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(71) Applicant: **HALDOR TOPSØE A/S** [DK/DK]; Haldor Topsøes Allé 1, 2800 Kgs. Lyngby (DK).

(72) Inventors: **KNUDSEN, Arne**; Holsteinsgade 11, 1.th, 2100 Copenhagen Ø (DK). **NIELSEN, Jan Due**; c/o Haldor Topsøe A/S, Haldor Topsøes Allé 1, 2800 Kgs. Lyngby (DK). **MENJON, Ian**; Rønnegade 14, 5th, 2100 Copenhagen Ø (DK).

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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(54) Title: HEAVY GASOLINE SEPARATION

(57) Abstract: The present relates to a plant and a process for treating raw gasoline, said process comprising the steps of (1) In a first splitter separating a raw gasoline stream into at least a first light fraction, a first durene rich fraction and a heavy gasoline fraction, and (2) In a second splitter separating the first durene rich fraction into a second light fraction and a second durene rich fraction.

Title: Heavy gasoline separation

In the MTG processes, raw gasoline, light ends, LPG and water are produced from methanol. The majority of the raw gasoline is already within the gasoline range with relatively good product properties, but some fraction is too heavy or contains too much durene and therefore it needs to be treated.

Treatment of the raw gasoline may be achieved by a process for treating raw synthetic gasoline, said process comprising the steps of

- In a first splitter separating a raw gasoline stream into at least a first light fraction, a first durene rich fraction and a heavy gasoline fraction, and
- In a second splitter separating the first durene rich fraction into a second light fraction and a second durene rich fraction.

By splitting the first durene rich fraction in a second splitter it is possible to have detailed control of the composition of the second durene rich fraction. Depending on the use and further treatment of the second durene rich fraction in may be highly advantageous to have a reduced content of light gasoline in the second durene rich fraction.

The first light fraction may be ready for blending in the gasoline product pool.

The present setup with the second splitter may advantageously be applied in relation to a gasoline upgrading unit

(GUU) i.e. where the second durene rich gasoline fraction is sent to a gasoline upgrading unit in which the second durene rich fraction is upgraded to an upgraded product stream. If light gasoline is sent to the GUU it may negatively contribute to a lover product yield and a higher gas/LPG yield due to cracking/de-alkylation reactions in the GUU. Therefore the second splitter and separation of the first durene rich fraction into a second durene rich fraction and second light fraction is advantageously applied as it ensures that a good separation is achieved and an optimized stream (second durene rich fraction) is send to the GUU.

From the GUU an upgraded product stream and a third LPG stream is withdrawn.

In the GUU the durene content may be reduced and the octane number increased in the upgraded product stream compared to the second durene rich gasoline fraction. Reduced durene content and/or increased octane number may be an advantage as durene may negatively influence cloud point and increased octane number may provide a better fuel.

In several embodiments the durene rich gasoline fraction is subject to isomerization, (mild) hydrotreatment and/or (mild) hydrocracking in the gasoline upgrading unit (GUU).

A stabilization step (such as mild hydrocracking) may also take place in the GUU. Stabilization may e.g. be carried out by stripping (e.g. with steam, N_2, LPG) and/or by distillation in the GUU.

I.e. the GUU may comprise at least one reaction step and at least one stabilization step.

The first splitter comprises a number of stages for example 5 - 50 stages, such as 10 - 30 stages, such as 15 - 20 stages. More stages provide a more refined separation and fewer stages results in a more crude separation which for example may result in more light components in the heavy fraction and/or the need to recycle more heavy components separated from the first light fraction to the first splitter.

Preferably, the first durene rich stream is separated from the first splitter in the rectification zone. For example the first durene rich fraction may be separated from the first splitter in a centre zone of the splitter such as at or near one or more middle stages. If e.g. the first splitter comprises 16 stages, the first durene rich stream may be separated near the 6^{th} - 10^{th} stage, such as by the 8^{th} stage.

By selecting the point of separation from the first splitter it is possible to adjust the composition of the first durene rich fraction.

If the first durene rich stream is separated from the first splitter in order to maximize 1,2,4-trimethylbenzene and/or durene in the second durene rich stream sent to the GUU it may be possible to optimize its operation.

Also the first durene rich stream may be separated from the first splitter in order to minimize the concentration of

xylenes since xylenes may de-alkylate in an isomerization reactor which entails a yield loss.

Thus, the present invention may advantageously be used in relation to synthetic raw gasoline as the composition of the synthetic raw gasoline may be well known whereby the specific components to be separated from the first splitter into the first durene rich stream can be selected as described above.

In some embodiments the heavy gasoline constitutes a no sulfur fuel.

