

Integrated process for simultaneous preparation of alkali metal methoxides

In a first aspect, the present invention relates to an integrated process for simultaneously preparing n mixtures $P(i)$ comprising alkali metal methoxide and methanol, the process comprising preparing the one or more alkali metal methoxides in n reactive distillation columns $K(i)$ under reactive distillation conditions from n streams $H(i)$ and n streams $G(i)$ comprising methanol, thereby obtaining n top streams $W(i)$ comprising methanol and water; and obtaining n bottoms streams $P(i)$ comprising alkali metal methoxide $A(i)OMe$ and methanol; the process further comprising preparing at least three streams G , $T(1a)$ and $T(1b)$ from a vapor phase V from the top of a rectification column D , wherein at least a part of the stream $T(1a)$ is passed as a heating medium through an intermediate reboiler $V(1a)$ of the rectification column D , obtaining a stream $T_c(1a)$, and at least a part of the stream $T(1b)$ is passed as a heating medium through a bottom reboiler $V(1b)$ of the rectification column D , obtaining a stream $T_c(1b)$, wherein one or more of at least a part of one or more of the top streams $W(i)$, at least a part of the stream $T_c(1a)$, and at least a part of the stream $T_c(1b)$ are fed (back) into the rectification column D .

In a second aspect, the invention relates to a chemical production unit for carrying out the process according to the first aspect; and a third aspect of the invention is related to the use of the chemical production unit according to the second aspect or of the process according to the first aspect for simultaneously producing n mixtures $P(i)$ comprising alkali metal methoxide and methanol.

State of the art

In the prior art, processes are described wherein a mixture comprising an alkali metal alkoxide and methanol is prepared in a reactive distillation column from a methanol stream and an aqueous stream which comprises a dissolved alkali metal hydroxide. According to these processes, the methanol stream fed into the reactive distillation column is prepared by separating methanol from water in a distillation column upstream of the reactive distillation column and using the respectively obtained methanol to the reactive distillation column. In this respect, reference is made, for example, to US 2002/0183566 A1, US 2008/0296786 A1, or WO 2013/168113 A1. However, according to the teaching of these prior art documents, only one specific mixture comprising alkali metal methoxide and methanol could be produced.

WO 2021/148174 A1 refers to a process for simultaneously preparing two mixtures comprising sodium metal alkoxide and potassium metal alkoxide as well as methanol, wherein a single dis-

tillation column D is employed for generating a methanol stream which is then used as a methanol source for two parallel downstream reactive distillation columns in which the two different mixtures comprising alkali metal alkoxide and methanol are simultaneously prepared.

5 WO 2022/263032 A1 also discloses a process for simultaneously preparing two mixtures comprising alkali metal alkoxide and methanol in separate reactive distillation columns with one distillation column for methanol. Therein, serial connected compressors are required for a multiple
10 step compression of a vapor phase comprising methanol, initially taken from the rectification column, wherein the resulting multiple compressed phase is then used for providing energy to an intermediate reboiler and a bottom reboiler of the rectification column.

WO 2022/117803 A1 discloses a process for simultaneously preparing two or more mixtures comprising alkali metal alkoxide and methanol, wherein a single distillation column D is employed for generating a methanol stream which is then used, after a suitable dividing into two or
15 more substreams, as a methanol source for two or more parallel downstream reactive distillation columns in which two or more different mixtures comprising alkali metal methoxide and methanol are simultaneously prepared. Therein, a part stream of a vapor phase comprising methanol and taken at the top of the rectification column D, is compressed and used as heating medium for an intermediate reboiler of the rectification column D, thus covering the energy demand of
20 said intermediate reboiler.

However, there is still a need for improvement, both in terms of energy demand and in terms of apparatus costs.

25 Therefore, it was an object of the present invention to provide an economically advantageous process for simultaneously preparing two or more mixtures comprising alkali metal hydroxide and methanol. It was a further object of the present invention to provide a process for preparing two or more mixtures comprising alkali metal hydroxide and methanol which allows for a reduction of the demand of external energy.

30 Surprisingly, it was found that these objects can be solved by a process according to which a single rectification column is used, the intermediate reboiler and bottom reboiler thereof being provided with energy from stream(s) prepared from a vapor phase comprising methanol taken from the rectification column, using at least two compression units, wherein at least a part of a
35 stream after having passed the first compression unit is used as heating medium for an intermediate reboiler of the rectification column, in combination with at least a second compression unit,

the stream coming therefrom being used as heating medium for a bottom reboiler of the rectification column. This approach allows a significant reduction of demand of external energy (heating steam, H_2O_{gaseous}) required for the rectification column.

- 5 In a first aspect, the invention thus relates to an integrated process for simultaneously preparing n mixtures P(i) comprising alkali metal methoxide and methanol, comprising providing n reactive distillation columns K(i);
providing n aqueous liquid streams H(i), a given stream H(i) comprising a dissolved alkali metal hydroxide A(i)OH, wherein n is an integer with $n \geq 2$ and $i = 1 \dots n$; and
- 10 providing a rectification column D comprising at least one intermediate reboiler V(1a) and at least one bottom reboiler (V1b);
providing a first compression unit $C_T(1)$, a second compression unit $C_T(2)$ and at least one further compression unit C_G ;
wherein the process comprises preparing the one or more alkali metal methoxides in the n reactive distillation column K(i) under reactive distillation conditions from the n streams H(i) and n
- 15 streams G(i) comprising methanol, thereby obtaining n top streams W(i) comprising methanol and water; and obtaining n bottoms streams P(i) comprising alkali metal methoxide A(i)OMe and methanol;
the process further comprising
- 20 (a) obtaining a vapor phase V comprising methanol at the top of the rectification column D, said vapor phase V having a pressure p_V and a temperature T_V ;
- (b) preparing at least three streams from the vapor phase V, said at least three streams comprising a vapor stream G having a pressure p_G and a temperature T_G with $p_G = p_V$ and $T_G = T_V$, and further comprising two streams T(1a) and T(1b), said stream T(1a) having a
- 25 pressure $p_{T(1a)}$ and a temperature $T_{T(1a)}$ with $p_{T(1a)} > p_V$ and $T_{T(1a)} > T_V$ and said stream T(1b) having a pressure $p_{T(1b)}$ and a temperature $T_{T(1b)}$ with $p_{T(1b)} > p_V$ and $T_{T(1b)} > T_V$,
wherein for preparing the streams T(1a) and T(1b), the first compression unit $C_T(1)$ and the second compression unit $C_T(2)$ are employed;
- (c) preparing n streams G(i) from the vapor stream G, each of the streams G(i) having a pressure $p_{G(i)}$ and a temperature $T_{G(i)}$ with $p_{G(i)} > p_G$ and $T_{G(i)} > T_G$ for each stream G(i), and feeding each stream G(i) into the respective reactive distillation column K(i), wherein for preparing the n streams G(i), the at least one compression unit C_G is employed;
- 30 (d) passing at least a part of the stream T(1a) as a heating medium through an intermediate reboiler V(1a) of the rectification column D, obtaining a stream $T_{C(1a)}$ having a temperature $T_{Tc(1a)}$ with $T_{Tc(1a)} < T_{T(1a)}$;
- 35 (e) passing at least a part of the stream T(1b) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_{C(1b)}$ having a temperature $T_{Tc(1b)}$ with $T_{Tc(1b)} < T_{T(1b)}$;

- (f) feeding one or more of
- (f.1) at least a part of one or more of the top streams $W(i)$,
- (f.2) at least a part of the stream $T_c(1a)$, and
- (f.3) at least a part of the stream $T_c(1b)$

5 into the rectification column D.

Feeding of at least a part of the stream $T_c(1a)$ into the rectification column D according to (f.2) is preferably done as explained in more detail herein below, and also feeding at least a part of the stream $T_c(1b)$ into the rectification column D according to (f.3) is preferably done as explained

10 in more detail herein below.

In some preferred embodiments of the process, preparing the at least three streams according to (b) comprises

- (b.1) splitting the vapor phase V into at least two vapor streams comprising the stream G and a vapor stream $T(1)$ having a pressure $p_{T(1)}$ and a temperature $T_{T(1)}$ with $0.95 \leq p_{T(1)}/p_v \leq$
- 15 1.00;
- (b.2) preparing at least the two streams $T(1a)$ and $T(1b)$ from the vapor stream $T(1)$.

Preferably, at least 90 weight-%, more preferably at least 91 weight-%, more preferably at least 92 weight-%, more preferably at least 93 weight-%, more preferably at least 94 weight-%, of stream $T_c(1a)$ and/or of stream $T_c(1b)$, preferably of stream $T_c(1a)$ and of stream $T_c(1b)$, are in condensed form, based on the total weight of the respective stream being 100 weight-%.

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Rectification column D

- 25 In some preferred embodiments of the process, the rectification column D is operated at a pressure at the top of D p_{TD} in the range of from 0.5 to 10 bar(abs), preferably in the range of from 0.75 to 6 bar(abs), more preferably in the range of from 1 to 5 bar(abs), more preferably in the range of from 1 to 3 bar(abs).
- 30 In some preferred embodiments of the process, the rectification column D is operated at a temperature at the top of D T_{TD} in the range of from 45 to 137 °C, preferably in the range of 49 to 118, more preferably in the range of from 64 to 111 °C, more preferably in the range of from 64 to 95°C.
- 35 In some preferred embodiments of the process, the rectification column D is operated at a reflux ratio of at least 0.5:1, preferably in the range of from 0.55:1 to 1.4:1, more preferably in the range of from 0.6:1 to 1.4:1.

As to the rectification column D, it is preferred that it has from 20 to 100, more preferably from 30 to 80, more preferably from 40 to 60 theoretical stages. Conceivable preferred ranges are, for example, from 40 to 50 or from 45 to 55 or from 50 to 60. Generally, the pressure at the top of the rectification column D can be chosen freely within a wide range with the proviso that the
5 desired separation task is fulfilled.

Preferably, rectification column D comprises one or more internals, preferably selected from the group consisting of tray, unstructured (random) packing, structured packing and mixtures of two or more thereof. A tray is preferably selected from the group consisting of bubble tray, sieve
10 tray, valve tray, tunnel tray, slot tray and mixtures of two or more thereof. An unstructured packing is preferably selected from the group consisting of Raschig rings, Pall rings, Berl saddles, Intalox saddles and mixtures of two or more thereof. Structured packings are sold, for example, under the trade name Mellapack® from Sulzer. In addition to the internals mentioned, other suitable internals are known to those skilled in the art and can also be used. If structured packings or unstructured packings are contained in the rectification column, these can be divided or there
15 can be one continuous packing.

Rectification column D with top vapor recompression

In some preferred embodiments of the process, the rectification column is operated with top vapor
20 recompression. Preferably, realizing the reflux ratio comprises preparing from the vapor phase V a further vapor stream T(2), passing said stream T(2) through a condenser V(2), obtaining a liquid stream T(3) and a waste gas stream T(2w), and feeding the liquid stream T(3) into the top of the rectification column D. Preferably, the waste gas stream T(2w) essentially consists of oxygen, nitrogen, carbon dioxide and methanol, wherein the amount of methanol in
25 T(2w) is preferably in the range of from 2 to 80 weight-%, preferably in the range of from 10 to 30 weight-% based on the total weight of T(2w).

With first and second compression units $C_T(1)$, $C_T(2)$

30 In some preferred embodiments of the process, (b.2) comprises splitting vapor stream T(1) into at least two streams and passing a first part stream of T(1) through the first compression unit $C_T(1)$, obtaining T(1a), and passing a second part stream of T(1) through the second compression unit $C_T(2)$, obtaining T(1b).

35 In some preferred embodiments of the process, (b.2) comprises passing vapor stream T(1) through the first compression unit $C_T(1)$, obtaining T(1a); and passing a part of T(1a) through the second compression unit $C_T(2)$, obtaining T(1b).

The ratio of the heat flow rate of T(1a) to the heat flow rate of T(1b) $f(T(1a)) / f(T(1b))$ is in the range of from 0 to 12, preferably in the range of from 2 to 8, more preferably in the range of from 3 to 6.

5 *Recirculation of $T_c(1a)$ and/or $T_c(1b)$ into D*

In some preferred embodiments of the process, $T_c(1a)$ and/or $T_c(1b)$, preferably $T_c(1a)$ and $T_c(1b)$, each at least partially, is/are fed to a first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas
10 stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) in depressurized form, obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

In particular in view of overall energy consumption topics, the rectification column D is operated
15 with top vapor recompression. Reference is made, for example, to the schematic overview in Figure 1 showing a process according to the present invention with reflux. When the rectification column is operated with top vapor recompression, it is also preferred that realizing the reflux ratio comprises using 2 condensers, V(2) and V(3), as described below in that

- (i) in addition to the at least three streams G, T(1a) and T(1b), which are prepared from the
20 vapor phase V, preparing a further stream T(2) from the vapor phase V and passing said stream T(2) through the condenser V(2), obtaining a liquid stream T(2l) and a gas stream T(2g); passing the gas stream T(2g) through the condenser V(3), obtaining a liquid stream T(2gl) and a waste gas stream T(2w); and combining the liquid streams T(2l) and (T2gl) in a second condensate drum CD(2) in depressurized form;
- 25 (ii) feeding $T_c(1a)$ and/or $T_c(1b)$, preferably $T_c(1a)$ and $T_c(1b)$, each at least partially, to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) together with stream T(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) in depressurized form in the second condensate
30 drum CD(2), obtaining from said second condensate drum CD(2) a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

Certainly, as far as step (i) above is concerned, the skilled person may also realize, if need be, said reflux ratio by using more than the 2 condensers V(2) and V(3).

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Preferably, $T_c(1a)$ at least partially is fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined

with the liquid streams T(2l) and (T2g) in depressurized form; and T_c(1b) at least partially is fed to a third condensate drum CD(3), wherein from said third condensate drum CD(3) a gaseous stream T(4) is obtained, which is fed into the top of the rectification column D and/or into the vapor phase V, and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into the vapor phase V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor phase V, and from said condensate drum CD(3) further a liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

Using a set-up with first and second compression units CT(1), CT(2) may result in that not enough stream T(1) is available for working said compression units. This can happen, for example, if the feed flows in the system are cold and the efficiency of the compressors is high. Furthermore, a non-sufficient steam pressure in D may result in back flow of methanol steam from V(2) into the head of D, thus disrupting the process. Using third condensation drum CD(3) with decompression of the condensate allows to have more methanol steam available for T(2), G, T(1) and/or directly in D, thus avoiding a methanol steam shortage in the process.

(Fully) electrified –with C_T(1), C_T(2)

In some preferred embodiments of the process, the n reactive columns K(i) have each a reboiler, preferably bottom reboiler, V_K(i) and wherein (e) comprises

- (e.1) passing at least a first part of the stream T(1b) (T(1b.1)) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream T_c(1b.1) having a temperature T_{Tc(1b.1)} with T_{Tc(1b.1)} < T_{T(1b)};
- (e.2) passing at least a second part of stream T(1b) (T(1b.2)) as a heating medium through at least one bottom reboiler V_K(i) of one of the n reactive distillation column K(i), obtaining a stream T_c(1b.2) having a temperature T_{Tc(1b.2)} with T_{Tc(1b.2)} < T_{T(1b)}.

Passing at least another part of stream T(1b) as a heating medium through all bottom reboilers V_K(i) enables a process wherein no heating medium especially no hot water steam (H₂O_{gaseous}), from other sources is required for operating D and K(i), since all thermal energy needed is generated by the process itself. Only input of compression energy (electrical energy) is required.

When green electricity is used, the integrated process for simultaneously preparing n mixtures P(i) comprising alkali metal methoxide and methanol can thus be carried out CO₂-neutral.

Preferably, stream T_c(1b.2) is fed into the first condensate drum CD(1).

