant legal provisions:**

EPC Art. 52(1), 56

**Keyword:**

Inventive step -  
claimed process not obvious in the light of prior art invoked  
Remittal to the examining division

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**  
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Case Number: T 0354/15 - 3.3.06

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.06**  
**of 12 February 2016**

**Appellant:** Chimec S.p.A.  
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**Representative:** Pipparelli, Claudio  
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**Decision under appeal:** **Decision of the Examining Division of the European Patent Office posted on 2 September 2014 refusing European patent application No. 10803648.4 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairman** B. Czech  
**Members:** E. Bendl  
C. Vallet

## Summary of Facts and Submissions

- I. The appeal lies from the decision of the examining division to refuse European patent application No. 10 803 648.4.
- II. In the appealed decision the examining division concluded that the subject-matter of the independent claims 1 (gasoline), 5 (process for obtaining a gasoline) and 6 (use of aromatic amines for increasing the octane number of base gasoline) according to the only then pending request did not involve an inventive step in the light of document
- D3: J. E. Brown et al, "Mechanism of Aromatic Amine Antiknock Action"; Industrial and Engineering Chemistry 47(10) 2141 to 2146, 1955).
- III. Under cover of its statement of grounds, the appellant (applicant) filed two sets of amended claims as main and (first) auxiliary request. It argued that the examining division erred in its judgement since it was based on a wrong interpretation of D3 and because the teaching of this document was not applicable to modern high octane gasoline. It also commented on the disclosure of document
- D4: US 5 470 358 A,
- already cited by the examining division against previously pending claims in support of an inventive step objection, and referred to newly filed documents including
- A3: J. J. McKetta Jr., Encyclopedia of Chemical Processing and Design, vol. 2, 1977, page 3,

entry "Additives, Engine Fuel".

- IV. In preparation of oral proceedings the board issued a communication indicating its non-binding preliminary opinion regarding the pending sets of claims. More particular the board called into question whether the independent product claims 1 according to the two pending requests met the requirements of Articles 123(2), 83 and 84 EPC.
- V. On 8 February 2016, the appellant submitted by fax two amended sets of claims as new main request and (first) auxiliary request, consisting of process claims only. It also announced that it would not be represented at the oral proceedings, but that further comments regarding the board's communication would be filed.
- VI. On 10 February 2016 the appellant filed the announced comments by fax, and included a further copy of the pending claim requests.
- VII. During a phone call that took place on 11 February 2016, the chairman of the board informed the appellant's representative that in the board's view the pending amended claims still appeared to be objectionable under Article 84 EPC since process claim 1 did not express that the addition of the specific aromatic amine(s) actually resulted in a increased RON number of the fuel composition so obtained.
- VIII. On the same day, the appellant submitted a further amended main claim request by fax.
- IX. Claim 1 according to this new main request reads as follows:

"1. Process for obtaining a fuel composition useful for internal combustion engine having an octane number from 95 to 105 **(RON) by increasing the Octane Number (RON)** comprising the addition to an unleaded and devoid of organometal compounds base gasoline having an octane number (RON) from 90.1 to 103 of one or more aromatic amines selected from the group consisting of 2,4-dialkylaniline, wherein the alkyl groups in position 2 and 4, independently one from the other, are selected from the group consisting of methyl, ethyl, n-propyl, iso-propyl".

Dependent claims 2 to 5 relate to more specific embodiments of the process according to claim 1.

- X. Oral proceedings were held on 12 February 2016 in the absence of the duly summoned appellant (Rule 115(1) EPC).
- XI. The appellant requested in writing that the decision under appeal be set aside and a patent be granted on the basis of claims 1 to 5 of the main request, filed by fax on 11 February 2016 or, alternatively, on the basis of the first auxiliary request, filed by fax on 10 February 2016.
- XII. The arguments of the appellant of relevance having regard to the claims according to the main request can be summarised as follows:

Claim 1 finds basis in the application as originally filed, more particularly in process claim 7 thereof.

