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**Datasheet for the decision
of 19 January 2023**

Case Number: T 0706/21 - 3.3.06

Application Number: 06845094.9

Publication Number: 1973995

IPC: C10G65/02, C10G45/00, C10G69/02

Language of the proceedings: EN

Title of invention:

PROCESS FOR UPGRADING HEAVY OIL USING A HIGHLY ACTIVE SLURRY
CATALYST COMPOSITION

Applicant:

Chevron U.S.A. Inc.

Headword:

HEAVY OIL UPGRADING/Chevron

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

Novelty - main request and auxiliary requests 1 to 3 (no)
Inventive step - auxiliary request 4 - obvious modification

Decisions cited:

Catchword:



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Case Number: T 0706/21 - 3.3.06

D E C I S I O N
of Technical Board of Appeal 3.3.06
of 19 January 2023

Appellant: Chevron U.S.A. Inc.
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Representative: Haseltine Lake Kempner LLP
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted on 22 December
2020 refusing European patent application No.
06845094.9 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman J.-M. Schwaller
Members: P. Ammendola
S. Fernández de Córdoba

Summary of Facts and Submissions

- I. The appeal lies from the decision of the examining division to refuse European patent application 06845094.9, because the subject-matter of claim 1 of the then pending main and first to third auxiliary requests 1 to 3 lacked novelty over the prior art disclosed in document **D2** (US 3,215,617). Further the subject-matter of claim 1 of auxiliary request 6 lacked an inventive step (Article 56 EPC) over D2.
- II. With its grounds of appeal, the **appellant** filed five sets of claims labelled as main request and auxiliary requests 1 to 4, with the main request and the auxiliary requests 1 to 3 being identical to those with the same numbering refused in the decision under appeal, and auxiliary request 4 being identical to auxiliary request 6 refused in the decision under appeal.
- III. Claim 1 of the **main request** reads as follows:
"1. A process for the hydroconversion of heavy oils, said process employing at least two upflow reactors in series with a separator in between each reactor, said process comprising the following steps:
(a) combining a heated heavy oil feed, an active slurry catalyst composition and a hydrogen-containing gas to form a mixture;
(b) passing the mixture of step (a) to the bottom of the first reactor, which is maintained at hydroprocessing conditions, including elevated temperature and pressure;
(c) removing a vapor stream comprising products and hydrogen, unconverted material and slurry catalyst from

the top of the first reactor and passing it to a first separator;

(d) in the first separator, removing the products and hydrogen overhead as vapor to further processing and unconverted material and slurry catalyst as a liquid bottoms stream;

(e) combining the bottoms of step (d) with additional feed oil resulting in an intermediate mixture;

(f) passing the intermediate mixture of step (e) to the bottom of the second reactor, which is maintained at hydroprocessing conditions, including elevated temperature and pressure;

(g) removing a vapor stream comprising products and hydrogen, unconverted material and slurry catalyst from the top of the second reactor and passing it to a second separator;

(h) in the second separator, removing the products and hydrogen overhead as vapor to further processing and passing the liquid bottoms stream, comprising unconverted material and slurry catalyst, to further processing;

wherein the heavy oil is selected from the group consisting of atmospheric residuum, vacuum residuum, tar from a solvent deasphalting unit, atmospheric gas oils, vacuum gas oils, deasphalted oils, olefins, oils derived from tar sands or bitumen, oils derived from coal, heavy crude oils, synthetic oils from Fischer-Tropsch processes, and oils derived from recycled oil wastes and polymers."

Claim 1 of **auxiliary request 1** differs therefrom by the deletion of the feature "olefins" in the group of materials listed at the end of the claim.

Claim 1 of **auxiliary request 2** differs from that of the main request for the appended wording: "; wherein the

reactors are liquid recirculating reactors and the hydroprocessing conditions include a pressure in the range from 1500 to 3500 psia (10.34 to 24.13 MPa), and a reaction temperature of from 700 to 900F (371 to 482°C)".

Claim 1 of **auxiliary request 3** differs from that of the main request for the appended wording: "*; wherein the reactors are liquid recirculating reactors*".

Claim 1 of **auxiliary request 4** differs from that of the main request in the final part as follows (differences are made apparent): "~~*wherein the heavy oil is selected from the group consisting of atmospheric residuum, vacuum residuum, tar from a solvent deasphalting unit, atmospheric gas oils, vacuum gas oils, deasphalted oils, olefins, oils derived from tar sands or bitumen, oils derived from coal, heavy crude oils, synthetic oils from Fischer-Tropsch processes, and oils derived from recycled oil wastes and polymers*~~
(i) passing the bottoms material of step (h) to the bottom of a third reactor which is maintained at slurry hydroprocessing conditions, including elevated temperature and pressure."