In some preferred embodiments with two reactive distillation columns K(1) and K(2), at least a first part of T(1b.2) is passed to a bottom reboiler V_K(1) of a reactive distillation column K(1) and a second part of T(1b.2) is passed to a bottom reboiler V_K(2) of a reactive distillation column K(2). Preferably, from V_K(1) and V_K(2) each a condensed stream is obtained, wherein these condensed streams, either separately or at least partially combined as T_c(1b.2), are fed into the first condensate drum CD(1).

Preferably, at least a part of T_c(1a) is fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2g) in depressurized form; and T_c(1b.1) and/or T_c(1b.2), preferably T_c(1b.1) and T_c(1b.2), at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream T(4) is obtained, which is fed into the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

Having only CD(1), CD(2) results in a ratio f of the mass flow rate of stream T(1) to the mass flow rate of stream T(2) $f(T(1)) / f(T(2)) > 2000$. This, as indicated above, can result in non-sufficient methanol steam pressure in D, which in turn may result in back flow of methanol steam from V(2) into the head of D, thus disrupting the process. Using additionally the third condensation drum CD(3) with decompression of the condensate allows to have more methanol steam available for the vapor stream V and/or for the stream G and/or for stream T(1) and/or directly in D, thus avoiding a methanol steam shortage in the process. Preferably, $f(T(1)) / f(T(2))$ when the third condensation drum CD(3) is used is < 1000 , preferably < 500 , more preferably < 200 .

With trans alcoholization

In some preferred embodiments of the process, at least one of the n bottoms streams P(i) comprising alkali metal methoxide A(i)OMe and methanol is at least partially fed to a trans alcoholization unit TAU, wherein

- (x) the (part)stream comprising alkali metal methoxide $A(i)OMe$ and methanol is contacted in the trans alcoholisation unit TAU with an alcohol HOX , wherein X represents an alkyl residue selected from the group consisting of C2 to C10 alkyl, preferably C2 alkyl, thereby obtaining a stream $S(1)$ comprising alkali metal alkoxide $A(i)OX$ and alcohol XOH and a stream $S(2)$ comprising methanol;
- (y) removing the stream $S(2)$ comprising methanol from the trans alcoholisation unit TAU, preferably as a liquid stream, more preferably as a liquid top stream; and removing the stream $S(1)$ comprising alkali metal alkoxide $A(i)OX$ and alcohol XOH from the trans alcoholisation unit TAU, preferably as a liquid stream, more preferably as a liquid stream from the lower part of TAU, more preferably as a liquid bottoms stream.

Preferably, the liquid stream $S(2)$ is obtained in that a gaseous stream $S(O)$ is obtained within TAU, which is condensed within TAU, more preferably using an internal condenser.

- Alternatively preferred, the liquid stream $S(2)$ is obtained in that a gaseous stream $S(O)$ is removed from the upper part of TAU, more preferably from the top of TAU and passed through at least one heat exchanger; thereby obtaining from the heat exchanger at least one, preferably liquid, stream $S(2)$ comprising methanol; wherein preferably at least a part of stream $S(2)$ is reintroduced into TAU, preferably in the upper part of TAU, preferably at a feeding point $TAU(S(2))$.

Preferably, at least 90 volume-%, more preferably at least 95 volume-%, of stream $S(2)$ are reintroduced into TAU at feeding point $TAU(S(2))$, wherein preferably, at least a stream $S(2.a)$ comprising methanol is removed from TAU at a position $TAU(S(2a))$, wherein $TAU(S(2a))$ is located below $TAU(S(2))$.

In some preferred embodiments, the stream $S(2)$, at least partially, and/or the stream $S(2.a)$ at least partially, is fed to the rectification column D, either separately or combined with stream M, and/or fed to the reactive distillation column $K(i)$, either separately or combined with stream $M(i)$.

- Preferably, the trans alcoholisation unit TAU has a reboiler, more preferably bottom reboiler, V_{TAU} .

1st option – three parts of T(1b)

- In some preferred embodiments of the process, (e) comprises
- (e.1) passing at least a first part of the stream $T(1b)$ ($T(1b.1)$) as a heating medium through a bottom reboiler $V(1b)$ of the rectification column D, obtaining a stream $T_C(1b.1)$ having a temperature $T_{T_C(1b.1)}$ with $T_{T_C(1b.1)} < T_{T(1b)}$;

- (e.2) passing at least a second part of stream T(1b) (T(1b.2)) as a heating medium through at least one bottom reboiler $V_{K(i)}$ of one of the n reactive distillation column K(i), obtaining a stream $T_{C(1b.2)}$ having a temperature $T_{T_{C(1b.2)}}$ with $T_{T_{C(1b.2)}} < T_{T(1b)}$,
- 5 (e.3) passing at least a third part of stream T(1b) (T(1b.3)) as a heating medium through the bottom reboiler V_{TAU} of the trans alcoholisation unit TAU, obtaining a stream $T_{C(1b.3)}$ having a temperature $T_{T_{C(1b.3)}}$ with $T_{T_{C(1b.3)}} < T_{T(1b)}$.

Preferably, the stream $T_{C(1b.3)}$ is fed into the first condensate drum CD(1).

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In some preferred embodiments of the process, at least a part of $T_{C(1a)}$ is fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2g) in depressurized form; and

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$T_{C(1b.1)}$ and/or $T_{C(1b.2)}$, and/or $T_{C(1b.3)}$, preferably $T_{C(1b.1)}$ and $T_{C(1b.2)}$ and $T_{C(1b.3)}$, at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream T(4) is obtained, which is fed into the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

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2nd option – T(1b) split into T(1b.1) and T(1b.2), T(1b.2) split further into T(1b.2.1) and T(1b.2.2)

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In some preferred embodiments of the process, (e) comprises

- (e.1) passing at least a first part of the stream T(1b) (T(1b.1)) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_{C(1b.1)}$ having a temperature $T_{T_{C(1b.1)}}$ with $T_{T_{C(1b.1)}} < T_{T(1b)}$;
- (e.2.1) splitting a second part of stream T(1b) (T(1b.2)) into at least two sub-streams (T(1b.2.1)) and (T(1b.2.2));
- 35 (e.2.2) passing at least sub-stream (T(1b.2.1)) as a heating medium through at least one bottom reboiler $V_{K(i)}$ of one of the n reactive distillation column K(i), obtaining a stream $T_{C(1b.2.1)}$ having a temperature $T_{T_{C(1b.2.1)}}$ with $T_{T_{C(1b.2.1)}} < T_{T(1b)}$;

(e.2.3) passing at least subs-stream (T(1b.2.2)) as a heating medium through the bottom reboiler V_{TAU} of the trans alcoholisation unit TAU, obtaining a stream $T_c(1b.2.2)$ having a temperature $T_{T_c(1b.2.2)}$ with $T_{T_c(1b.2.2)} < T_{T(1b)}$.

5 Preferably, stream $T_c(1b.2.2)$ is fed into the first condensate drum CD(1).

In some preferred embodiments of the process, at least a part of $T_c(1a)$ is fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and
 10 said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2g) in depressurized form; and
 $T_c(1b.1)$ and/or $T_c(1b.2.1)$, and/or $T_c(1b.2.2)$, preferably $T_c(1b.1)$ and $T_c(1b.2.1)$ and $T_c(1b.2.2)$, at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream T(4) is obtained, which is fed into the top of the rectifica-
 15 tion column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the
 20 liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

3rd option –parts of T(1a)

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In some preferred embodiments of the process, (d) comprises

- (d.1) passing at least a first part of the stream T(1a) (T(1a.1)) as a heating medium through an intermediate reboiler V(1a) of the rectification column D, obtaining a stream $T_c(1a.1)$ having a temperature $T_{T_c(1a.1)}$ with $T_{T_c(1a.1)} < T_{T(1a.1)}$;
 30 (d.2) passing at least a second part of stream T(1a) (T(1a.2)) as a heating medium through the bottom reboiler V_{TAU} of the trans alcoholisation unit TAU, obtaining a stream $T_c(1a.2)$ having a temperature $T_{T_c(1a.2)}$ with $T_{T_c(1a.2)} < T_{T(1a)}$.

Preferably, stream $T_c(1a.2)$ is fed into the first condensate drum CD(1).

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In some preferred embodiments of the process, at least a part of $T_c(1a.1)$ and $T_c(1a.2)$ at least partially are fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being

fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2g) in depressurized form; and
T_c(1b.1) and/or T_c(1b.2), preferably T_c(1b.1) and T_c(1b.2), at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream
5 T(4) is obtained, which is fed into the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in
10 depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

The trans alcoholisation unit TAU preferably comprises at least one reactive distillation column,
15 which is preferably operated at a top pressure in the range of from 0.2 to 10 bar(abs), more preferably at a top pressure in the range of from 0.5 to 3 bar (abs), more preferably at a top pressure in the range of from 0.8 to 2 bar(abs). Preferably, at a given pressure, the bottom temperature of TAU's at least one reactive distillation column is selected so that the alkali metal alkoxide A(i)OX remains dissolved. For example, for XOH being ethanol and A(1)OMe being sodium methanolate, the bottoms temperature of TAU's at least one reactive distillation column is
20 in the range of from 73 to 123 °C (top pressure in the range of from 0.5 to 3 bar (abs)), more preferably in the range of from 85 to 110 °C (top pressure in the range of from 0.8 to 2 bar(abs)), and/or, preferably and, the top temperature of TAU is in the range of from 48 to 95 °C (top pressure in the range of from 0.5 to 3 bar (abs)), more preferably in the range of from 58 to
25 83 °C (top pressure in the range of from 0.8 to 2 bar(abs)). Preferably, TAU's at least one reactive distillation column comprises in the range of from 20 to 200 overall theoretical stages (OTS), more preferably in the range of from 30 to 100 overall theoretical stages (OTS).
Preferably, TAU's at least one reactive distillation column comprises fillings and/or packings and/or trays. Fillings are preferably selected from the group consisting of Raschig ring (a hollow
30 cylinder), Pall ring, Hiflow ring and Intalox saddle, made from, for example, glass, ceramic, metal and/or plastics. Packings are preferably structured packings. Preferably, TAU comprises one or more tray(s) selected from the group consisting of sieve tray, bell tray or valve tray, tunnel tray and Thormann® tray. Preferably, the upper part (the reinforcement part) of TAU's at least one reactive distillation column comprises packings, and the lower part of TAU's at least
35 one reactive distillation column, preferably the part of TAU's at least one reactive distillation column below the feeding point of the at least one of the n bottoms streams P(i), comprises trays. Preferably, the at least one of the n bottoms streams P(i) comprising alkali metal methoxide A(i)OMe and methanol is at least partially fed to a trans alcoholisation unit TAU's at least one

reactive distillation column at a position in the middle part of TAU's at least one reactive distillation column, preferably at a theoretical stage in the range of from 0.3 x OTS to 0.7 x OTS, more preferably in the range of from 0.4 x OTS to 0.6 x OTS, each preferably counted from the bottom of TAU's at least one reactive distillation column.

5

TAU's at least one reactive distillation column has preferably a sump circulation; for details, reference is made to WO 2021/122702 A1.

10 Preferably, the steps (x), (y) as described herein above refer to TAU's at least one reactive distillation column. Further details of trans alcoholisation unit TAU and TAU's at least one reactive distillation column respectively are as disclosed for the reactive distillation column in WO 2021/122702 A1.

With a third compression unit $C_T(3)$

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In some preferred embodiments of the process, a providing a third compression unit $C_T(3)$ is provided, wherein (b) comprises preparing at least four streams from the vapor phase V, said at least four streams comprising vapor stream G, stream T(1a), stream T(1b), and a further stream T(1c), said stream T(1c) having a pressure $p_{T(1c)}$ and a temperature $T_{T(1c)}$ with $p_{T(1c)} > p_V$ and
20 $T_{T(1c)} > T_V$, wherein for preparing the stream T(1c), the third compression unit $C_T(3)$ is employed.

In some preferred embodiments, preparing the at least four streams according to (b) comprises splitting the vapor phase V into at least two vapor streams comprising the stream G and a vapor stream T(1) having a pressure $p_{T(1)}$ and a temperature $T_{T(1)}$ with $0.95 \leq p_{T(1)}/p_V \leq 1.00$; and preparing at least the three streams T(1a), T(1b) and T(1c) from the vapor stream T(1). Said preparing at least the three streams T(1a), T(1b) and T(1c) from the vapor stream T(1) comprises
25 in some preferred embodiments a splitting of T(1) into at least two streams; passing a first part stream of T(1) through $C_T(1)$, obtaining T(1a), and passing a second part stream of T(1) through the second compression unit $C_T(2)$, obtaining T(1b), and splitting T(1a) into at least two streams and passing a part stream of T(1a) through the third compression unit $C_T(3)$, obtaining T(1c).
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In some alternatively preferred embodiments, said preparing at least the three streams T(1a), T(1b) and T(1c) from the vapor stream T(1) comprises splitting T(1) into at least two streams; passing a first part stream of T(1) through $C_T(1)$, obtaining T(1a), and passing a second part stream of T(1) through the third compression unit $C_T(3)$, obtaining T(1c); and splitting T(1a) into
35 at least two streams and passing a part stream of T(1a) through the second compression unit $C_T(2)$, obtaining T(1b).

In some other alternative preferred embodiments, said preparing at least the three streams T(1a), T(1b) and T(1c) from the vapor stream T(1) comprises splitting vapor stream T(1) into at least three streams; passing a first part stream of T(1) through the first compression unit C_T(1), obtaining T(1a), passing a second part stream of T(1) through the second compression unit
 5 C_T(2), obtaining T(1b), and passing a third part stream of T(1) through the third compression unit C_T(3), obtaining T(1c).

In some other alternative preferred embodiments, said preparing at least the three streams T(1a), T(1b) and T(1c) from the vapor stream T(1) comprises passing T(1) through the first compression unit C_T(1), obtaining T(1a); splitting T(1a) into at least three part streams, passing a
 10 part stream of T(1a) through the second compression unit C_T(2), obtaining T(1b), and passing a part stream of T(1a) through the third compression unit C_T(3), obtaining T(1c).

Recirculation of T_c(1a) and/or T_c(1b) into D

15 In some preferred embodiments of the process, T_c(1a) and/or T_c(1b), preferably T_c(1a) and T_c(1b), each at least partially, is/are fed to a first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined
 20 with the liquid streams T(2l) and (T2gl) in depressurized form, obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

In "depressurized form" regarding the liquid streams T(1l), T(2l) and (T2gl) and the combined stream respectively means that these streams and respectively the combined liquid stream
 25 therefrom have a pressure p_{cs} about equal to the pressure at the top of rectification column D as described above, i.e. $0.95 \leq p_{cs}/p_{TD} \leq 1.05$.

(Fully) electrified – with also C_T(3)

30 In some preferred embodiments of the process, the n reactive columns K(i) have each a re-boiler, preferably bottom reboiler, V_K(i) and wherein at least a part of T(1c) is passed as heating medium through at least one bottom reboiler V_K(i) of one of the n reactive distillation column K(i), obtaining a stream T_c(1c) having a temperature T_{Tc(1c)} with $T_{Tc(1c)} < T_{T(1c)}$.