The objections raised by the board under Articles 83 and 84 EPC were overcome, since claim 1 was no longer directed to a gasoline defined in terms of features

objected by the board. RON values as referred to in claim 1 could serve to sufficiently and unambiguously define a fuel composition.

As regards inventive step, the high RON (avgas) fuel compositions, which according to D4 are further boosted using aromatic amines, were more similar to the fuel compositions treated according to the process of claim 1 at issue than the synthetic test fuels used according to the much older publication D3 in testing the antiknock effect provided by various aromatic amines, including 2,4-dimethyl aniline. However, as apparent from e.g. document A3, it was known that the performance of an antiknock agent was highly dependent on the composition of the gasoline. Since D4 taught that an alkyl substitution at the 2-position of aniline "limits the octane boosting value", the skilled person was directed away from the present invention. The skilled person knowing D3 and D4 was thus not induced to study the use of 2,4-dialkyl aniline as a possible anti-knock agent for base gasoline having relatively high RON values. The claimed process was thus inventive in the light of the prior art invoked in the decision under appeal.

## **Reasons for the Decision**

### *Main request*

#### *Admissibility of the main claim request*

1. The claims according to the main request at issue comprise amendments made in response to the reasons given in the contested decision and in reaction to objections raised and/or maintained by the board in the course of the appeal procedure.

- 1.1 Said objections are overcome by virtue of the amended claims according to the main request. The amendments made contributed to the convergence of the debate and raised no further complex issues.
- 1.2 The board therefore decided to admit the main request at issue into the procedure (Article 13(3) RPBA).

*Allowability of the amendments*

2. The board is satisfied that the amended claims according to the main request at issue find basis in the application as filed as indicated below.

Claim 1:

See claim 7; page 1, lines 3/4 and page 5, lines 6/7 of the application as filed.

Claim 2:

See description of the preferred embodiment on page 1, lines 9/10 of the application as filed.

Claim 3:

See page 1, lines 13/14 of the application as filed.

Claim 4:

See page, lines 6 to 16 of the application as filed.

Claim 5:

See page 6, line 18, of the application as filed.

Hence, the claims of the main request meet the requirements of Article 123(2) EPC.



*Sufficiency, clarity and support by the description*

3. The board is satisfied that by virtue of the amendments made to the claims, the objections raised with respect to sufficiency and clarity/support by the description having regard to previous versions of the claims (including an objectionable product claim 1) are no longer relevant.

More particularly, since the fuel composition obtained is now defined in terms of its RON value, and since claim 1 expressly requires that the RON value is increased due to addition of the aromatic amine to the base gasoline, the board holds that process claims 1 to 5 at issue are clear, concise and supported by the description (Article 84 EPC), and that the invention as claimed is sufficiently disclosed (Article 83 EPC).

*Novelty*

4. The Board sees no reason for calling into question novelty of the claimed subject-matter over the prior art invoked in the decision under appeal and referred to by the appellant in the course of the appeal proceedings.
  - 4.1 More particularly, as regards D3, i.e. the only document on which a novelty objection was based in the examination proceedings, the board notes the following. D3 discloses the possibility of increasing the RON of a fuel composition for internal combustion engines by adding to it an aromatic amine, for instance 2,4-dimethylaniline (see table I, second column, third compound; figure 3, uppermost formula) as "antiknock" agent.

However, the RON of the synthetic test fuel used in

determining the antiknock effect achieved has a value of only about 77 (see page 2141, right-hand column, paragraph "Test Fuel", and e.g. figure 1). It is thus lower than the minimum RON of 90.1 prescribed by claim 1 at issue with regard to the base gasoline treated.

- 4.2 Document D4 (see columns 1 and 2, "Summary of the invention"), referred to in connection with inventive step only, discloses increasing the (motor) octane number of an unleaded fuel composition for piston driven aircraft engines by adding an aromatic amine thereto.

The aromatic amine may be a dialkylaniline, but the use of **2,4**-dialkylaniline(s) is not disclosed in D4 (see also point 10.2.1, *infra*).