- IV. With letter of 21 November 2022 the appellant filed the textbook T1: "*Resid and Heavy Oil Processing*", J.F. Le Page *et al.*, 1992.
- V. At the oral proceedings held before the board on 19 January 2023, the appellant requested that the decision under appeal be set aside and that the case be remitted to the examining division for further examination on the basis of the claims of the main request, or alternatively, of one of auxiliary requests 1 to 4, all as filed with the statement of grounds of

appeal. In the alternative it requested that a patent be granted on the basis of one of these requests. Further, it requested reimbursement of the appeal fee due to an alleged substantial procedural violation.

Reasons for the Decision

1. Main request - Novelty

The examining division found the subject-matter of claim 1 at issue to lack novelty over the process for hydroprocessing heavy hydrocarbon oil depicted in Figure 1 of D2.

1.1 The appellant disputed this finding arguing that this prior art process would not possess the features defined in steps "(d)", "(e)" and "(h)" of claim 1 at issue.

1.2 In particular, it argued that the claimed process would differ from the prior art directly and unambiguously disclosed in D2 in connection with Figure 1 in that:

i) products were not withdrawn from separator 28 through conduit 32 (compare with step "(d)", wherein the vapour removed from the first separator is described to also comprise "*products*");

ii) products were not withdrawn from separator 62 through conduit 42 (compare with step "(h)", wherein the vapour removed from the second separator is described to also comprise "*products*");

iii) slurry catalyst was not withdrawn from separator 28 through conduit 29 (compare with step "(d)", wherein the liquid bottoms removed from the first separator are described to also comprise "*slurry catalyst*");

iv) unconverted material was not withdrawn from separator 62 through valve 66 and conduit 20 (compare

with step "(h)", wherein the liquid bottoms removed from the second separator are described to also comprise "*unconverted material*"), and

v) additional feed oil was not transported in conduit 48 (compare with step "(e)", wherein the bottoms of step "(d)" are combined with "*additional feed oil*").

- 1.3 As to the alleged differences (i) and (ii), the board notes that appellant correctly stressed that D2 does not explicitly disclose the presence of products of the hydroprocessing steps in the "*vapors*" withdrawn from separator 28 through conduit 32 and/or in the "*gaseous fraction*" withdrawn from separator 62 through conduit 42 (see in particular column 5, lines 59 to 66; column 6, lines 5 to 10 and 70 to 75).

However, in establishing the direct and unambiguous disclosure of D2 it must also be taken into account the necessary implications of the explicit teachings in this document, as well as the common general knowledge of the person skilled in the technical field of hydroprocessing of hydrocarbons.

- 1.3.1 In this respect, the skilled reader of D2, noting that the "PRODUCT" of the hydroprocessing process is explicitly indicated in Figure 1 as being withdrawn from the bottom of separator 36 (via conduit 38), must necessarily conclude that the same liquid "PRODUCT" must have previously been present (together with hydrogen) in the conduit which feeds separator 36, i.e. in the conduit 32 which withdraws matter from the head of separator 28 and carries it through the cooler 34, before feeding it to the separator 36.

Hence, "*products*" of the hydroprocessing process of D2 are necessarily present in the stream of conduit 32.

Therefore, and since step "(d)" of present claim 1 does not require any specific amounts for the "products" (and the "hydrogen") of the vapor stream, the separation occurring in separator 28 of D2 is found to remove "products and hydrogen overhead as vapor", as required in step "(d)" of claim 1.

1.3.2 D2 discloses at column 12, lines 18 to 35, that the hydrocarbon product of the exemplified hydroprocessing process (i.e. the "PRODUCT" that is withdrawn through conduits 37 and 65) comprises substantial amounts of hydrocarbon fractions with boiling points up to 80°C and from 80°C to 200°C. Any skilled chemist reading D2 would therefore immediately consider that at least the hydrocarbon products with boiling point up to 80°C, but plausibly also several of those boiling between 80°C or 200°C, will necessarily be present in separators 36 and 62 not only in the liquid fractions present at the bottom of these separators and from which the "PRODUCT" is withdrawn, but also as vapour, i.e. in the vapour phase above those liquid fractions. Hereinafter these products of the hydroprocessing process exemplified in D2 will also be referred to as volatile products.