35 In some preferred embodiments, at least a first part of T(1c) (T(1c.1)) is passed to a bottom re-boiler V_K(1) of a reactive distillation column K(1) and a second part of T(1c) (T(1c.2)) is passed to a bottom reboiler V_K(2) of a reactive distillation column K(2). Passing at least a part of stream T(1c) as a heating medium through all bottom reboilers V_K(i), enables a process wherein no

heating medium especially no hot water steam ($\text{H}_2\text{O}_{\text{gaseous}}$), from other sources is required for operating D and K(i), since all thermal energy needed is generated by the process itself. Only input of compression energy (electrical energy) is required. When green electricity is used, the integrated process for simultaneously preparing n mixtures P(i) comprising alkali metal methoxide and methanol can thus be carried out CO_2 -neutral. In some preferred embodiments with two reactive distillation columns K(1), K(2), at least a first part of T(1c) (T(1c.1)) is passed to a bottom reboiler $V_K(1)$ of a reactive distillation column K(1) and a second part of T(1c) (T(1c.2)) is passed to a bottom reboiler $V_K(2)$ of a reactive distillation column K(2). Preferably, from $V_K(1)$ a stream $T_c(1c.1)$ and from $V_K(2)$ a stream $T_c(1c.2)$ is/are obtained, which are then, either separately or at least partially combined as $T_c(1c)$, fed into the same (first) condensate drum CD(1), into which also $T_c(1a)$ and/or $T_c(1b)$ are fed.

In particular in view of overall energy consumption topics, the rectification column D is operated with top vapor recompression. Reference is made, for example, to the schematic overviews in Figures 3-6 showing a process according to the present invention with reflux. When the rectification column is operated with top vapor recompression, it is also preferred that realizing the reflux ratio comprises using 2 condensers, V(2) and V(3), as described below in that

- (i) in addition to the at least three streams G, T(1a) and T(1b), which are prepared from the vapor phase V, preparing a further stream T(2) from the vapor phase V and passing said stream T(2) through the condenser V(2), obtaining a liquid stream T(2l) and a gas stream T(2g); passing the gas stream T(2g) through the condenser V(3), obtaining a liquid stream T(2gl) and a waste gas stream T(2w); and combining the liquid streams T(2l) and (T2gl) in a second condensate drum CD(2) in depressurized form;
- (ii) feeding $T_c(1c)$, preferably with $T_c(1a)$ and $T_c(1b)$, each at least partially, to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) together with stream T(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) in depressurized form in the second condensate drum CD(2), obtaining a combined liquid stream from said second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

Certainly, as far as step (i) above is concerned, the skilled person may also realize, if need be, said reflux ratio by using more than the 2 condensers V(2) and V(3) or by using only one condenser V(2).

Vapor phase V

- In some preferred embodiments of the process, the vapor phase V has a pressure p_V , in the range of from 0.5 to 10 bar(abs), preferably in the range of from 0.75 to 6 bar(abs), more preferably in the range of from 1 to 5 bar(abs), more preferably in the range of from 1 to 3 bar(abs). In some preferred embodiments of the process, the vapor phase V has a temperature T_V in the
- 5 range of from 45 to 137 °C, preferably in the range of 49 to 118, more preferably in the range of from 64 to 111 °C, more preferably in the range of from 64 to 95°C.

Streams taken from rectification column D for heating purpose

- 10 In some preferred embodiments of the process, a stream $T(D_i)$ having a temperature $T_{T(D_i)}$ is taken from the rectification column D at an intermediate position and passed for heating purpose through the intermediate reboiler V(1a) of the rectification column D, obtaining a heated stream $T_h(D_i)$ having a temperature $T_{T_h(D_i)}$ with $T_{T_h(D_i)} > T_{T(D_i)}$, wherein heated stream $T_h(D_i)$ is re-introduced into rectification column D;
- 15 and
- a stream $T(D_b)$ having a temperature $T_{T(D_b)}$ is taken from the rectification column D at a bottom position and passed for heating purpose through the bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_h(D_b)$ having a temperature $T_{T_h(D_b)}$ with $T_{T_h(D_b)} > T_{T(D_b)}$, wherein heated stream $T_h(D_b)$ is reintroduced into rectification column D.
- 20 Heated stream $T_h(D_i)$ preferably comprises two phases, i.e. a gaseous and a liquid part. Analogously, heated stream $T_h(D_b)$ preferably comprises two phases, i.e. a gaseous and a liquid part.

Stream $T(K_i)$

- 25 In some preferred embodiments of the process, a bottom stream $T(K_i)$ having a temperature $T_{T(K_i)}$ is taken from the bottom of the n reactive columns $K(i)$ and passed for heating purpose through a bottom reboiler $V_{K(i)}$, thereby obtaining a heated stream $T_h(K_i)$ having a temperature $T_{T_h(K_i)}$ and wherein $T_{T_h(K_i)} > T_{T(K_i)}$; wherein heated stream $T_h(K_i)$ is reintroduced into rectification
- 30 column D.

Stream $T(1)$

- In some preferred embodiments of the process, stream $T(1)$ has a temperature $T_{T(1)}$ with $0.95 \leq T_{T(1)}/T_V \leq 1.00$ and/or a pressure $p_{T(1)}$ with $0.95 \leq p_{T(1)}/p_V \leq 1.00$.
- 35

Stream $T(1a)$

In some preferred embodiments of the process, stream T(1a) has a pressure $p_{T(1a)}$, which is adjusted so that $T_{\text{cond}T(1a)} \geq T_{\text{boil}T(Di)} + 3 \text{ K}$, wherein $T_{\text{cond}T(1a)}$ is the condensation temperature of stream T(1a) at a pressure $p_{T(1a)}$ and $T_{\text{boil}T(Di)}$ is the boiling temperature of stream T(Di) at a pressure $p_{T(Di)}$. Stream T(1a) preferably has a condensation temperature $T_{\text{cond}T(1a)}$ which is in the

5 range of from 3 to 30 K, preferably in the range of from 4 and 25 K, more preferably in the range of from 5 and 20 K, higher than $T_{\text{boil}T(Di)}$.

Stream T(1b)

10 In some preferred embodiments of the process, stream T(1b) has a pressure $p_{T(1b)}$, which is adjusted so that $T_{\text{cond}T(1b)} \geq T_{\text{boil}T(Db)} + 3 \text{ K}$, wherein $T_{\text{cond}T(1b)}$ is the condensation temperature of stream T(1b) at a pressure $p_{T(1b)}$ and $T_{\text{boil}T(Db)}$ is the boiling temperature of stream T(Db) at a pressure $p_{T(Db)}$. Stream T(1b) preferably has a condensation temperature $T_{\text{cond}T(1b)}$ which is in the range of from 3 to 30 K, more preferably in the range of from 4 and 25 K, more preferably in the

15 range of from 5 and 20 K, higher than $T_{\text{boil}T(Db)}$.

Stream T(1c)

In some preferred embodiments of the process, stream T(1c) has a pressure $p_{T(1c)}$, which is adjusted so that $T_{\text{cond}T(1c)} \geq T_{\text{boil}T(Ki)} + 3 \text{ K}$, wherein $T_{\text{cond}T(1c)}$ is the condensation temperature of stream T(1c) at a pressure $p_{T(1c)}$ and $T_{\text{boil}T(Ki)}$ is the boiling temperature of stream T(Ki). Stream T(1c) preferably has a condensation temperature $T_{\text{cond}T(1c)}$ which is in the range of from 3 to 30 K, more preferably in the range of from 4 and 25 K, more preferably in the range of from 5 and 20 K, higher than $T_{\text{boil}T(Ki)}$.

20

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Stream T(4)

In some preferred embodiments of the process, gaseous stream T(4) has a pressure $p_{T(4)}$ in the range of $p_{T(1b)} > p_{T(4)} > p_v$.

30

In some preferred embodiments, the process comprises

(g) feeding a stream M comprising methanol into the rectification column D at a position I(M). A stream M comprising methanol is fed into the rectification column D. This stream M, also referred to as fresh methanol stream M, is fed into D in order provide sufficient methanol for the

35 overall process, in particular to compensate the loss of methanol removed from the process via the mixtures P(i). Generally, there are no specific requirements as far as the methanol content of M is concerned, and the skilled person will be in the position to choose suitable methanol streams M. Preferably, however, it is preferred that the stream M comprises only a low amount

of water. Therefore, it is further preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of the stream M consist of methanol and optionally water, wherein the amount of water comprised in the stream M is preferably at most 2000 weight-ppm, more preferably at most 1500 weight-ppm, more preferably at most 1000 weight-ppm, such as at most 750 weight-ppm or at most 500 weight-ppm or at most 250 weight-ppm.

Generally, the stream M can be fed into the rectification column D at any suitable position. Preferably, the stream M is fed to the upper part of D, more preferably at least 2, 3 or 4 theoretical stages from the top of D, more preferably at least 4 theoretical stages from the top of D, more preferably between the 4th and the 20th theoretical stage from the top of D, more preferably between the 6th and the 15th theoretical stage from the top of D, such as between the 6th and the 10th theoretical stage or between to 8th and the 12th theoretical stage or between the 10th and the 14th theoretical stage or between to 12th and the 15th theoretical stage. As far as the temperature of the stream M is concerned at which the stream M is fed into D, it is preferred that the temperature is in the range of from ambient temperature up to the boiling point of methanol at the column pressure of D; more preferably the temperature is ambient temperature.

$K(i), K(1), K(2)$

In some preferred embodiments, the process further comprises for at least one reactive distillation column K(i), preferably for n reactive distillation columns K(i), feeding the stream G(i) into the lower part of the reactive distillation column K(i) and feeding the aqueous liquid stream H(i) into the upper part of the reactive distillation column K(i).

In some preferred embodiments of the process, a stream H(1) comprises dissolved sodium hydroxide and a stream H(2) comprises dissolved potassium hydroxide, wherein sodium methoxide is prepared in the reactive distillation column K(1) from which the stream W(1) is obtained and potassium methoxide is prepared in the reactive distillation column K(2) from which the stream W(2) is obtained. In some preferred embodiments of the process n is 2 ($n = 2$).

With respect to the stream G, it is preferred that said stream G comprises methanol and water, wherein more preferably from 99.95 to 100 weight-% of G consist of methanol and water, and wherein the water content of G is at most 200 weight-ppm, more preferably at most 150 weight-ppm, more preferably at most 100 weight-ppm, wherein more preferably, said water content is in the range of from 5 to 100 weight-ppm, more preferably in the range of from 10 to 100 weight-ppm, more preferably in the range of from 15 to 100 weight-ppm. According to (c), n streams G(i) are prepared from the vapor stream G, each of the streams G(i) having a pressure $p_{G(i)}$ and

a temperature $T_{G(i)}$ with $p_{G(i)} > p_G$ and $T_{G(i)} > T_G$ for each stream $G(i)$, and feeding each stream $G(i)$ into the respective reactive distillation column $K(i)$, wherein for preparing the n streams $G(i)$, the at least one compression unit C_G is employed. Preferably, the stream G is divided into the two streams $G(1)$ and $G(2)$, wherein the stream G has a mass flow rate $f(G)$, the stream $G(1)$ has a mass flow rate $f(G(1))$ and the stream $G(2)$ has a mass flow rate $f(G(2))$, wherein $f(G) = f(G(1)) + f(G(2))$. Generally, the stream G can be divided by any conceivable method. Preferably (c) comprises passing the stream G into a stream dividing device S , said device more preferably comprising a pipe junction. In context, it is noted that the term "the stream is divided into two streams" refers to a method according to which the streams obtained from said dividing have the same chemical composition as the stream G . As far as the ratios $f(G(1))/f(G)$ and $f(G(2))/f(G)$ are concerned, the present invention allows for a flexible adjusting of said ratios in that the individual flow rates $f(G(1))$ and $f(G(2))$ can be chosen depending on the desired amount of $A(1)OMe$, preferably sodium methoxide, to be obtained relative to the desired amount of $A(2)OMe$, preferably potassium methoxide, to be obtained.

Prior to dividing according to (c), the stream G can be passed through the at least one compression unit C_G , thereby realizing a pressure increase of G . Preferably, the pressure is suitably increased so that the pressure of the streams after dividing is adapted to the desired pressure when the streams are fed into the reactive distillation columns $K(i)$ and ultimately, via the streams $W(i)$, back into D . Preferably, said pressure increase is in the range of from 0.1 to 0.8 bar, more preferably in the range of from 0.15 to 0.6 bar, more preferably in the range of from 0.2 to 0.4 bar. According to this embodiment of the present invention, it is preferred that the dividing according to (c) comprises passing the compressed stream G into a stream dividing device S , said device preferably comprising a pipe junction and at least one control device allowing for adjusting the ratio $f(G(1))/f(G(2))$, wherein said at least one control device is located downstream of said pipe junction. At least one of these control devices is located either in the stream $G(1)$ or in the stream $G(2)$ or in both streams $G(1)$ and $G(2)$, and it is preferred that the at least one control device preferably is a control valve. Afterwards, the compressed stream G is fed into the dividing device S and subsequently, the resulting streams $G(1)$ and $G(2)$ are fed into the reactive distillation columns $K(1)$ and $K(2)$ respectively. Alternatively, the pressure increase mentioned above is realized not by compressing the stream G prior to, but after dividing. In this alternative embodiment, stream G is fed to a dividing device S and divided in a stream $G(1)$ and a stream $G(2)$. Prior to be fed into the reactive distillation column $K(1)$, the stream $G(1)$ is passed through a compression unit $C_G(1)$, thereby realizing a pressure increase of $G(1)$ in the range of from 0.1 to 0.8 bar, preferably in the range of from 0.15 to 0.6 bar, more preferably in the range of from 0.2 to 0.4 bar. Certainly, said compression of $G(1)$ can be combined with a pre-compression of the stream G prior to dividing; however, it is preferred that this compressing of $G(1)$ is performed with no compression of G being performed prior to dividing. Consequently,

in this alternative embodiment, it is also preferred that prior to be fed into the reactive distillation column K(2), the stream G(2) is passed through a compressor C_G(2), thereby realizing a pressure increase of G(2) in the range of from 0.1 to 0.8 bar, preferably in the range of from 0.15 to 0.6 bar, more preferably in the range of from 0.2 to 0.4 bar. Certainly, said compression of G(2) can be combined with a pre-compression of the stream G prior to dividing; however, it is preferred that this compressing of G(2) is performed with no compression of G being performed prior to dividing.

As far as the stream H(1) is concerned, it is preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of the stream H(1) consist of A(1)OH and water, wherein more preferably from 37.5 to 58 weight-%, more preferably from 40 to 55 weight-%, more preferably from 42.5 to 52 weight-% of the stream H(1) consist of A(1)OH, preferably sodium hydroxide. Preferably the stream H(1) is fed into the reactive distillation column K(1) at a temperature of H(1) in the range of from ambient temperature to its boiling temperature, more preferably in the range of from 50 to 80 °C such as from 50 to 60 °C or from 60 to 70 °C or from 70 to 80 °C. Heating of the stream H(1) to this temperature may be accomplished with any suitable means such as a heat exchanger. It is preferred that the stream H(1) is fed into the top of the reactive distillation column K(1), more preferably to the first theoretical stage from the top.

As to the reactive distillation column K(1), it is preferred that said column has from 5 to 50, more preferably from 10 to 40, more preferably from 15 to 30 theoretical stages, such as from 15 to 20 or from 20 to 25 or from 25 to 30 theoretical stages. Generally, the stream G(1) can be fed at any suitable position into K(1); preferably, G(1) is fed into the reactive distillation column K(1) at a position between the bottoms and the 5th theoretical stage, more preferably between the bottoms and the 3rd theoretical stage, more preferably between the bottoms and the 2nd theoretical stage of the reactive distillation column K(1). Preferably, the reactive distillation column K(1) is operated at a pressure at the top in the range of from 0.5 to 10 bar(abs), more preferably in the range of from 1 to 6 bar(abs), more preferably in the range of from 1 to 5 bar(abs). Suitable preferred ranges are, for example, from 1 to 3 bar(abs) or from 2 to 4 bar(abs) or from 3 to 5 bar(abs). While it is generally possible to operate the reactive distillation column K(1) with reflux, it is preferred that the reactive distillation column K(1) is operated at a reflux ratio of 0:1.