*Inventive step*

5. The invention

The present invention relates to a process for providing a fuel composition for internal combustion engines with a high RON (see claim 1).

6. The closest prior art

- 6.1 Considering the similarities between the claimed invention and the disclosure of D4 in terms of the technical problems addressed and the means (fuel compositions) proposed, the board holds that this document is the most appropriate starting point for the assessment of inventive step.

- 6.2 Indeed, D4, published in 1995, relates to the use of (*inter alia*) dialkylanilines for further increasing the octane number of an unleaded base gasoline already

having a high motor octane number (MON) of 90 to 93, i.e. a RON of from about 100 to 103 (see D4, column 1, "Field of the invention"; claim 1; column 2, lines 12 to 22), in order to obtain high octane fuel compositions useful as high octane aviation gasolines for piston driven, i.e. internal combustion, engines.

- 6.3 For the board, D3 is a less appropriate starting point for assessment of inventive step according to the problem and solution approach for the following reasons. D3 is a scientific study published in 1955, using of a synthetic test fuel composition (unleaded) supposed to be representative of commercial automotive fuels of 1955 (see page 2142; paragraph "Test Fuel"). However, the commercial automotive fuels of 1955, supposed to be represented by said test fuel, differ significantly in terms of their chemical composition (e.g. in terms of the relative amounts of aromates, oxygenated compounds, sulphur, etc.) from modern unleaded base gasoline fuels with a relatively high RON of 90.1 or more.

7. The technical problem according to the application

- 7.1 The teaching of the closest prior art D4 is not acknowledged in the application as filed.

Nevertheless, the application as filed appears to indicate that **all** 2,4-dialkylanilines encompassed by the definition according to claim 1 at issue are superior, in terms of the RON increase they may impart when added to unleaded modern base gasoline fuels, compared to other structurally similar aromatic amines (see page 5, third paragraph, and example 1).

- 7.2 The board notes, however, that there is no evidence on file convincingly showing that not only 2,4-dimethyl

aniline, but all 2,4-dialkyl anilines as defined in claim 1 actually perform better than the dialkyl anilines recommended by D4 in boosting the RON of any unleaded fuel composition for internal combustion engines with an RON of 90.1 to 103, i.e. across the full ambit of claim 1 at issue.

7.3 Hence, for the board, the technical problem in the light of the closest state of the art D4 can only be seen in providing a further method of the same type.

8. The solution

As the solution to this technical problem, the application proposes the process for obtaining a fuel composition for internal combustion engines with an RON from 95 to 105 according to claim 1 at issue, which is characterised in particular in that it comprises the step of *"increasing the Octane Number (RON)"* by adding to *"an unleaded and devoid of organometal compounds base gasoline having an Octane Number (RON) from 90.1 to 103"* *"one or more 2,4-dialkyl aniline(s), wherein the alkyl groups in positions 2 and 4, independently one from the other, are selected from the group consisting of methyl, ethyl, n-propyl iso-propyl"*.

9. The success of the solution

Considering the experimental data presented in the application as filed (Examples 1 to 9), and absent any evidence to the contrary, the board accepts as plausible that by adding a sufficient amount of a dialkyl aniline compound as defined in claim 1 at issue to the base gasoline as defined in claim 1, a fuel composition with a significantly increased RON may be obtained and,

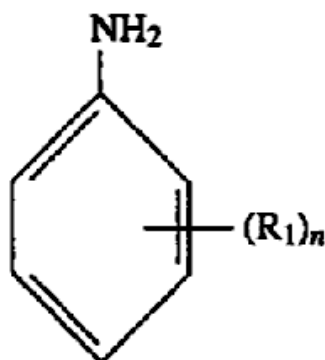
hence, that the posed technical problem is effectively solved by the claimed process.