Hence, it is also self-evident for the skilled reader of Figure 1 of D2 that the volatile products must also be present in the "gases" (also undisputedly comprising hydrogen) withdrawn from separator 36 through conduit 39 (see in D2 column 5, lines 59 to 66) and in the "gaseous product" (also undisputedly comprising hydrogen) withdrawn from separator 62 through conduit 42 (see in D2 column 6, lines 70 to 75).

Accordingly, at least the volatile products of the hydroprocessing process of D2 are necessarily present in particular in the stream of conduit 42.

Therefore, and since step "(h)" of present claim 1 does not require any specific amount of "products" (and "hydrogen") in the vapor removed overhead, the separation occurring in separator 62 of D2 is found to remove "products and hydrogen overhead as vapor", as required in step "(h)".

- 1.3.3 For the above reasons, the alleged differences (i) and (ii) between steps "(d)" and "(h)" of claim 1 under consideration and the prior art described in Figure 1 of D2 are found not existing.

- 1.4 As to the further alleged differences (iii) and (iv), the appellant correctly stressed that the explicit disclosure provided in D2 only disclosed the presence of unconverted material in conduit 29 and the presence of slurry catalyst in conduit 20.
 - 1.4.1 The board notes that neither claim 1 of the main request nor the reminder the application provide any definition of the "liquid bottoms stream" withdrawn from the first and second separators in steps "(d)" and "(h)" or of the "unconverted material" present in these streams. In particular, the claim's wording neither requires these streams to be withdrawn e.g. at the lowest point of the separators, nor that each of these streams must be the sole stream withdrawn at the bottom of each separator. Hence, and since steps "(d)" and "(h)" do not require any specific amount of "unconverted material" and "slurry catalyst" in the respective "liquid bottoms stream"s, in these steps of the claimed process the "liquid bottoms stream" can be any partially liquid mixture comprising detectable amounts of "unconverted material and slurry catalyst" that can be withdrawn near the bottom of the

separators, whereby the "unconverted material" can be any hydrocarbon that can still be hydroprocessed.

In the prior art disclosed in D2, it is apparent and undisputable that both the catalyst slurry and the hydrocarbon liquids present in the mixtures fed to separators 28 and 62, must move downwards to the bottom of these separators, where they tend to spontaneously separate under the action of gravity.

However, for the skilled person already the continuous character of such separation and the diversity in properties of the materials which accumulate at the separators' bottoms, render it evident the impossibility to achieve complete separation between the catalyst slurry and the hydrocarbon liquids present therein, and thus the impossibility to withdraw from these separators any (bottom) stream only consisting of the (aqueous) slurry of the solid catalyst and any (bottom) stream only consisting of the liquid hydrocarbons (and thus of "unconverted materials").

Hence, it is apparent to the skilled reader of Figure 1 of D2 in particular that:

- detectable traces of slurry catalyst must be expected in the liquid (hydrocarbon) fraction continuously formed just above the slurry catalyst fraction, and thus also necessarily withdrawn near to the bottom of separator 28, i.e. through conduit 29, and
- detectable traces of the liquid (hydrocarbon) fraction must be expected in the slurry catalyst fraction withdrawn near the bottom of separator 62, i.e. through conduit 20 (and valve 66).

Therefore, the separations occurring in separator 28 and in separator 62 of Figure 1 of D2 are respectively found to remove "*unconverted material and slurry catalyst as liquid bottoms stream*" via conduit 29, and to pass to further processing "*the liquid bottoms streams comprising unconverted material and slurry catalyst*" via conduit 20, as required in steps "(d)" and "(h)" of claim 1 under consideration.

1.4.2 For the above reasons, the alleged differences (iii) and (iv) between steps "(d)" and "(h)" of claim 1 under consideration and the prior art described in Figure 1 of D2 are also found not existing.