As far as the stream W(1) is concerned which is obtained from the top of K(1), it is preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of W(1) consist of methanol and water. More preferably, from 1 to 10 weight-%, more preferably from 2 to 8 weight-%, more preferably from 4 to 7 weight-%, more preferably from 5 to 6 weight-% of the stream W(1) consist of water.

As far as the mixture P(1) is concerned, it is preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of the stream P(1) consist of A(1)OMe, preferably sodium methoxide, and methanol. More preferably, from 10 to 50 weight-%, more preferably from 20 to 40 weight-%, more preferably from 25 to 35 weight-% of the stream P(1) consist of A(1)OMe, preferably sodium methoxide. More preferably, at most 5000 weight-ppm, more preferably at most 2000 weight-ppm, more preferably at most 1000 weight-ppm of the stream P(1) consist of water. Conceivable maximum water contents may include, for example, 750 weight-ppm or 500 weight-ppm or 250 weight-ppm. Preferably, the concentration of A(1)OMe, preferably sodium methoxide in the stream P(1) are realized by the skilled person by operating the reactive distillation column K(1) at a respective reboiler duty.

According to the present invention, it is preferred that the top of the reactive distillation column K(1) is equipped with a suitable droplet separating device D(1), preferably a demister. Thus, the process preferably comprises separating droplets comprising A(1)OH, preferably sodium hydroxide, from the vapor stream in the top of K(1). It is further preferred that, in particular for cleaning purposes, said demister is suitably treated with a suitable stream M(1). A preferred treating may comprise, preferably consist of at least temporarily spraying the demister with the stream M(1). Regarding the chemical composition of M(1), it is especially preferred that M(1) comprises methanol, wherein it is more preferred that M(1) is branched from a condensed top stream removed from the rectification column D, for example one of the streams described above, or being a fresh methanol stream, for example a stream branched from the stream M described above.

As far as the stream H(2) is concerned, it is preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of the stream H(2) consist of A(2)OH, preferably potassium hydroxide, and water, wherein more preferably 30 to 55 weight-%, more preferably from 40 to 52.5 weight-%, more preferably from 45 to 50 weight-% of the stream H(2) consist of A(2)OH, preferably potassium hydroxide. Preferably the stream H(2) is fed into the reactive distillation column K(2) at a temperature of H(2) in the range of from ambient temperature to its boiling temperature, more preferably in the range of from 50 to 80 °C such as from 50 to 60 °C or from 60 to 70 °C or from 70 to 80 °C. Heating of the stream H(2) to this temperature may be accomplished with any suitable means such as a heat exchanger. It is preferred that the stream H(2) is fed into the top of the reactive distillation column K(2), more preferably to the first theoretical stage from the top.

As to the reactive distillation column K(2), it is preferred that said column has from 5 to 50, more preferably from 10 to 40, more preferably from 15 to 30 theoretical stages, such as from 15 to

20 or from 20 to 25 or from 25 to 30 theoretical stages. Generally, the stream G(2) can be fed at any suitable position into K(2); preferably, G(2) is fed into the reactive distillation column K(2) at a position between the bottoms and the 5th theoretical stage, more preferably between the bottoms and the 3rd theoretical stage, more preferably between the bottoms and the 2nd theoretical stage of the reactive distillation column K(2). Preferably, the reactive distillation column K(2) is operated at a pressure at the top in the range of from 0.5 to 10 bar(abs), more preferably in the range of from 1 to 6 bar(abs), more preferably in the range of from 1 to 5 bar(abs). Suitable preferred ranges are, for example, from 1 to 3 bar(abs) or from 2 to 4 bar(abs) or from 3 to 5 bar(abs). While it is generally possible to operate the reactive distillation column K(2) with reflux, it is preferred that the reactive distillation column K(2) is operated at a reflux ratio of 0:1.

As far as the stream W(2) is concerned which is obtained from the top of K(2), it is preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of W(2) consist of methanol and water. More preferably, from 1 to 15 weight-%, more preferably from 2 to 12 weight-%, more preferably from 6 to 10 weight-% of the stream W(2) consist of water.

As far as the mixture P(2) is concerned, it is preferred that from 99 to 100 weight-%, more preferably from 99.5 to 100 weight-%, more preferably from 99.9 to 100 weight-% of the stream P(2) consist of A(2)OMe, preferably potassium methoxide, and methanol. More preferably, from 10 to 50 weight-%, more preferably from 20 to 40 weight-%, more preferably from 25 to 35 weight-% of the stream P(2) consist of A(2)OMe, preferably potassium methoxide. More preferably, at most 5000 weight-ppm, more preferably at most 2000 weight-ppm, more preferably at most 1000 weight-ppm of the stream P(2) consist of water. Conceivable maximum water contents may include, for example, 750 weight-ppm or 500 weight-ppm or 250 weight-ppm. Preferably, the concentration of A(2)OM, preferably potassium methoxide in the stream P(2) are realized by the skilled person by operating the reactive distillation column K(2) at a respective reboiler duty.

According to the present invention, it is preferred that the top of the reactive distillation column K(2) is equipped with a suitable droplet separating device D(2), preferably a demister. Thus, the process preferably comprises separating droplets comprising A(2)OH, preferably potassium hydroxide, from the vapor stream in the top of K(2). It is further preferred that, in particular for cleaning purposes, said demister is suitably treated with a suitable stream M(2). A preferred treating may comprise, preferably consist of at least temporarily spraying the demister with the stream M(2). Regarding the chemical composition of M(2), it is especially preferred that M(2) comprises methanol, wherein it is more preferred that M(2) is branched from a condensed top stream removed from the rectification column D, for example one of the streams described

above, or being a fresh methanol stream, for example a stream branched from the stream M described above.

In the above, it was described that according to the present invention, the stream G, prior to dividing, is preferably passed through a compression unit C_G . According to the present invention, it is also possible that either in addition to at least one of the above alternatives or, preferably as the sole respective compression, prior to being fed into the rectification column D, the stream W(1) is passed through a compressor C(1), thereby realizing a pressure increase of W(1) preferably in the range of from 0.1 to 0.8 bar, more preferably in the range of from 0.15 to 0.6 bar, more preferably in the range of from 0.2 to 0.4 bar, and prior to being fed into the rectification column D, the stream W(2) is passed through a compressor C(2), thereby realizing a pressure increase of W(2) in the range of from 0.1 to 0.8 bar, more preferably in the range of from 0.15 to 0.6 bar, more preferably in the range of from 0.2 to 0.4 bar. According to this embodiment of the present invention, it is also possible to suitably combine the streams W(1) and W(2), prior to being passed through a compressor, in a combining device to obtain a respective combined stream W, and pass said combined stream W, prior to being fed into D, through a compressor, thereby realizing a pressure increase of W(1) preferably in the range of from 0.1 to 0.8 bar, more preferably in the range of from 0.15 to 0.6 bar, more preferably in the range of from 0.2 to 0.4 bar. Said combining device preferably comprises a pipe junction and at least one control device, preferably a control valve.

As far as the integrated process of the present invention is concerned, it is noted that for simultaneously preparing, in addition to the 2 mixtures P(1) and P(2) as described above in detail, a 3rd mixture P(3) etc. can be obtained, the skilled person, based on his general knowledge, will be in the position to derive from said details above in a straight-forward manner also any detail adjusting the overall process. According to the present invention, it is also conceivable that from at least one of the streams P(i), A(i)OMe is at least partially separated from methanol, more preferably obtaining solid, more preferably crystalline A(i)OMe. Thus, solid, preferably crystalline sodium methoxide and solid, preferably crystalline potassium methoxide, can be obtained.

Recycling of W(i) into rectification column D

- Concept A

Generally, it is preferred according to the process of the present invention that at least a part of one or more of the top streams W(i) is fed into rectification column D (feature (f.1)).

In some preferred embodiments of the process, feeding of the stream W(i) into the rectification column D according to (f.1) comprises

(f.1.1) feeding at least a part of the top stream W(1) into the lower part of the rectification column D at a position I(1);

- 5 (f.1.2) feeding at least a part of the top stream W(2) into the lower part of the rectification column D at a position I(2), wherein the position I(2) is located below the position I(1);

wherein between the positions I(1) and I(2), the rectification column D is equipped with internals.

10

The rectification column D's internals are selected from tray, unstructured (random) packing, structured packing and mixtures of two or more thereof. Preferably, rectification column D comprises one or more internals, preferably selected from the group consisting of tray, unstructured (random) packing, structured packing and mixtures of two or more thereof. A tray is preferably
15 selected from the group consisting of bubble tray, sieve tray, valve tray, tunnel tray, slot tray and mixtures of two or more thereof. An unstructured packing is preferably selected from the group consisting of Raschig rings, Pall rings, Berl saddles, Intalox saddles and mixtures of two or more thereof. Structured packings are sold, for example, under the trade name Mellapack® from Sulzer. In addition to the internals mentioned, other suitable internals are known to those skilled in
20 the art and can also be used. If structured packings or unstructured packings are contained in the rectification column, these can be divided or there can be one continuous packing.

Position I(2) is preferably located in the lower third of rectification column D and position I(1) is also located in the lower third of rectification column D, wherein preferably in the range of from 1
25 to 15 preferably of from 2 to 10, more preferably of from 3 to 5, theoretical trays are present between the position I(2) and I(1).

The methanol concentration in stream W(1) $c_{MeOH}(1)$ is preferably higher than the methanol concentration in W(2) $c_{MeOH}(2)$ with $c_{MeOH}(1) > c_{MeOH}(2)$, so that W(1) is fed into rectification column
30 D at a position I(1), wherein the methanol concentration at that position I(1) within the rectification column D $c_{MeOH}(D1)$ is preferably about equal to $c_{MeOH}(1)$ with $0.95 \leq c_{MeOH}(1)/c_{MeOH}(D1) \leq 1.05$. W(2) is preferably fed into rectification column D at a position I(2), wherein the methanol concentration at that position I(2) within the rectification column D $c_{MeOH}(D2)$ is preferably about equal to $c_{MeOH}(2)$ with $0.95 \leq c_{MeOH}(2)/c_{MeOH}(D2) \leq 1.05$. This preferred feeding manner enables
35 a most efficient processing of rectification column D.

In some preferred embodiments of the process, stream W(1) comprises methanol and water at a molar methanol-to-water ratio $r(1)$ and wherein the stream W(2) comprises methanol and water at a molar methanol-to-water ratio $r(2)$ with $r(2) < r(1)$.

5 Preferably, the process comprises

(g) feeding a stream M comprising methanol into the rectification column D at a position I(M); wherein the positions I(1) and I(2) are located below the position I(M).

- *Concept BCD*

10

Generally, as indicated above, it is preferred according to the process of the present invention that at least a part of one or more of the top streams W(i) is fed into rectification column D. In some preferred embodiments, (f) comprises

(f.1) feeding at least a part of the top stream W(1) into the lower part of the rectification column D at a position I(1);

15 (f.2) at least partially condensing at least a part of the top stream W(2), obtaining an at least partially condensed stream $W_C(2)$, and feeding at least a part of the stream $W_C(2)$ into the rectification column at a position I(2); (f.3) feeding at least a part of the stream $T_C(1a)$ into the rectification column D.

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Feeding of at least a part of the stream $T_C(1a)$ into the rectification column D according to (f.3) is preferably done as explained in more detail herein.

- *Concept B*

25

Regarding these preferred embodiments with (f) comprising (f.1), (f.2) and (f.3), the process in one alternative preferably comprises

(g) feeding a stream M comprising methanol into the rectification column D at a position I(M); wherein (f.2') comprises passing the top stream W(2) having a temperature $T_{W(2)}$ through at least one heat exchanger E, obtaining an at least partially condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$, and feeding at least a part of the at least partially condensed stream $W_C(2)$ into the rectification column D at the position I(2); and

30 wherein (g) comprises passing the stream M having a temperature T_{M1} through one or more of said at least one of heat exchangers E, obtaining a stream M having a temperature T_{M2} with $T_{M2} > T_{M1}$, and feeding the stream M having the temperature T_{M2} into the rectification column D at the position I(M).

35

Preferably, at least partially condensing at least a part of the top stream $W(2)$, obtaining an at least partially condensed stream $W_C(2)$, and feeding at least a part of the stream $W_C(2)$ into the rectification column at a position $I(2)$ comprises passing the top stream $W(2)$ having a temperature $T_{W(2)}$ through a heat exchanger $E(1a)$, obtaining a partially condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$; feeding at least a part of the at least partially condensed stream $W_C(2)$ into the rectification column D at the position $I(2)$.

In these preferred embodiments, (g) preferably comprises

- (g.1) passing the stream M having the temperature T_{M1} through the heat exchanger $E(1a)$, obtaining the stream M having the temperature T_{M2} ;
- (g.2) feeding the stream M having the temperature T_{M2} into the rectification column D at the position $I(M)$.

In some preferred embodiments, at least partially condensing at least a part of the top stream $W(2)$, obtaining an at least partially condensed stream $W_C(2)$, and feeding at least a part of the stream $W_C(2)$ into the rectification column at a position $I(2)$ comprises passing the top stream $W(2)$ having a temperature $T_{W(2)}$ through a heat exchanger $E(1a)$, obtaining a partially condensed stream $W_{C1}(2)$ having a temperature $T_{WC1(2)}$ with $T_{WC1(2)} < T_{W(2)}$; passing the stream $W_C(2)$ having the temperature $T_{WC1(2)}$ through a heat exchanger $E(1b)$, obtaining a stream $W_{C2}(2)$ having a temperature $T_{WC2(2)}$ with $T_{WC2(2)} < T_{WC1(2)}$; feeding at least a part of the stream $W_{C2}(2)$ into the rectification column D at the position $I(3)$.

Preferably, $I(M)$ is above $I(2)$ and $I(2)$ is above $I(1)$.

In these preferred embodiments, (g) preferably comprises

- (g.1) passing the stream M having the temperature T_{M1} through the heat exchanger $E(1a)$, obtaining the stream M having the temperature T_{M2} ;
- (g.2) feeding at least a part of the stream M having the temperature T_{M2} into the rectification column D at the position $I(M)$.

The methanol concentration in stream $W(1)$ $c_{MeOH}(1)$ is preferably higher than the methanol concentration in $W(2)$ $c_{MeOH}(2)$ with $c_{MeOH}(1) > c_{MeOH}(2)$. $W(1)$ is fed into rectification column D at a position $I(1)$, wherein the methanol concentration at that position $I(1)$ within the rectification column D $c_{MeOH}(D1)$ is preferably about equal to $c_{MeOH}(1)$ with $0.95 \leq c_{MeOH}(1)/c_{MeOH}(D1) \leq 1.05$.

At least partially condensed stream $W_C(2)$ has a methanol concentration $c_{MeOH}(2')$ equal to the methanol concentration in $W(2)$ and lower than the methanol concentration in $W(1)$. $W_C(2)$ is preferably fed into rectification column D at a position $I(2)$, wherein the methanol concentration

at that position I(2) within the rectification column D $c_{MeOH}(D2)$ is preferably about equal to $c_{MeOH}(2')$ with $0.95 \leq c_{MeOH}(2')/c_{MeOH}(D2) \leq 1.05$. This preferred feeding manner enables a most efficient processing of rectification column D. The same applies with respect to $W_{C2}(2)$. Heat emitted from stream $W_{C1}(2)$ in heat exchanger E(1b) is taken up by a cooling medium such as water or ambient air.

I(M) is in the upper half of rectification column D, preferably in its upper third. Preferably, there is at least one, more preferably there are at least 2, theoretical stages between I(M) and the head of the rectification column D. I(2), which is above I(1), and I(1) are both in the lower half of rectification column D, preferably both in its lower third, wherein more preferably I(2) is preferably at least one, more preferably at least 5, theoretical stages above I(1).