10. Obviousness

10.1 Regarding the question whether the claimed solution was obvious to the skilled person having regard to the state of the art invoked by the examining division, the board came to the following conclusions:

10.2 Document D4 taken alone

10.2.1 D4 uses as additives aromatic amines having the formula



where  $R_1$  is  $C_1$  to  $C_{10}$  alkyl or halogen and  $n$  is an integer from 0 to 3 **with the proviso that when  $R_1$  is alkyl, it cannot occupy the 2- or 6-position on the aromatic ring.**

Thus, the use of anilines that are (also) substituted by an alkyl group at the 2 position, as required by present claim 1, are expressly excluded from the teaching of D4 (see also column 1, lines 51 to 62).

10.2.2 D4 furthermore expressly teaches that "*alkyl groups in the 2- or 6-position result in aromatic amines which **cannot boost** octane to a MON value of 98*" (column 2, lines 47 to 49; emphasis added).

Thus, D4 does not only explicitly exclude aromatic amines substituted with an alkyl group at the 2-position, but actually teaches away from the present invention, as it strongly recommends **not** to use (*inter alia*) **2,4**-substituted anilines.

10.2.3 Thus, the board concludes that in the light of the closest prior art D4, it was not obvious to the skilled person to use 2,4 dialkyl aniline as anti-knock agent to increase to RON of an unleaded base gasoline already having a relatively high RON of from 90.1 to 103.

10.3 Documents D4 and D3 taken together

10.3.1 In D3 the author of the document, referring also to the so-called Boyd study of 1924, comes to the conclusion that a comparison of anti-knock properties with fuels of different composition is not possible and that therefore a separate study was needed: "*Other than the early Boyd publication, no systematic investigation has been reported concerning the effect on antiknock quality—with comparable motor fuels and under comparable engine conditions of alkyl substitution on the nitrogen atom and on the ring. Little information is available in the literature on the effect of aromatic amines on the antiknock properties of **modern fuels**, which have **greater proportions of olefinic and aromatic hydrocarbons**, as well as **increased sulfur contents** and **higher octane numbers**, than fuels used at the time of the Boyd work. Furthermore, the effect of aromatic amines on fuel antiknock quality has not been evaluated under the more precise rating procedures available today.*" (D3, page 2141, left-hand column, second paragraph; emphasis added).

10.3.2 Document A3, illustrating common general knowledge, also

confirms that "*the response of a gasoline to an antiknock agent is **highly dependent both upon the composition of the gasoline** and on the engine condition*" (page 3; emphasis added).

10.3.3 Additionally, D4 states the following concerning **high-octane** aviation gasolines: "*However, motor gasolines have much lower octane requirements than aviation gasolines for piston driven aircraft. **One cannot predict performance of a given antiknock agent in an aviation gasoline based on its performance as an antiknock agent in a motor gasoline.***" (D4, column 1, lines 30 to 35; emphasis added).

10.4 The board concludes that the skilled person starting from the closest prior art D4, taking into account common general knowledge and seeking to solve the technical problem posed (point 7, *supra*) would not consider the content of D3 as a potential source of useful suggestions, irrespective of the results reported in D3 and achieved in testing certain aromatic amines as anti-knock agents added to a synthetic fuel.

This applies all the more so considering that D3 is a more than sixty year old study preformed using a test fuel supposed to represent the relatively low-octane automotive commercial fuels of 1955, having a composition differing substantially in terms of their chemical composition from (modern) unleaded and devoid of organometal compounds base gasoline already having a RON of 90.1 or more.

11. Thus, in the board's judgement, the method according to claim 1 and, consequently, according to dependent claims 2 to 5, was not obvious to the skilled person having regard to D3 and D4 and thus involves an inventive step

in the light of these prior art documents (Articles 52(1) and 56 EPC).

12. Remittal

By virtue of the allowable amendments made to the claims, the objection based on D3 and D4 having lead to the refusal of the application is overcome. The board therefore considers it appropriate to remit the case to the examining division for further prosecution (Article 111(1) EPC).

**Order**

**For these reasons it is decided that:**

1. The appealed decision is set aside.
2. The case is remitted to the examining division for further prosecution.

The Registrar:

The Chairman:



D. Magliano

B. Czech

Decision electronically authenticated