The present application also relates to a plant for treating raw gasoline comprising

- A first splitter wherein raw gasoline is separated into a light fraction, a durene rich gasoline fraction and a heavy gasoline fraction
- A second splitter wherein the durene rich gasoline fraction is separated into a second light fraction and a second durene rich stream
- A GUU for upgrading the second durene rich stream into a upgraded product.

The plant may further be arranged so that the first durene rich stream is separated from the first splitter in order to maximize 1,2,4-trimethylbenzene and/or durene and/or in order to minimize the concentration of xylenes in the second durene rich stream sent to the GUU.

Thus, according to the present process and plant the second durene rich fraction is sent to the gasoline upgrading unit

(GUU), thus minimizing the LPG production and allowing a better control of the final boiling point of the final product.

The invention is further illustrated in the drawings

Fig. 1 illustrates the process flow and simplified plant layout.
Fig. 2 Illustrates Concentration curves in the first splitter.

The drawings are exemplary and are not to be construed as limiting to the invention.

Figure 1 illustrates the process flow and plant. The stabilized gasoline [1] is separated in a first gasoline splitter distillation column [11] into a first light fraction (IBP ~ 165°C) [5] which is ready for product blending, a first durene rich fraction (138- 198°C) [8] and a heavy gasoline fraction (195 - 260°C) [9].

The gas phase (first light fraction) leaves the overhead [2] and is condensed [12] and recovered [13]. A reflux pump [14] is typically used to return the liquid to the column [4] and/or to send the first light gasoline fraction to storage and/or blending.

If light gasoline is sent to the GUU [18] it may negatively contribute to a higher gas/LPG yield due to cracking and/or de-alkylation reactions, therefore a second splitter (side column) [15] ensures that a good separation is achieved. A

reboiler [17] supplies the heat input for the separation in the gasoline splitter.

The first durene rich fraction [6], which typically constitutes a ~25 wt% of the stabilized gasoline, is sent to a second splitter (side column) where the gas phase [7] is returned to the first splitter and a second durene rich fraction is taken from the bottom. A reboiler [16] may be used to supply the necessary heat input to drive the separation.

The second durene rich fraction is sent to a GUU where durene content is reduced and/or octane number (RON, MON) is increased.

In the GUU Durene may be isomerized to other types of tetra-methlybenzenes and/or de-alkylate to trymethyl benzenes. Tri methylbenzenes may be isomerized to other types of trimethylebenzenes and/or de-alkylate to xylenes and/or toluene and/or benzene. Gases may be produced as a consequence (C1-C4).

The heavy gasoline fraction may e.g. be used as a no-sulfur fuel or sent to post treatment.

Fig 2 illustrates where the first durene rich fraction may be taken from the first separator based on the concentrations of various components. The curves are normalised and the values on the x-axis is tray number, i.e. the present example is for a 16 tray column. Concentration curves are indicated by A, B, C. For example the first durene rich stream may advantageously be separated from the first

splitter at or near (e.g. +/- 1 or +/- 2) the 8th tray, as this point may result in a first durene rich fraction which is relatively low in Xylenes (A) while containing a substantial amount of the desired components (B, C) for example tetra-methlybenzenes (incl. durene) and 1,2,4-trimethylbenzene.

Claims

1. Process for treating raw gasoline, said process comprising the steps of
   - In a first splitter separating a raw gasoline stream into at least a first light fraction, a first durene rich fraction and a heavy gasoline fraction, and
   - In a second splitter separating the first durene rich fraction into a second light fraction and a second durene rich fraction.

2. Process for treating raw gasoline according to claim 1 wherein the first light fraction is ready for blending.

3. Process for treating raw gasoline according to any of the preceding claims, wherein the second durene rich gasoline fraction is sent to a gasoline upgrading unit wherein the second durene rich fraction is upgraded to an upgraded product.

4. Process for treating raw gasoline according to any of the preceding claims, wherein the durene content is reduced and the octane number increased in the upgraded product stream compared to the second durene rich gasoline fraction.

5. Process for treating raw gasoline according to any of the preceding claims, wherein the second durene rich gasoline fraction is subject to isomerization, (mild)

hydrotreatment and/or hydrocracking in the gasoline upgrading unit.

6. Process for treating raw gasoline according to any of the preceding claims, wherein the first durene rich stream is separated from the first splitter in order to maximize 1,2,4-trimethylbenzene and/or durene in the second durene rich stream sent to the GUU.

7. Process for treating raw gasoline according to any of the preceding claims, wherein the first durene rich stream is separated from the first splitter in order to minimize the concentration of xylenes in the second durene rich stream sent to the GUU.