- *Alternative C*

Regarding these preferred embodiments with (f) comprising (f.1), (f.2) and (f.3), the process in another alternative preferably comprises

(g) feeding a stream M comprising methanol into the rectification column D at a position I(M); wherein (f.2) and (g) comprise passing the top stream $W(2)$ having a temperature $T_{W(2)}$, through at least one heat exchanger E(2), obtaining an at least partially, preferably essentially completely, condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$; and admixing the stream M, prior to feeding it into the rectification column D at the position I(M), with at least a part of the stream $W_C(2)$, wherein I(M) is preferably above I(1).

The methanol concentration in stream $W(1)$ $c_{MeOH}(1)$ is preferably higher than the methanol concentration in $W(2)$ $c_{MeOH}(2)$ with $c_{MeOH}(1) > c_{MeOH}(2)$. $W(1)$ is fed into rectification column D at a position I(1), wherein the methanol concentration at that position I(1) within the rectification column D $c_{MeOH}(D1)$ is preferably about equal to $c_{MeOH}(1)$ with $0.95 \leq c_{MeOH}(1)/c_{MeOH}(D1) \leq 1.05$.

At least partially condensed stream $W_C(2)$ has a methanol concentration $c_{MeOH}(2')$ equal to the methanol concentration in $W(2)$ and lower than the methanol concentration in $W(1)$. The mixture of $W_C(2)$ and M having a methanol concentration $c_{MeOH}(\text{mixture})$ is preferably fed into rectification column D at a position I(M), wherein the methanol concentration at that position I(M) within the rectification column D $c_{MeOH}(DM)$ is preferably about equal to $c_{MeOH}(\text{mixture})$ with $0.95 \leq c_{MeOH}(\text{mixture})/c_{MeOH}(D2) \leq 1.05$. This preferred feeding manner enables a most efficient processing of rectification column D. Heat emitted from stream $W(2)$ in heat exchanger E(2) is taken up by a cooling medium such as water or ambient air.

I(M), where the mixture of stream M and at least a part of the stream W_c(2) is fed into the rectification column D is in its lower half. Preferably, there is at least one, more preferably there are at least 2, theoretical stages between I(1) and I(M). I(1) is in the lower half of rectification column D, preferably in its lower third.

5

- *Alternative D*

Regarding these preferred embodiments with (f) comprising (f.1), (f.2) and (f.3), the process in still another alternative preferably comprises

- 10 (g) feeding a stream M comprising methanol into the rectification column D at a position I(M); wherein (f.2) and (g) comprise admixing the top stream W(2) having a temperature $T_{W(2)}$ with the stream M having a temperature T_{M1} with $T_{W(2)} > T_{M1}$, thereby at least partially, preferably only partially, condensing the stream W(2), and feeding the stream obtained from mixing into the rectification column D at the position I(M), wherein I(M) is preferably above I(1).

15

The methanol concentration in stream W(1) $c_{MeOH}(1)$ is preferably higher than the methanol concentration in W(2) $c_{MeOH}(2)$ with $c_{MeOH}(1) > c_{MeOH}(2)$. W(1) is fed into rectification column D at a position I(1), wherein the methanol concentration at that position I(1) within the rectification column D $c_{MeOH}(D1)$ is preferably about equal to $c_{MeOH}(1)$ with $0.95 \leq c_{MeOH}(1)/c_{MeOH}(D1) \leq 1.05$.

20

The mixture of W(2) and M having a methanol concentration $c_{MeOH}(\text{mixture})$ is preferably fed into rectification column D at a position I(M), wherein the methanol concentration at that position I(M) within the rectification column D $c_{MeOH}(DM)$ is preferably about equal to $c_{MeOH}(\text{mixture})$ with $0.95 \leq c_{MeOH}(\text{mixture})/c_{MeOH}(DM) \leq 1.05$. This preferred feeding manner enables a most efficient

25 processing of rectification column D.

30

I(M), where the mixture of stream M and stream W(2) is fed into the rectification column D is in its lower half. Preferably, there is at least one, more preferably there are at least 2, theoretical stages between I(1) and I(M). I(1) is in the lower half of rectification column D, preferably in its lower third.

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Everything described above especially applies to the process of the invention being carried out in normal run stage, i.e. after the process had been initiated in a start-up stage. Regarding the start-up stage, it is understood that for starting the process, external energy is applied, for example, external heating steam is used, or electrically heating takes place. Preferably, external heating steam (H_2O_{gaseous}) is applied by one or more further reboiler(s). These one or more further reboiler(s) are only in use until the boiling temperature of the respective liquid phase in the bottom of the rectification column D and in the reactive distillation column K(i) has been reached

and/or, preferably and, the remaining volume of the columns, which is not filled by the respective liquid phase, is filled with methanol steam. Then, the one or more further reboiler(s) are taken out of operation.

5 2nd aspect - Chemical production unit

A second aspect of the present invention relates to a chemical production unit for carrying out the process according to the first aspect, comprising

- a rectification column D comprising
 - 10 -- in its lower part, inlet means for feeding streams $W(i)$ or one or more combined stream thereof into D;
 - in its upper part, outlet means for removing a vapor stream V or divided streams thereof, comprising at least a gaseous stream G and at a stream T(1), from the top of D;
 - 15 -- an intermediate reboiler V(1a);
 - a bottom reboiler V(1b);
- optionally a stream dividing device S_o for dividing T(1) into sub streams thereof;
- a first compressor $C_T(1)$ for compressing T(1) or a part thereof;
- a second compressor $C_T(2)$ for compressing a part stream of T(1) and/or for compressing
 - 20 a compressed sub stream of T(1) or a part thereof;
- means for passing compressed sub streams of T(1) from $C_T(1)$ and/or $C_T(2)$ as heating medium through intermediate reboiler V(1a) and bottom reboiler V(1b);
- a stream dividing device S for dividing the stream G into n streams $G(i)$;
- 25 - means for passing the stream G to said stream dividing device S;
- n reactive distillation columns $K(i)$, $n \geq 2$ and $i = 1 \dots n$; said reactive distillation columns $K(i)$ being arranged in parallel, each reactive distillation column $K(i)$ comprising
 - in its upper part, preferably in its top, inlet means for feeding a stream H(i) into
 - 30 $K(i)$;
 - in its lower part, inlet means for feeding a stream $G(i)$ into $K(i)$;
 - outlet means for removing a stream $W(i)$ from the top of $K(i)$;
 - bottom reboilers $V_k(i)$;
 - outlet means for removing a bottoms stream from $K(i)$;
 - 35 -- a stream dividing means for separating a stream $P(i)$ from the bottoms stream removed from $K(i)$;
- means for passing the streams $G(i)$ to the reactive distillation columns $K(i)$;
- means for passing the streams $W(i)$ to the rectification column D;

- one or more compressors $C_{G(i)}$ for compressing either the stream G and/or the streams $G(i)$ and/or the streams $W(i)$.

In some preferred embodiments, the chemical production unit further comprises a trans alcohol-
5 isation unit TAU, wherein TAU comprises

- a reactive distillation column comprising
 - inlet means for feeding a stream comprising alkali metal methoxide $A(i)OMe$ into TAU;
 - inlet means for feeding a stream comprising alcohol HOX into TAU;
 - 10 -- outlet means for removing a stream $S(2)$ comprising methanol from the upper part of TAU;
 - bottom reboiler V_{TAU} ;
 - outlet means for removing a bottoms stream $S(1)$ comprising alkali metal alkoxide $A(i)OX$ and alcohol XOH from TAU;
- 15 the chemical production unit further comprising
 - means for passing a bottoms stream comprising alkali metal methoxide $A(i)OMe$ from $K(i)$ to TAU;
 - optionally means for passing the stream $S(2)$ comprising methanol to the rectification column D and/or to the reactive distillation columns $K(i)$.

20

In some preferred embodiments, the chemical production unit comprises a third compressor $C_T(3)$ for compressing sub streams of $T(1)$ or for compressing compressed sub streams of $T(1)$.

- 25 In some preferred embodiments of the chemical production unit, the reactive distillation columns $K(i)$ comprise bottom reboilers $V_{K(i)}$ and the chemical production unit comprises means for passing compressed sub streams of $T(1)$ as heating medium through one or more bottom reboilers $V_{K(i)}$.

- 30 In some preferred embodiments, the chemical production unit comprises means for passing condensed sub streams of $T(1)$ after passage through intermediate reboiler $V(1a)$ and/or bottom reboiler $V(1b)$ and/or bottom reboilers $V_{K(i)}$ into D, the means preferably comprising
- at least one condenser, preferably a condenser $V(2)$ and optionally a further condenser $V(3)$ arranged downstream of $V(2)$, having inlet means for receiving condensed sub streams of $T(1)$ after passage through intermediate reboiler $V(1a)$ and/or bottom reboiler $V(1b)$ and/or bottom reboilers $V_{K(i)}$, and having outlet means for removing a condensed stream $T(3)$ and for removing a waste gas stream;
 - 35 - inlet means for feeding the stream $T(3)$ to the top of D.

In some preferred embodiments, the chemical production unit comprises inlet means for feeding a methanol stream M into D.

Preferably, the top of at least one, more preferably of each reactive distillation column K(i) is
5 equipped with a droplet separating device D(i), more preferably a demister, said demister more preferably comprising an inlet means for feeding a stream M(i) comprising methanol into said demister. Preferably each of the reactive distillations columns K(i) comprises, independently from one another, from 5 to 50, more preferably from 10 to 40, more preferably from 15 to 30 theoretical stages. It is preferred that the means for passing the streams G(i) to the reactive dis-
10 tillation columns K(i) are located, independently from one another, at a position between the bottoms and the fifth theoretical stage, more preferably between the bottoms and the third theoretical stage, more preferably between the bottoms and the second theoretical stage of K(i). Preferably, the means for passing the streams H(i) into the reactive distillation columns K(i) are located at the top of K(i), preferably at the uppermost theoretical stage. Preferably at least one,
15 more preferably each reactive distillation columns K(i) does not comprise means for being operated at a reflux ratio of greater than 0:1. Preferably each reactive distillation column K(i) is equipped with trays.

It is preferred that the chemical production unit of the present invention comprises at least one
20 compression unit C_G arranged upstream of K(i) for compressing the stream G before passage into the stream dividing device S. Alternatively, it is preferred that the unit of the present invention comprises n compression units C(i) arranged downstream of K(i) and upstream of D for compressing the streams W(i).

25 As to the rectification column D, it is preferred that said column has from 20 to 100, more preferably from 30 to 80, more preferably from 40 to 60 theoretical stages. Preferably, the inlet means of D for feeding the streams W(i) or one or more combined stream thereof into D is/are located at a position between the bottoms and the 15th theoretical stage, more preferably between the bottoms and the 10th theoretical stage, more preferably between the bottoms and the 8th theoretical of D. It is preferred that the inlet means for feeding the stream M into D are located at
30 least 4 theoretical stages from the top of D, more preferably between the 4th and the 20th theoretical stage from the top of D, more preferably between the 6th and the 15th theoretical stage from the top of D.

35 It is preferred that the unit of the present invention further comprises at least one condensate drum (second condensate drum CD(2)) for a liquid stream removed from V(2) and optionally from V(3) and further comprising means for passing at least part of the liquid contained in said

second condensate drum CD(2) in depressurized form as the stream T(3) to the top of D. According to the present invention, it is preferred that the unit further comprises at least one (first) condensate drum CD(1) for the condensed stream removed from intermediate reboiler V(1a) and/or bottom reboiler V(1b) and/or bottom reboilers $V_{K(i)}$, the unit more preferably further comprising means for passing at least part of a gas phase obtained in said first condensate drum CD(1) to V(2) and means for passing at least part of a liquid phase obtained in said first condensate drum CD(1) to a second condensate drum CD(2) as defined in the foregoing.

In the context of the present invention, it is also conceivable that suitable reactive distillation columns K(i) are essentially bubble cap tray, valve tray and sieve tray columns. Specifically in the case of valve trays and sieve trays, the trays should be configured so that the raining-through of the liquid is minimized. A person skilled in the art will be familiar with the constructional measures required for this. It is also conceivable that the columns are provided with random packing elements or structured packings, with structured packings being preferred over random packing elements with a view to uniform distribution of the liquid.

Further, it may be preferred that the unit further comprises means for separating an alkali metal methoxide A(i)OMe from at least one of the streams P(i). Preferably, the number of reactive distillation columns K(i), n, is in the range of from 2 to 10, more preferably in the range of from 2 to 5, more preferably 2 or 3, more preferably 2.

All details, embodiments and preferred embodiments as well as alternative (preferred) embodiments described above in the section related to the first aspect of the invention apply also for the second aspect of the invention.

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3rd aspect – Use

A third aspect of the present invention relates to the use of a chemical production unit according to the second aspect of the invention or of a process according to the first aspect of the present invention for simultaneously producing n mixtures P(i) comprising alkali metal methoxide and methanol, n being an integer with $n \geq 2$ and $i = 1 \dots n$, wherein either at least 2 of the mixtures P(i) comprise different alkali metal methoxides A(i)OMe, and/or at least 2 of the mixtures P(i) comprise the same alkali metal alkoxide A(i)OMe at different concentrations.

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All details, embodiments and preferred embodiments as well as alternative (preferred) embodiments described above in the section related to the first aspect of the invention or in the section related to the second aspect of the invention apply also for the third aspect of the invention.

The present invention is further illustrated by the following set of embodiments and combinations of embodiments resulting from the dependencies and back-references as indicated. In particular, it is noted that in each instance where a range of embodiments is mentioned, for example in the context of a term such as "The integrated process of any one of embodiments 1 to 4", every embodiment in this range is meant to be explicitly disclosed for the skilled person, i.e. the wording of this term is to be understood by the skilled person as being synonymous to "The integrated process of any one of embodiments 1, 2, 3 and 4". Further, it is explicitly noted that the following set of embodiments represents a suitably structured part of the general description directed to preferred aspects of the present invention, and, thus, suitably supports, but does not represent the claims of the present invention.