1.5 As to the last alleged difference (v), the appellant stressed that, contrary to the finding of the examining division, the stream of conduit 48 of Figure 1 of D2 could not represent the "*additional feed oil*" described in step "(e)" of claim 1 of the main request. This stream was only described in D2 as "hydrogen-containing recycle gas" with 75 vol.% of hydrogen (see D2, column 6, lines 26 to 30 and column 11, lines 59 to 66). Moreover, even in the hypothetical case that low boiling hydrocarbons were possibly present in the stream transported by conduit 48, such material would not be a "*heavy oil*", as defined at the end of claim 1. In the appellant's view, an "*additional oil feed*" was necessarily made of the compounds encompassed by the definition of "*heavy oil*" at the end of the same claim, definition which would also apply to the initial "*heavy oil feed*" used in step "(a)". For the skilled person the expression "*heavy oil*" would manifestly imply high boiling points of that ingredient, and thus exclude the possibility that the "*additional feed oil*" of step "(e)" of claim 1 could be made of clearly low-boiling hydrocarbons (such as, for instance, the olefin 1-

hexene). To support this argument the appellant also provided T1 as evidence of the high viscosity and boiling point characteristics conventionally associated to the term "heavy oil". In the appellant's view, a skilled person would consider these properties implied in the material listed as "heavy oil" at the end of claim 1 (and thus also implied in the "olefins" that can be considered "heavy oil").

- 1.5.1 The board stresses preliminarily that, as already indicated above, conduit 29 withdraws "*unconverted material and slurry catalyst as liquid bottoms stream*" from separator 28 of Figure 1 of D2, and volatile hydrocarbon products with boiling point up to 80°C, but plausibly also several of those boiling between 80°C or 200°C, are present as vapour in separators 36 and 62 of Figure 1 of D2 and, thus, also are part of the overhead streams withdrawn by conduits 39 and 42, which are then joined, treated with water (to remove ammonia and H₂S in scrubber 43), compressed in compressor 45 and then fed to line 48.

Hence, the combination (just below the reactor 51 in Figure 1 of D2) of the hydrogen gas stream carried by conduit 48 with the liquid withdrawn from the separator 28 and going through conduit 29 also combines liquid bottoms of the first separator with additional feed oil.

Thus, and since in present claim 1 the step "(e)" does not impose any limit as to the minimum amount of "*additional feed oil*" to be used, the combinations of the streams of conduits 29 and 48 in Figure 1 of D2 is found in accordance with step "(e)" of claim 1 of the main request.

1.5.2 The board stresses further that the wording of this step does not impose any restriction as to how the required "combination" has to be carried out. In particular, step "(e)" does not require or imply the use of a (pure) stream of "*additional feed oil*", nor does it exclude the presence of other materials taking part in this mixing step.

Hence, the skilled person would consider the combination required in step "(e)" of claim 1 to be present in the process depicted in Figure 1 of D2, in spite of the fact that in this prior art the "*additional feed oil*" is fed with a stream mostly made of hydrogen, because as long as stream 48 comprises substantial amounts of materials that can be considered "*additional feed oil*", any mixing of such a stream with the bottoms transported by conduit 29 will inevitably produce a combination as required in step "(e)".

1.5.3 Finally, the board too finds that the skilled reader of claim 1 can only reasonably conclude that the "*additional feed oil*" of step "(e)" can only be any of the materials encompassed by the broad definition of "*heavy oil*" at the end of claim 1.

1.5.4 The board further notes that T1 only reports a meaning (see the sentence on page 3, lines 6 to 8 starting with: "*[i]n this classification ...*", emphasis added by the board) conventionally attributed to the expression "*heavy oil*" in the context of crude oils. Hence, T1 at most allows to identify a conventional meaning of the term "*heavy crude oil*" also present in the group of materials listed at the end of claim 1 at issue. Such conventional meaning does not allow however to attribute a clear meaning to the expression "*heavy oil*" for the other classes of materials listed at the end of

claim 1, different from "heavy crude oil". In other words, the information in T1 does not allow to identify which "deasphalted oils", "olefins", "oils derived from tar sands or bitumen", "oils derived from coal" or "synthetic oils from Fischer-Tropsch processes" are "heavy oils" in the sense of claim 1, and which are not.

Accordingly, and in the absence in the application of any clear definition of the expression "heavy oil", the skilled reader of present claim 1 can only conclude that this expression does not result in any clear limitation as to the nature of this ingredient.

Therefore, the skilled person must conclude that not only low boiling "olefins" but also any other low boiling hydrocarbons (in particular paraffins and olefins) that can result from "Fischer-Tropsch processes" or from deasphalting oils, or that can even be "derived" from "coal" or from "tar sands or bitumen" may also be "heavy oil"s in the sense of claim 1.

Of course such broad construction of the vague expression "heavy oil" also applies to the term "additional feed oil" used in step "(e)" of claim 1.