8. Process for treating raw gasoline according to any of the preceding claims, wherein the heavy gasoline constitutes a no sulfur fuel.

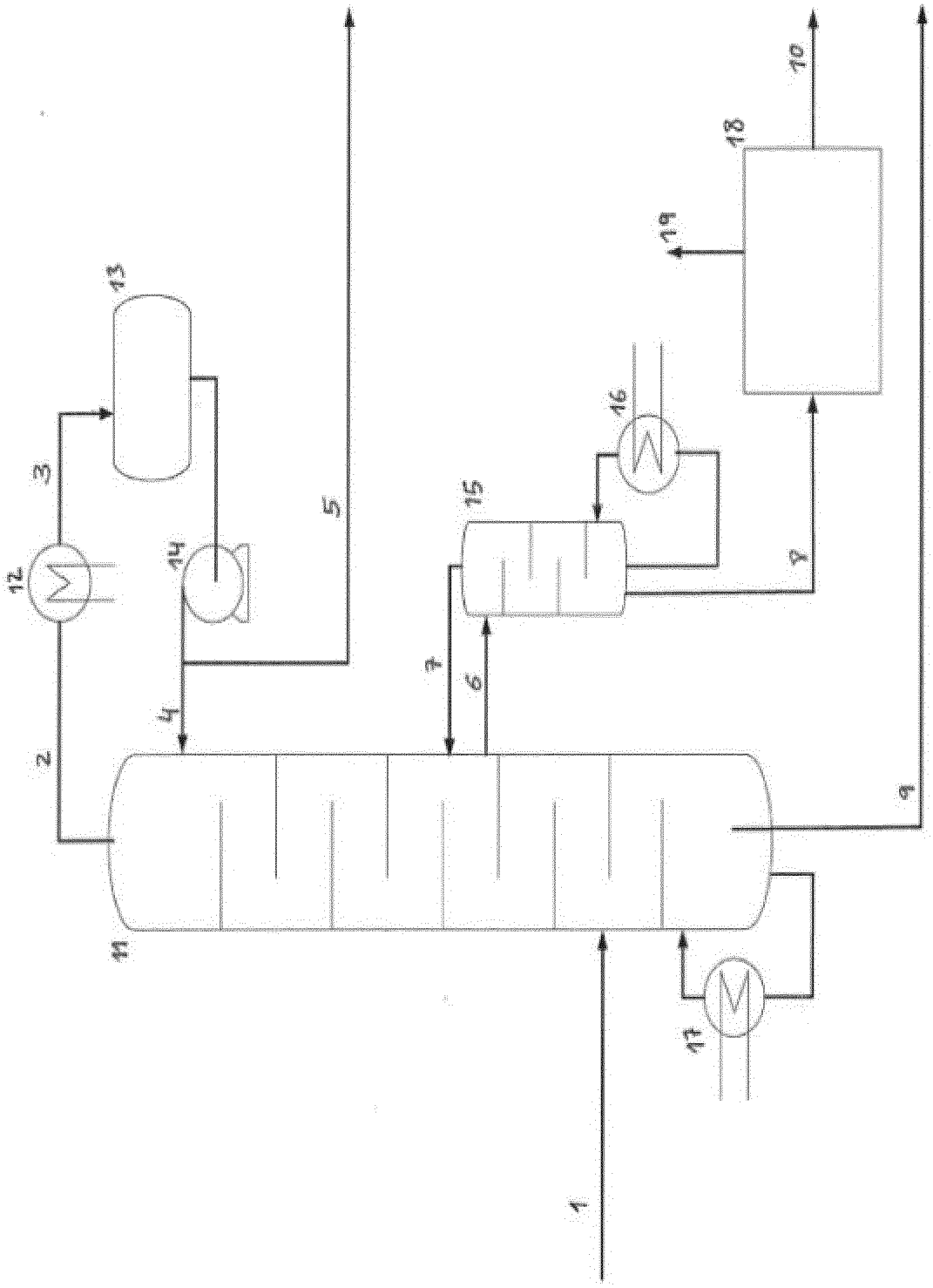
9. Plant for treating raw gasoline comprising
- A first splitter wherein raw gasoline is separated into a first light fraction, a first durene rich fraction and a heavy gasoline fraction
- A second splitter, wherein the first durene rich gasoline fraction is separated into a second light fraction and a second durene rich fraction
- A GUU for upgrading the second durene rich fraction into an upgraded product.

10. A plant according to claim 9, wherein the first durene rich steam is separated from the first split-

ter in order to maximize 1,2,4-trimethylbenzene and/or durene in the second durene rich stream sent to the GUU.