1. An integrated process for simultaneously preparing n mixtures $P(i)$ comprising alkali metal methoxide and methanol, comprising
 - providing n reactive distillation columns $K(i)$;
 - providing n aqueous liquid streams $H(i)$, a given stream $H(i)$ comprising a dissolved alkali metal hydroxide $A(i)OH$, wherein n is an integer with $n \geq 2$ and $i = 1 \dots n$; and
 - providing a rectification column D comprising at least one intermediate reboiler $V(1a)$ and at least one bottom reboiler $V(1b)$;
 - providing a first compression unit $C_T(1)$, a second compression unit $C_T(2)$ and at least one further compression unit C_G ;
 - wherein the process comprises preparing the one or more alkali metal methoxides in the n reactive distillation column $K(i)$ under reactive distillation conditions from the n streams $H(i)$ and n streams $G(i)$ comprising methanol, thereby obtaining n top streams $W(i)$ comprising methanol and water; and obtaining n bottoms streams $P(i)$ comprising alkali metal methoxide $A(i)OMe$ and methanol;
 - the process further comprising
 - (a) obtaining a vapor phase V comprising methanol at the top of the rectification column D , said vapor phase V having a pressure p_V and a temperature T_V ;
 - (b) preparing at least three streams from the vapor phase V , said at least three streams comprising a vapor stream G having a pressure p_G and a temperature T_G with $p_G = p_V$ and $T_G = T_V$, and further comprising two streams $T(1a)$ and $T(1b)$, said stream $T(1a)$ having a pressure $p_{T(1a)}$ and a temperature $T_{T(1a)}$ with $p_{T(1a)} > p_V$ and $T_{T(1a)} > T_V$ and said stream $T(1b)$ having a pressure $p_{T(1b)}$ and a temperature $T_{T(1b)}$ with $p_{T(1b)} > p_V$ and $T_{T(1b)} > T_V$, wherein for preparing the streams $T(1a)$ and $T(1b)$, the first compression unit $C_T(1)$ and the second compression unit $C_T(2)$ are employed;
 - (c) preparing n streams $G(i)$ from the vapor stream G , each of the streams $G(i)$ having a pressure $p_{G(i)}$ and a temperature $T_{G(i)}$ with $p_{G(i)} > p_G$ and $T_{G(i)} > T_G$ for each stream

- G(i), and feeding each stream G(i) into the respective reactive distillation column K(i), wherein for preparing the n streams G(i), the at least one compression unit C_G is employed;
- (d) passing at least a part of the stream T(1a) as a heating medium through an intermediate reboiler V(1a) of the rectification column D, obtaining a stream $T_C(1a)$ having a temperature $T_{T_C(1a)}$ with $T_{T_C(1a)} < T_{T(1a)}$;
- (e) passing at least a part of the stream T(1b) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_C(1b)$ having a temperature $T_{T_C(1b)}$ with $T_{T_C(1b)} < T_{T(1b)}$;
- (f) feeding one or more of
- (f.1) at least a part of one or more of the top streams W(i),
 - (f.2) at least a part of the stream $T_C(1a)$, and
 - (f.3) at least a part of the stream $T_C(1b)$
- into the rectification column D.
2. The process of embodiment 1, wherein preparing the at least three streams according to (b) comprises
- (b.1) splitting the vapor phase V into at least two vapor streams comprising the stream G and a vapor stream T(1) having a pressure $p_{T(1)}$ and a temperature $T_{T(1)}$ with $0.95 \leq p_{T(1)}/p_v \leq 1.00$;
 - (b.2) preparing at least the two streams T(1a) and T(1b) from the vapor stream T(1).
3. The process of embodiment 1 or 2, wherein the rectification column D is operated at a pressure at the top of D p_{TD} in the range of from 0.5 to 10 bar(abs), preferably in the range of from 0.75 to 6 bar(abs), more preferably in the range of from 1 to 5 bar(abs), more preferably in the range of from 1 to 3 bar(abs).
4. The process of any one of embodiments 1 to 3, wherein the rectification column D is operated at a temperature at the top of D T_{TD} in the range of from 45 to 137 °C, preferably in the range of 49 to 118, more preferably in the range of from 64 to 111 °C, more preferably in the range of from 64 to 95°C.
5. The process of any one of embodiments 1 to 4, wherein the rectification column D is operated at a reflux ratio of at least 0.5:1, preferably in the range of from 0.55:1 to 1.4:1, more preferably in the range of from 0.6:1 to 1.4:1.

6. The process of embodiment 5, wherein the rectification column is operated with top vapor recompression.
7. The process of embodiment 6, wherein realizing the reflux ratio comprises preparing from the vapor phase V a further vapor stream T(2), passing said stream T(2) through a condenser V(2), obtaining a liquid stream T(3) and a waste gas stream T(2w), and feeding the liquid stream T(3) into the top of the rectification column D.
8. The process of embodiment 7, wherein the waste gas stream T(2w) essentially consists of oxygen, nitrogen, carbon dioxide and methanol, wherein the amount of methanol in T(2w) is preferably in the range of from 2 to 80 weight-%, preferably in the range of from 10 to 30 weight-% based on the total weight of T(2w).
10. The process of any one of embodiments 2 to 9, wherein (b.2) comprises splitting vapor stream T(1) into at least two streams and passing a first part stream of T(1) through the first compression unit C_T(1), obtaining T(1a), and passing a second part stream of T(1) through the second compression unit C_T(2), obtaining T(1b).
11. The process of any one of embodiments 2 to 9, wherein (b.2) comprises passing vapor stream T(1) through the first compression unit C_T(1), obtaining T(1a); and passing a part of T(1a) through the second compression unit C_T(2), obtaining T(1b).
12. The process of any one of embodiments 1 to 11, wherein T_c(1a) and/or T_c(1b), preferably T_c(1a) and T_c(1b), each at least partially, is/are fed to a first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2g) in depressurized form, obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.
13. The process of any one of embodiments 1 to 12, wherein a further stream T(2) is prepared from the vapor phase V and said stream T(2) is passed through the condenser V(2), obtaining a liquid stream T(2l) and a gas stream T(2g); wherein the gas stream T(2g) is passed through a condenser V(3), obtaining a liquid stream T(2gl) and a waste gas stream T(2w); and the liquid streams T(2l) and (T2gl) are combined in a second condensate drum CD(2) in depressurized form.
14. The process of any one of embodiments 1 to 13, wherein

- $T_c(1a)$ at least partially is fed to a first condensate drum $CD(1)$, wherein from said first condensate drum $CD(1)$, a gas stream $T(1g)$ and a liquid stream $T(1l)$ are removed, said gas stream $T(1g)$ being fed into the condenser $V(2)$ and said liquid stream $T(1l)$ being combined with the liquid streams $T(2l)$ and $(T2g)$ in depressurized form; and
- 5 $T_c(1b)$ at least partially is fed to a third condensate drum $CD(3)$, wherein from said third condensate drum $CD(3)$ a gaseous stream $T(4)$ is obtained, which is fed into the top of the rectification column D and/or into the vapor phase V and/or into the stream G and/or into the stream $T(1)$, preferably into the top of the rectification column D or into the vapor phase V or into the stream G or into the stream $T(1)$, more preferably into the top of the rectification column D or into the vapor phase V , and from said condensate drum $CD(3)$ further a liquid stream $T(5)$ is obtained, which is fed to the second condensate drum $CD(2)$, wherein $T(5)$ is combined with the liquid streams $T(2l)$ and $(T2gl)$ in $CD(2)$ in depressurized form,
- 10 obtaining a combined liquid stream from the second condensate drum $CD(2)$, which is fed as the stream $T(3)$ into the top of the rectification column D .
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15. The process of any one of embodiments 10 to 14, wherein the n reactive columns $K(i)$ have each a reboiler, preferably bottom reboiler, $V_K(i)$ and wherein (e) comprises
- (e.1) passing at least a first part of the stream $T(1b)$ ($T(1b.1)$) as a heating medium through a bottom reboiler $V(1b)$ of the rectification column D , obtaining a stream $T_c(1b.1)$ having a temperature $T_{T_c(1b.1)}$ with $T_{T_c(1b.1)} < T_{T(1b)}$;
- 20 (e.2) passing at least a second part of stream $T(1b)$ ($T(1b.2)$) as a heating medium through at least one bottom reboiler $V_K(i)$ of one of the n reactive distillation column $K(i)$, obtaining a stream $T_c(1b.2)$ having a temperature $T_{T_c(1b.2)}$ with
- 25 $T_{T_c(1b.2)} < T_{T(1b)}$.
16. The process of embodiment 15, wherein stream $T_c(1b.2)$ is fed into the first condensate drum $CD(1)$.
- 30 17. The process of embodiment 15, wherein at least a part of $T_c(1a)$ is fed to the first condensate drum $CD(1)$, wherein from said first condensate drum $CD(1)$, a gas stream $T(1g)$ and a liquid stream $T(1l)$ are removed, said gas stream $T(1g)$ being fed into the condenser $V(2)$ and said liquid stream $T(1l)$ being combined with the liquid streams $T(2l)$ and $(T2g)$ in depressurized form; and
- 35 $T_c(1b.1)$ and/or $T_c(1b.2)$, preferably $T_c(1b.1)$ and $T_c(1b.2)$, at least partially is/are fed to the third condensate drum $CD(3)$, wherein from said third condensate drum $CD(3)$, the gaseous stream $T(4)$ is obtained, which is fed into the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream $T(1)$, preferably into

- the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.
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18. The process of any one of embodiments 1 to 17, wherein at least one of the n bottoms streams P(i) comprising alkali metal methoxide A(i)OMe and methanol is at least partially fed to a trans alcoholisation unit TAU, wherein
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- (x) the (part)stream comprising alkali metal methoxide A(i)OMe and methanol is contacted in the trans alcoholisation unit TAU with an alcohol HOX, wherein X represents an alkyl residue selected from the group consisting of C2 to C10 alkyl, preferably C2 alkyl, thereby obtaining a stream S(1) comprising alkali metal alkoxide A(i)OX and alcohol XOH and a stream S(2) comprising methanol;
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- (y) removing the stream S(2) comprising methanol from the trans alcoholisation unit TAU, preferably as a liquid stream, more preferably as a liquid top stream; and removing the stream S(1) comprising alkali metal alkoxide A(i)OX and alcohol XOH from the trans alcoholisation unit TAU, preferably as a liquid stream, more preferably as a liquid stream from the lower part of TAU, more preferably as a liquid bottoms stream.
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19. The process of embodiment 18, wherein the liquid stream S(2) is obtained in that a gaseous stream S(O) is obtained within TAU, which is condensed within TAU, preferably using an internal condenser.
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20. The process of embodiment 18 wherein the liquid stream S(2) is obtained in that a gaseous stream S(O) is removed from the upper part of TAU, preferably from the top of TAU and passed through at least one heat exchanger; thereby obtaining from the heat exchanger at least one, preferably liquid, stream S(2) comprising methanol; wherein preferably at least a part of stream S(2) is reintroduced into TAU, preferably in the upper part of TAU, preferably at a feeding point TAU(S(2)).
- 30
21. The process of embodiment 20, wherein at least 90 volume-%, preferably at least 95 volume-%, of stream S(2) are reintroduced into TAU at feeding point TAU(S(2)), wherein preferably, at least a stream S(2.a) comprising methanol is removed from TAU at a position TAU(S(2a)), wherein TAU(S(2a)) is located below TAU(S(2)).
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22. The process of any one of embodiments 18 to 21, wherein the trans alcoholisation unit TAU has a reboiler, preferably bottom reboiler, V_{TAU} .
- 5 23. The process of any one of embodiments 18 to 22, wherein (e) comprises
- (e.1) passing at least a first part of the stream T(1b) (T(1b.1)) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_{C(1b.1)}$ having a temperature $T_{Tc(1b.1)}$ with $T_{Tc(1b.1)} < T_{T(1b)}$;
- 10 (e.2) passing at least a second part of stream T(1b) (T(1b.2)) as a heating medium through at least one bottom reboiler $V_{K(i)}$ of one of the n reactive distillation column K(i), obtaining a stream $T_{C(1b.2)}$ having a temperature $T_{Tc(1b.2)}$ with $T_{Tc(1b.2)} < T_{T(1b)}$,
- 15 (e.3) passing at least a third part of stream T(1b) (T(1b.3)) as a heating medium through the bottom reboiler V_{TAU} of the trans alcoholisation unit TAU, obtaining a stream $T_{C(1b.3)}$ having a temperature $T_{Tc(1b.3)}$ with $T_{Tc(1b.3)} < T_{T(1b)}$.
24. The process of embodiment 23, wherein stream $T_{C(1b.3)}$ is fed into the first condensate drum CD(1).
- 20 25. The process of embodiment 23, wherein at least a part of $T_{C(1a)}$ is fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) in depressurized form; and
- 25 $T_{C(1b.1)}$ and/or $T_{C(1b.2)}$, and/or $T_{C(1b.3)}$, preferably $T_{C(1b.1)}$ and $T_{C(1b.2)}$ and $T_{C(1b.3)}$, at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream T(4) is obtained, which is fed into the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum
- 30 CD(2), which is fed as the stream T(3) into the top of the rectification column D.
- 35 26. The process of any one of embodiments 18 to 22, wherein (e) comprises

- (e.1) passing at least a first part of the stream T(1b) (T(1b.1)) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream T_C(1b.1) having a temperature T_{T_C(1b.1)}} with T_{T_C(1b.1)}} < T_{T(1b)}};
- 5 (e.2.1) splitting a second part of stream T(1b) (T(1b.2)) into at least two sub-streams (T(1b.2.1)) and (T(1b.2.2));
- (e.2.2) passing at least sub-stream (T(1b.2.1)) as a heating medium through at least one bottom reboiler V_{K(i)} of one of the n reactive distillation column K(i), obtaining a stream T_C(1b.2.1) having a temperature T_{T_C(1b.2.1)}} with T_{T_C(1b.2.1)}} < T_{T(1b)}};
- 10 (e.2.3) passing at least sub-stream (T(1b.2.2)) as a heating medium through the bottom reboiler V_{TAU} of the trans alcoholisation unit TAU, obtaining a stream T_C(1b.2.2) having a temperature T_{T_C(1b.2.2)}} with T_{T_C(1b.2.2)}} < T_{T(1b)}}.
27. The process of embodiment 26, wherein stream T_C(1b.2.2) is fed into the first condensate drum CD(1).
- 15 28. The process of embodiment 26, wherein at least a part of T_C(1a) is fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being
- 20 combined with the liquid streams T(2l) and (T2g) in depressurized form; and T_C(1b.1) and/or T_C(1b.2.1), and/or T_C(1b.2.2), preferably T_C(1b.1) and T_C(1b.2.1) and T_C(1b.2.2), at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream T(4) is obtained, which is fed into
- 25 the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate
- 30 drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.
29. The process of any one of embodiments 18 to 22, wherein (d) comprises
- 35 (d.1) passing at least a first part of the stream T(1a) (T1a.1) as a heating medium through an intermediate reboiler V(1a) of the rectification column D, obtaining a stream T_C(1a.1) having a temperature T_{T_C(1a.1)}} with T_{T_C(1a.1)}} < T_{T(1a.1)}};

(d.2) passing at least a second part of stream T(1a) (T(1a.2)) as a heating medium through the bottom reboiler V_{TAU} of the trans alcoholisation unit TAU, obtaining a stream $T_c(1a.2)$ having a temperature $T_{T_c(1a.2)}$ with $T_{T_c(1a.2)} < T_{T(1a)}$.