Thus, the board sees no reason for excluding the possibility that the "additional feed oil" to be used in step "(e)" might as well be formed of low boiling hydrocarbons, such as the volatile products present in the stream of conduit 48 of Figure 1 of D2.

- 1.5.5 For the above reasons, the alleged difference (v) between step "(e)" of claim 1 at issue and the prior art described in Figure 1 of D2 is thus also found not existing.

1.6 Accordingly, the board sees no reason to reverse the finding of the examining division that the subject-matter of claim 1 of the main request is anticipated by this prior art and that this request does not comply with the requirements of Article 54 EPC.

2. *Auxiliary requests 1 to 3 - Novelty*

The examining division found the subject-matter of each version of claim 1 according to auxiliary requests 1 to 3 to lack novelty for substantially the same reasons given in respect of claim 1 of the main request.

The board too finds in particular that the differences in wording respectively distinguishing each version of claim 1 according to these requests from claim 1 of the main request (see III above) do not deprive of relevance any of the reasons given above for the finding that claim 1 of the main request is anticipated by process depicted in Figure 1 of D2, nor introduce new features that are not present in this prior art (whose hydroprocessing conditions are described in particular in column 4, lines 41 to 49 of D2 and in which the reactors are manifestly liquid recirculating reactors).

Since the appellant did not identify any of these differences to result in features absent in the prior art process of D2, no further reason need to be given in this respect.

Thus, the board concurs with the finding of the examining division that the subject-matter of each version of claim 1 of auxiliary requests 1 to 3 is anticipated by the prior art described in Figure 1 of

D2, and thus also these auxiliary requests do not comply with the requirements of Article 54 EPC.

3. *Auxiliary request 4 - Inventive step (Article 56 EPC)*

3.1 The examining division found that the subject-matter of claim 1 of the then pending auxiliary request 6 (identical to auxiliary request 4 now on file) represented an obvious alternative to the prior art disclosed in D2, and thus lacked inventive step.

3.2 The board notes preliminarily that, in view of the reasons given above as to the lack of novelty of claim 1 of the main request over the prior art depicted in Figure 1 of D2, claim 1 of auxiliary request 4 only differs from this prior art for the use of a third slurry hydroprocessing reactor (i.e. for step "(i)" of claim 1 under consideration).

The board also notes that no technical advantage is disclosed in the patent application as descending from the use of a third reactor and that the use of a plurality of subsequent reactors is inherent in the field of hydrocarbon hydroprocessing.

Hence the board finds it convincing the examining division's reason 5.4 (see page 17 of the appealed decision) that "*a third conversion step is present in D2 through the recycling of the products of the second reactor to the first reactor and that the reactors of claim 1 are not further characterized. They could actually be the same reactors. Hence, the skilled person has a clear incitation in D2 to modify the process*".

3.3 In the appellant's view, this reasoning would be erroneous since the conversions steps carried out in the two reactors of D2 would be different. Moreover, if a third reactor was added in Figure 1 of D2, it would interrupt conduit 20, and thus prevent the delivery of any catalyst to the first reactor (16).

3.4 The board finds however that even if the processes occurring in reactors 16 and 56 of Figure 1 of D2 are to some extent different, they remain hydroprocessing steps (in view of the fact that they both contribute to generate the "PRODUCT" that is finally collected through conduits 38 and 64 in combination).

Moreover, a skilled person would not regard as particularly problematic to interpose a third reactor along line 20, as the most obvious way to perform such modification of the prior art is by also adjoining to the third reactor a corresponding separator of its effluents (indeed each of the reactors of Figure 1 of D2 feeds its effluents to a separator). It is self-evident that the addition of a third reactor (e.g. identical to reactor 56) and a third separator (e.g. identical to separator 62) along conduit 20 of Figure 1 of D2 would also allow to maintain the recycling of the slurry catalyst to the first reactor.

3.5 Thus, the board finds it unconvincing the appellant's submission contrary to the finding of the examining division that the subject-matter of claim 1 according to auxiliary request 4 lacks an inventive step over D2.

The present auxiliary request 4 is therefore found to contravene Article 56 EPC and, thus, not allowable.

4. As none of the set of claims on file complies with the EPC, the appeal does not succeed. Hence, there is also no reason for the board to consider appellant's request of reimbursement of the appeal fees due to an alleged procedural violation (see Rule 103(1) (a) EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



A. Pinna

J.-M. Schwaller

Decision electronically authenticated