11. A plant according to claim 9 or 10, wherein the first durene rich stream is separated from the first splitter in order to minimize the concentration of xylenes in the second durene rich stream sent to the GUU.

Fig. 1



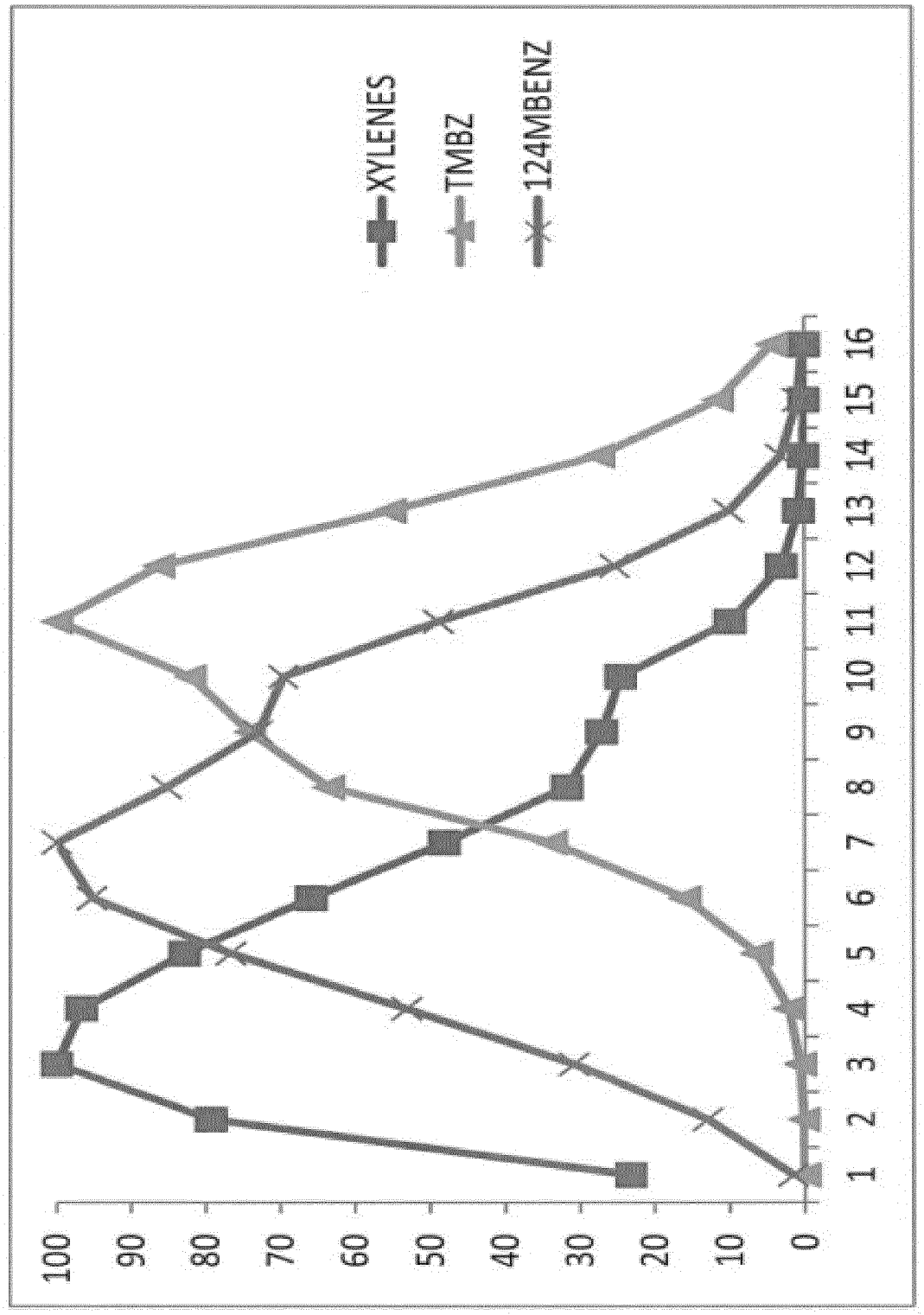

XYLENES
TMBZ
124MBENZ
100
90
80
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. C10G7/00 C10G45/02 C10G45/58 C10G47/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C10G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 4 304 951 A (GARWOOD WILLIAM E ET AL) 8 December 1981 (1981-12-08) column 2, lines 5-18	1-8
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Y	page 2, left-hand column, lines 9-49; figure 1	1-8
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Y	page 4, lines 63-84; figure XII	1-8

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	figure 1 claims 1-3	1-8

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A	figure 1 claims 1-16	1-8

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/059503

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