- 5 30. The process of embodiment 29, wherein stream $T_c(1a.2)$ is fed into the first condensate drum CD(1).
31. The process of embodiment 29, wherein
 - 10 at least a part of $T_c(1a.1)$ and $T_c(1a.2)$ at least partially are fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2g) in depressurized form; and
 - 15 $T_c(1b.1)$ and/or $T_c(1b.2)$, preferably $T_c(1b.1)$ and $T_c(1b.2)$, at least partially is/are fed to the third condensate drum CD(3), wherein from said third condensate drum CD(3), the gaseous stream T(4) is obtained, which is fed into the top of the rectification column D and/or into vapor stream V and/or into the stream G and/or into the stream T(1), preferably into the top of the rectification column D or into vapor stream V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor
 - 20 stream V, and from said third condensate drum CD(3) further the liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in depressurized form, thereby obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.
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32. The process of any one of embodiments 1 to 31, comprising providing a providing a third compression unit $C_T(3)$, wherein (b) comprises preparing at least four streams from the vapor phase V, said at least four streams comprising vapor stream G, stream T(1a), stream T(1b), and a further stream T(1c), said stream T(1c) having a pressure $p_{T(1c)}$ and a
 - 30 temperature $T_{T(1c)}$ with $p_{T(1c)} > p_v$ and $T_{T(1c)} > T_v$, wherein for preparing the stream T(1c), the third compression unit $C_T(3)$ is employed.
33. The process of embodiment 32, wherein $T_c(1a)$ and/or $T_c(1b)$, preferably $T_c(1a)$ and $T_c(1b)$, each at least partially, is/are fed to a first condensate drum CD(1), wherein from
 - 35 said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream

T(1l) being combined with the liquid streams T(2l) and (T2gl) in depressurized form, obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

- 5 34. The process of embodiment 32 or 34, wherein the n reactive columns K(i) have each a reboiler, preferably bottom reboiler, $V_{K(i)}$ and wherein at least a part of T(1c) is passed as heating medium through at least one bottom reboiler $V_{K(i)}$ of one of the n reactive distillation column K(i), obtaining a stream $T_{C(1c)}$ having a temperature $T_{Tc(1c)}$ with $T_{Tc(1c)} < T_{T(1c)}$.
- 10 35. The process of any one of embodiments 1 to 34, wherein vapor phase V has a pressure p_V , in the range of from 0.5 to 10 bar(abs), preferably in the range of from 0.75 to 6 bar(abs), more preferably in the range of from 1 to 5 bar(abs), more preferably in the range of from 1 to 3 bar(abs).
- 15 36. The process of any one of embodiments 1 to 35, wherein vapor phase V has a temperature T_V in the range of from 45 to 137 °C, preferably in the range of 49 to 118, more preferably in the range of from 64 to 111 °C, more preferably in the range of from 64 to 95°C .
- 20 37. The process of any one of embodiments 1 to 36, wherein a stream T(Di) having a temperature $T_{T(Di)}$ is taken from the rectification column D at an intermediate position and passed for heating purpose through the intermediate reboiler V(1a) of the rectification column D, obtaining a heated stream $T_h(Di)$ having a temperature $T_{Th(Di)}$ with $T_{Th(Di)} > T_{T(Di)}$, wherein heated stream $T_h(Di)$ is reintroduced into rectification column D;
and
25 wherein a stream T(Db) having a temperature $T_{T(Db)}$ is taken from the rectification column D at a bottom position and passed for heating purpose through the bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_h(Db)$ having a temperature $T_{Th(Db)}$ with $T_{Th(Db)} > T_{T(Db)}$, wherein heated stream $T_h(Db)$ is reintroduced into rectification column D.
- 30 38. The process of any one of embodiments 1 to 37, wherein a bottom stream T(Ki) having a temperature $T_{T(Ki)}$ is taken from the bottom of the n reactive columns K(i) and passed for heating purpose through a bottom reboiler $V_{K(i)}$, thereby obtaining a heated stream $T_h(Ki)$ having a temperature $T_{hT(Ki)}$ and wherein $T_{hT(Ki)} > T_{T(Ki)}$; wherein heated stream $T_h(Ki)$ is reintroduced into rectification column D.
- 35 39. The process of any one of embodiments 2 to 38, wherein stream T(1) has a temperature $T_{T(1)}$ with $0.95 \leq T_{T(1)}/T_V \leq 1.00$ and/or a pressure $p_{T(1)}$ with $0.95 \leq p_{T(1)}/p_V \leq 1.00$.

40. The process of any one of embodiments 37 to 39, wherein stream T(1a) has a pressure $p_{T(1a)}$, which is adjusted so that $T_{\text{cond}T(1a)} \geq T_{\text{boil}T(Di)} + 3 \text{ K}$, wherein $T_{\text{cond}T(1a)}$ is the condensation temperature of stream T(1a) at a pressure $p_{T(1a)}$ and $T_{\text{boil}T(Di)}$ is the boiling temperature of stream T(Di) at a pressure $p_{T(Di)}$.
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41. The process of any one of embodiments 37 to 40, wherein stream T(1a) has a condensation temperature $T_{\text{cond}T(1a)}$ which is in the range of from 3 to 30 K, preferably in the range of from 4 and 25 K, more preferably in the range of from 5 and 20 K, higher than $T_{\text{boil}T(Di)}$.
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42. The process of any one of embodiments 37 to 41, wherein stream T(1b) has a pressure $p_{T(1b)}$, which is adjusted so that $T_{\text{cond}T(1b)} \geq T_{\text{boil}T(Db)} + 3 \text{ K}$, wherein $T_{\text{cond}T(1b)}$ is the condensation temperature of stream T(1b) at a pressure $p_{T(1b)}$ and $T_{\text{boil}T(Db)}$ is the boiling temperature of stream T(Db) at a pressure $p_{T(Db)}$.
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43. The process of any one of embodiments 37 to 42, wherein T(1b) has a condensation temperature $T_{\text{cond}T(1b)}$ which is in the range of from 3 to 30 K, preferably in the range of from 4 and 25 K, more preferably in the range of from 5 and 20 K, higher than $T_{\text{boil}T(Db)}$.
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44. The process of any one of embodiments 38 to 43, wherein stream T(1c) has a pressure $p_{T(1c)}$, which is adjusted so that $T_{\text{cond}T(1c)} \geq T_{\text{boil}T(Ki)} + 3 \text{ K}$, wherein $T_{\text{cond}T(1c)}$ is the condensation temperature of stream T(1c) at a pressure $p_{T(1c)}$ and $T_{\text{boil}T(Ki)}$ is the boiling temperature of stream T(Ki).
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45. The process of any one of embodiments 14 to 44, wherein the gaseous stream T(4) has a pressure $p_{T(4)}$ in the range of $p_{T(1b)} > p_{T(4)} > p_{V..}$.
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46. The process of any one of embodiments 1 to 45, further comprising
(g) feeding a stream M comprising methanol into the rectification column D at a position I(M).
- 35
47. The process of any one of embodiments 1 to 46, further comprising for at least one reactive distillation column K(i), preferably for n reactive distillation columns K(i), feeding the stream G(i) into the lower part of the reactive distillation column K(i) and feeding the aqueous liquid stream H(i) into the upper part of the reactive distillation column K(i).
48. The process of any one of embodiments 1 to 47, wherein a stream H(1) comprises dissolved sodium hydroxide and a stream H(2) comprises dissolved potassium hydroxide, wherein sodium methoxide is prepared in the reactive distillation column K(1) from which

the stream W(1) is obtained and potassium methoxide is prepared in the reactive distillation column K(2) from which the stream W(2) is obtained.

49. The process of any one of embodiments 1 to 48, wherein $n = 2$.
50. The process of any one of embodiments 1 to 49, wherein (f.1) comprises
- (f.1.1) feeding at least a part of the top stream W(1) into the lower part of the rectification column D at a position I(1);
- (f.1.2) feeding at least a part of the top stream W(2) into the lower part of the rectification column D at a position I(2), wherein the position I(2) is located below the position I(1);
- wherein between the positions I(1) and I(2), the rectification column D is equipped with internals.
51. The process of embodiment 50, wherein the stream W(1) comprises methanol and water at a molar methanol-to-water ratio $r(1)$ and wherein the stream W(2) comprises methanol and water at a molar methanol-to-water ratio $r(2)$ with $r(2) < r(1)$.
52. The process of embodiment 50 or 51, comprising
- (g) feeding a stream M comprising methanol into the rectification column D at a position I(M);
- wherein the positions I(1) and I(2) are located below the position I(M).
53. The process of any one of embodiments 1 to 49, wherein (f) comprises
- (f.1) feeding at least a part of the top stream W(1) into the lower part of the rectification column D at a position I(1);
- (f.2) at least partially condensing at least a part of the top stream W(2), obtaining an at least partially condensed stream $W_C(2)$, and feeding at least a part of the stream $W_C(2)$ into the rectification column at a position I(2);
- (f.3) feeding at least a part of the stream $T_C(1a)$ into the rectification column D.
54. The process of embodiment 53, comprising
- (g) feeding a stream M comprising methanol into the rectification column D at a position I(M);
- wherein (f.2') comprises passing the top stream W(2) having a temperature $T_{W(2)}$ through at least one heat exchanger E, obtaining an at least partially condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$, and feeding at least a part of the at least partially condensed stream $W_C(2)$ into the rectification column D at the position I(2); and

wherein (g) comprises passing the stream M having a temperature T_{M1} through one or more of said at least one of heat exchangers E, obtaining a stream M having a temperature T_{M2} with $T_{M2} > T_{M1}$, and feeding the stream M having the temperature T_{M2} into the rectification column D at the position I(M).

5

55. The process of embodiment 53, comprising

(g) feeding a stream M comprising methanol into the rectification column D at a position I(M);

10 wherein (f.2) and (g) comprise passing the top stream W(2) having a temperature $T_{W(2)}$ through at least one heat exchanger E(2), obtaining an at least partially, preferably essentially completely, condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$; and admixing the stream M, prior to feeding it into the rectification column D at the position I(M), with at least a part of the stream $W_C(2)$, wherein I(M) is preferably above I(1).

15 56. The process of embodiment 53, comprising

(g) feeding a stream M comprising methanol into the rectification column D at a position I(M);

20 wherein (f.2) and (g) comprise admixing the top stream W(2) having a temperature $T_{W(2)}$ with the stream M having a temperature T_{M1} with $T_{W(2)} > T_{M1}$, thereby at least partially, preferably only partially, condensing the stream W(2), and feeding the stream obtained from mixing into the rectification column D at the position I(M), wherein I(M) is preferably above I(1).

25 57. A chemical production unit for carrying out the process according to any one of embodiments 1 to 56, comprising

- a rectification column D comprising
 - in its lower part, inlet means for feeding streams W(i) or one or more combined stream thereof into D;
 - in its upper part, outlet means for removing a vapor stream V or divided streams thereof, comprising at least a gaseous stream G and at a stream T(1), from the top of D;
 - an intermediate reboiler V(1a);
 - a bottom reboiler V(1b);
- optionally a stream dividing device S_o for dividing T(1) into sub streams thereof;
- 30 - a first compressor $C_T(1)$ for compressing T(1) or a part thereof;
- 35 - a second compressor $C_T(2)$ for compressing a part stream of T(1) and/or for compressing a compressed sub stream of T(1) or a part thereof;

- means for passing compressed sub streams of T(1) from C_T(1) and/or C_T(2) as heating medium through intermediate reboiler V(1a) and bottom reboiler V(1b);
 - a stream dividing device S for dividing the stream G into n streams G(i);
 - 5 - means for passing the stream G to said stream dividing device S;
 - n reactive distillation columns K(i), n≥2 and i=1...n; said reactive distillation columns K(i) being arranged in parallel, each reactive distillation column K(i) comprising
 - in its upper part, preferably in its top, inlet means for feeding a stream H(i) into K(i);
 - 10 -- in its lower part, inlet means for feeding a stream G(i) into K(i);
 - outlet means for removing a stream W(i) from the top of K(i);
 - bottom reboilers V_K(i);
 - outlet means for removing a bottoms stream from K(i);
 - 15 -- a stream dividing means for separating a stream P(i) from the bottoms stream removed from K(i);
 - means for passing the streams G(i) to the reactive distillation columns K(i);
 - means for passing the streams W(i) to the rectification column D;
 - one or more compressors C_G(i) for compressing either the stream G and/or the streams G(i) and/or the streams W(i).
 - 20
58. The chemical production unit of embodiment 57 further comprising a trans alcoholisation unit TAU, wherein TAU comprises
- a reactive distillation column comprising
 - 25 -- inlet means for feeding a stream comprising alkali metal methoxide A(i)OMe into TAU;
 - inlet means for feeding a stream comprising alcohol HOX into TAU;
 - outlet means for removing a stream S(2) comprising methanol from the upper part of TAU;
 - 30 -- bottom reboiler V_{TAU};
 - outlet means for removing a bottoms stream S(1) comprising alkali metal alkoxide A(i)OX and alcohol XOH from TAU;
- the chemical production unit further comprising
- means for passing a bottoms stream comprising alkali metal methoxide A(i)OMe from K(i) to TAU;
 - 35 - optionally means for passing the stream S(2) comprising methanol to the rectification column D and/or to the reactive distillation columns K(i).

59. The chemical production unit of embodiment 57 or 58 comprising a third compressor $C_T(3)$ for compressing sub streams of $T(1)$ or for compressing compressed sub streams of $T(1)$.
- 5 60. The chemical production unit of any one of embodiments 57 to 59, wherein the reactive distillation columns $K(i)$ comprise bottom reboilers $V_{K(i)}$ and the chemical production unit comprises means for passing compressed sub streams of $T(1)$ as heating medium through one or more bottom reboilers $V_{K(i)}$.
- 10 61. The chemical production unit of any one of embodiment 57 to 60 comprising means for passing condensed sub streams of $T(1)$ after passage through intermediate reboiler $V(1a)$ and/or bottom reboiler $V(1b)$ and/or bottom reboilers $V_{K(i)}$ into D , the means preferably comprising
- at least one condenser, preferably a condenser $V(2)$ and optionally a further condenser $V(3)$ arranged downstream of $V(2)$, having inlet means for receiving
 - 15 condensed sub streams of $T(1)$ after passage through intermediate reboiler $V(1a)$ and/or bottom reboiler $V(1b)$ and/or bottom reboilers $V_{K(i)}$, and having outlet means for removing a condensed stream $T(3)$ and for removing a waste gas stream;
 - inlet means for feeding the stream $T(3)$ to the top of D .
- 20 62. The chemical production unit of any one of embodiment 57 to 61 comprising inlet means for feeding a methanol stream M into D .
- 25 63. Use of a chemical production unit according to any one of embodiments 57 to 62 or of a process according to any one of embodiments 1 to 56 for simultaneously producing n mixtures $P(i)$ comprising alkali metal methoxide and methanol, n being an integer with $n \geq 2$ and $i = 1 \dots n$, wherein
- 30 either at least 2 of the mixtures $P(i)$ comprise different alkali metal methoxides $A(i)OMe$, and/or at least 2 of the mixtures $P(i)$ comprise the same alkali metal alkoxide $A(i)OMe$ at different concentrations.

The present invention is further illustrated by the following reference examples, comparative examples, and examples.

35 Examples

1. Reference Example 1: Simultaneous production of sodium methoxide and

**potassium methoxide without top vapor recompression in
rectification column D**

Fig. 7 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH according to Reference Example 1. Regarding the operating conditions of the distillation column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 1a below. Regarding the relative mass flow rates, reference is made to Table 1b below.

Table 1a

Operating conditions of the columns D, K(1) and K(2)

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40

Table 1b

Relationships between the mass flow rates *f* of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from V(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water

Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G)^*$	0.92
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G)^*$	< 0.0015

*) $f(G) = f(G(1)) + f(G(2))$

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

5

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{\text{MeOH}}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{\text{MeOH}}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1),

10 $f_{\text{MeOH}}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{\text{MeOH}}(\text{water})$ is the mass flow rate of MeOH contained in the water stream, and $f_{\text{MeOH}}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

$$f_{\text{MeOH}}(M) = f_{\text{MeOH}}(P(1)) + f_{\text{MeOH}}(P(2)) + f_{\text{MeOH}}(\text{water}) + f_{\text{MeOH}}(\text{waste gas})$$

15

$$1.1 \quad f_{\text{MeOH}}(P(1)) = [(1 - C_{\text{NaOMe}}) * f(P(1))] + [(M_{\text{MeOH}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(H(1))]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg
C_{NaOMe} in P(1)	0.3	kg/kg

$$1.2 \quad f_{\text{MeOH}}(P(2)) = [(1 - C_{\text{KOMe}}) * f(P(2))] + [(M_{\text{MeOH}}/M_{\text{KOH}} * C_{\text{KOH}}) * f(H(2))]$$

20

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol

M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg
c_{KOMe} in P(2)	0.32	kg/kg

1.3 $f_{\text{MeOH}}(\text{water}) = 0.001 * f(\text{water})$ (maximum value)

1.4 $f_{\text{MeOH}}(\text{waste gas}) = 0$ (neglected)

5

In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\text{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

10 1.5 $f(\text{water}) = f_{\text{H}_2\text{O}}(\text{H}(1)) + f_{\text{H}_2\text{O}}(\text{H}(2)) + f_{\text{H}_2\text{O}}(\text{M}) - f_{\text{H}_2\text{O}}(\text{waste gas})$

$f_{\text{H}_2\text{O}}(\text{H}(1))$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\text{H}(2))$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\text{M})$ is the mass flow rate of water contained in the stream M:

15

1.5.1 $f_{\text{H}_2\text{O}}(\text{H}(1)) = [(1 - c_{\text{NaOH}}) * f(\text{H}(1))] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * c_{\text{NaOH}}) * f(\text{H}(1))]$

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg

1.5.2 $f_{\text{H}_2\text{O}}(\text{H}(2)) = [(1 - c_{\text{KOH}}) * f(\text{H}(2))] + [(M_{\text{H}_2\text{O}}/M_{\text{KOH}} * c_{\text{KOH}}) * f(\text{H}(2))]$

20

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg

1.5.3 $f_{\text{H}_2\text{O}}(\text{M}) = 0.001 * f(\text{M})$

1.5.4 $f_{\text{H}_2\text{O}}(\text{waste gas}) = 0$ (neglected)

25

2. Reference Example 2: Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first compression unit) for intermediate reboiler in rectification column D

5

Fig. 8 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH according to Reference Example 2. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 2a below. Regarding the relative mass flow rates, reference is made to Table 2b below.

The use of vapor recompression reduces the energy demand of the distillation in rectification column D considerably. It is possible to have a ratio of the heat streams to V(1b) and V(1a) of about 1:4. That means, the energy demand decreases to 20 %. But about 10 % (depending on the pressure) of the energy which is transferred in V(1a) is needed as power for the compressor C_T(1). All in all, there is already some energy saving by using vapor recompression.

15

Table 2a

Operating conditions of the columns D, K(1) and K(2)

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of C _T (1) / bar(abs)	5
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116

	Number of trays	40
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Table 2b

Relationships between the mass flow rates *f* of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from V(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water
Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G) *$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G) *$	< 0.0015
	$f(T(1)) / f(T(2))$	3.97

*) $f(G) = f(G(1)) + f(G(2))$

5

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{MeOH}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{MeOH}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1), $f_{MeOH}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{MeOH}(\text{water})$ is the mass flow rate of MeOH contained in the water stream, and $f_{MeOH}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

$$f_{MeOH}(M) = f_{MeOH}(P(1)) + f_{MeOH}(P(2)) + f_{MeOH}(\text{water}) + f_{MeOH}(\text{waste gas})$$

$$2.1 \quad f_{MeOH}(P(1)) = [(1 - C_{NaOMe}) * f(P(1))] + [(M_{MeOH}/M_{NaOH} * C_{NaOH}) * f(H(1))]$$

20

Molecular mass M / concentration c	values	units

M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg
c_{NaOMe} in P(1)	0.3	kg/kg

$$2.2 \quad f_{\text{MeOH}}(\mathbf{P(2)}) = [(1 - c_{\text{KOME}}) * f(\mathbf{P(2)})] + [(M_{\text{MeOH}}/M_{\text{KOH}} * c_{\text{KOH}}) * f(\mathbf{H(2)})]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg
c_{KOME} in P(2)	0.32	kg/kg

$$5 \quad 2.3 \quad f_{\text{MeOH}}(\mathbf{water}) = 0.001 * f(\mathbf{water}) \text{ (maximum value)}$$

$$2.4 \quad f_{\text{MeOH}}(\mathbf{waste gas}) = 0 \text{ (neglected)}$$

10 In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\mathbf{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

$$2.5 \quad f(\mathbf{water}) = f_{\text{H}_2\text{O}}(\mathbf{H(1)}) + f_{\text{H}_2\text{O}}(\mathbf{H(2)}) + f_{\text{H}_2\text{O}}(\mathbf{M}) - f_{\text{H}_2\text{O}}(\mathbf{waste gas})$$

15 $f_{\text{H}_2\text{O}}(\mathbf{H(1)})$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\mathbf{H(2)})$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\mathbf{M})$ is the mass flow rate of water contained in the stream M:

$$2.5.1 \quad f_{\text{H}_2\text{O}}(\mathbf{H(1)}) = [(1 - c_{\text{NaOH}}) * f(\mathbf{H(1)})] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * c_{\text{NaOH}}) * f(\mathbf{H(1)})]$$

20

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg

$$2.5.2 \quad f_{\text{H}_2\text{O}}(\mathbf{H(2)}) = [(1 - c_{\text{KOH}}) * f(\mathbf{H(2)})] + [(M_{\text{H}_2\text{O}}/M_{\text{KOH}} * c_{\text{KOH}}) * f(\mathbf{H(2)})]$$

Molecular mass M / concentration c	values	units
M _{H2O}	18	kg/kmol
M _{KOH}	56	kg/kmol
c _{KOH} in H(2)	0.48	kg/kg

2.5.3 $f_{H_2O}(M) = 0.001 \cdot f(M)$

2.5.4 $f_{H_2O}(\text{waste gas}) = 0$ (neglected)

5

3. Example 1: Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first and second compression units) for intermediate reboiler and bottom reboiler in rectification column D

10 Use of the second compression unit C_T(2) allowed a further reduction of heating steam (H₂O_{gaseous}) required for the bottom reboiler V(1b) of rectification column D. Compared to Reference Example 1 (without condenser), only 2.4 % of heating steam (H₂O_{gaseous}) were required (for operating bottom reboiler V_K(1) of K(1) and bottom reboiler V_K(2) of K(2)).

15 Fig. 9 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 3a below. Regarding the relative mass flow rates, reference is made to Table 3b below.

20 **Table 3a**

Operating conditions of the columns D, K(1) and K(2)

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of C _T (1) / bar(abs)	5
	Pressure at outlet of C _T (2) / bar(abs)	10
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89

	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40

Table 3bRelationships between the mass flow rates f of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from V(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water
Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G) *$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G) *$	< 0.0015
	$f(T(1)) / f(T(2))$	41
	$f(T(1a)) / f(T(1b))$	4.14

*) $f(G) = f(G(1)) + f(G(2))$

5

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

10 In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{\text{MeOH}}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{\text{MeOH}}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1), $f_{\text{MeOH}}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{\text{MeOH}}(\text{water})$ is the mass

flow rate of MeOH contained in the water stream, and $f_{\text{MeOH}}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

$$f_{\text{MeOH}}(\text{M}) = f_{\text{MeOH}}(\text{P}(1)) + f_{\text{MeOH}}(\text{P}(2)) + f_{\text{MeOH}}(\text{water}) + f_{\text{MeOH}}(\text{waste gas})$$

5

3.1 $f_{\text{MeOH}}(\text{P}(1)) = [(1 - C_{\text{NaOMe}}) * f(\text{P}(1))] + [(M_{\text{MeOH}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(\text{H}(1))]$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg
C_{NaOMe} in P(1)	0.3	kg/kg

3.2 $f_{\text{MeOH}}(\text{P}(2)) = [(1 - C_{\text{KOME}}) * f(\text{P}(2))] + [(M_{\text{MeOH}}/M_{\text{KOH}} * C_{\text{KOH}}) * f(\text{H}(2))]$

10

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
C_{KOH} in H(2)	0.48	kg/kg
C_{KOME} in P(2)	0.32	kg/kg

3.3 $f_{\text{MeOH}}(\text{water}) = 0.001 * f(\text{water})$ (maximum value)

3.4 $f_{\text{MeOH}}(\text{waste gas}) = 0$ (neglected)

15

In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\text{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

20

3.5 $f(\text{water}) = f_{\text{H}_2\text{O}}(\text{H}(1)) + f_{\text{H}_2\text{O}}(\text{H}(2)) + f_{\text{H}_2\text{O}}(\text{M}) - f_{\text{H}_2\text{O}}(\text{waste gas})$

$f_{\text{H}_2\text{O}}(\text{H}(1))$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\text{H}(2))$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\text{M})$ is the mass flow rate of water contained in the stream M:

25

3.5.1 $f_{\text{H}_2\text{O}}(\text{H}(1)) = [(1 - C_{\text{NaOH}}) * f(\text{H}(1))] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(\text{H}(1))]$

Molecular mass M / concentration c	values	units
M _{H2O}	18	kg/kmol
M _{NaOH}	40	kg/kmol
c _{NaOH} in H(1)	0.5	kg/kg

3.5.2 $f_{H_2O}(H(2)) = [(1 - c_{KOH}) * f(H(2))] + [(M_{H_2O}/M_{KOH} * c_{KOH}) * f(H(2))]$

Molecular mass M / concentration c	values	units
M _{H2O}	18	kg/kmol
M _{KOH}	56	kg/kmol
c _{KOH} in H(2)	0.48	kg/kg

5

3.5.3 $f_{H_2O}(M) = 0.001 * f(M)$

3.5.4 $f_{H_2O}(\text{waste gas}) = 0$ (neglected)

10 **4. Example 2: Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first and second compression units) for intermediate reboiler and bottom reboiler in rectification column D and use of the 2nd compression unit also for the bottom reboilers V_K(1) and V_K(2) of K(1) and K(2)**

15

Fig. 10 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 4a below. Regarding the relative mass flow rates, reference is made to Table 4b below.

20

Compared to Example 1, the use of the second compression unit C_T(2) combined with transfer of a first part of the resulting stream T(1b), i.e. T(1b.1), to the bottom reboiler V(1b) of rectification column D combined with transfer of a second part of the resulting T(1b), i.e. T(1b.2), to bottom reboilers V_K(1) and V_K(2) allowed a further reduction of heating steam (H₂O_{gaseous}) required. Compared to Reference Example 1), 0 % of heating steam (H₂O_{gaseous}) were required (for operating bottom reboiler V_K(1) of K(1) and bottom reboiler V_K(2) of K(2).

25

Table 4a
Operating conditions of the columns D, K(1) and K(2)

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of C _T (1) / bar(abs)	5
	Pressure at outlet of C _T (2) / bar(abs)	10
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40

Table 4bRelationships between the mass flow rates *f* of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from V(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water
Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G) *$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G) *$	< 0.0015

	$f(T(1)) / f(T(2))$	2176
	$f(T(1a)) / f(T(1b))$	3.68
	$f(T(1b.2.1)) / f(T(1b.1))$	0.091
	$f(T(1b.2.2)) / f(T(1b.1))$	0.033

*) $f(G) = f(G(1)) + f(G(2))$

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

5

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{MeOH}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{MeOH}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1),

10 $f_{MeOH}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{MeOH}(\text{water})$ is the mass flow rate of MeOH contained in the water stream, and $f_{MeOH}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

$$f_{MeOH}(M) = f_{MeOH}(P(1)) + f_{MeOH}(P(2)) + f_{MeOH}(\text{water}) + f_{MeOH}(\text{waste gas})$$

15

$$4.1 \quad f_{MeOH}(P(1)) = [(1 - C_{NaOMe}) * f(P(1))] + [(M_{MeOH}/M_{NaOH} * C_{NaOH}) * f(H(1))]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg
C_{NaOMe} in P(1)	0.3	kg/kg

$$4.2 \quad f_{MeOH}(P(2)) = [(1 - C_{KOMe}) * f(P(2))] + [(M_{MeOH}/M_{KOH} * C_{KOH}) * f(H(2))]$$

20

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
C_{KOH} in H(2)	0.48	kg/kg
C_{KOMe} in P(2)	0.32	kg/kg

$$4.3 \quad f_{MeOH}(\text{water}) = 0.001 * f(\text{water}) \text{ (maximum value)}$$

$$4.4 \quad f_{\text{MeOH}}(\text{waste gas}) = 0 \text{ (neglected)}$$

In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\text{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

$$4.5 \quad f(\text{water}) = f_{\text{H}_2\text{O}}(\text{H}(1)) + f_{\text{H}_2\text{O}}(\text{H}(2)) + f_{\text{H}_2\text{O}}(\text{M}) - f_{\text{H}_2\text{O}}(\text{waste gas})$$

10 $f_{\text{H}_2\text{O}}(\text{H}(1))$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\text{H}(2))$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\text{M})$ is the mass flow rate of water contained in the stream M:

$$4.5.1 \quad f_{\text{H}_2\text{O}}(\text{H}(1)) = [(1 - c_{\text{NaOH}}) * f(\text{H}(1))] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * c_{\text{NaOH}}) * f(\text{H}(1))]$$

15

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg

$$4.5.2 \quad f_{\text{H}_2\text{O}}(\text{H}(2)) = [(1 - c_{\text{KOH}}) * f(\text{H}(2))] + [(M_{\text{H}_2\text{O}}/M_{\text{KOH}} * c_{\text{KOH}}) * f(\text{H}(2))]$$

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg

$$20 \quad 4.5.3 \quad f_{\text{H}_2\text{O}}(\text{M}) = 0.001 * f(\text{M})$$

$$4.5.4 \quad f_{\text{H}_2\text{O}}(\text{waste gas}) = 0 \text{ (neglected)}$$

25 **5. Example 3: Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first and second compression units) for intermediate reboiler and bottom reboiler in rectification column D and use of a 3rd compression unit for the bottom reboiler of K(1) and bottom reboiler of K(2)**

Fig. 11 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 5a below. Regarding the relative mass flow rates, reference is made to Table 5b below. The amount of heating steam ($\text{H}_2\text{O}_{\text{gaseous}}$) required is reduced to zero when using the second compression unit $\text{C}_\text{T}(2)$ for the bottom reboiler $\text{V}(1\text{b})$ of rectification column D and the third compression unit $\text{C}_\text{T}(3)$ for the reboiler $\text{V}_\text{K}(1)$ of reactive distillation column K(1) and the reboiler $\text{V}_\text{K}(2)$ or reactive distillation column K(2).

Table 5a

Operating conditions of the columns D, K(1) and K(2)

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of $\text{C}_\text{T}(1)$ / bar(abs)	5
	Pressure at outlet of $\text{C}_\text{T}(2)$ / bar(abs)	10
	Pressure at outlet of $\text{C}_\text{T}(3)$ / bar(abs)	10
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40

Table 5b

Relationships between the mass flow rates f of the different streams

Definition of	Specified: H(1), H(2)
---------------	-----------------------

streams	M(1), M(2):	part of condensate from V(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water
Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G *)$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G *)$	< 0.0015
	$f(T(1)) / f(T(2))$	2176
	$f(T(1a)) / f(T(1b))$	4.14
	$f(T(1a)) / f(T(1c))$	33.5
	$f(T(1c.1)) / f(T(1c))$	0.736
	$f(T(1c.2)) / f(T(1c))$	0.264

*) $f(G) = f(G(1)) + f(G(2))$

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

5

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{MeOH}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{MeOH}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1), $f_{MeOH}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{MeOH}(\text{water})$ is the mass flow rate of MeOH contained in the water stream, and $f_{MeOH}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

10

$$f_{MeOH}(M) = f_{MeOH}(P(1)) + f_{MeOH}(P(2)) + f_{MeOH}(\text{water}) + f_{MeOH}(\text{waste gas})$$

15

5.1
$$f_{MeOH}(P(1)) = [(1 - C_{NaOMe}) * f(P(1))] + [(M_{MeOH}/M_{NaOH} * C_{NaOH}) * f(H(1))]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol

M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg
C_{NaOMe} in P(1)	0.3	kg/kg

$$5.2 \quad f_{\text{MeOH}}(\mathbf{P(2)}) = [(1 - C_{\text{KOME}}) * f(\mathbf{P(2)})] + [(M_{\text{MeOH}}/M_{\text{KOH}} * C_{\text{KOH}}) * f(\mathbf{H(2)})]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
C_{KOH} in H(2)	0.48	kg/kg
C_{KOME} in P(2)	0.32	kg/kg

$$5.3 \quad f_{\text{MeOH}}(\mathbf{water}) = 0.001 * f(\mathbf{water}) \text{ (maximum value)}$$

$$5.4 \quad f_{\text{MeOH}}(\mathbf{waste gas}) = 0 \text{ (neglected)}$$

10 In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\mathbf{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

$$5.5 \quad f(\mathbf{water}) = f_{\text{H}_2\text{O}}(\mathbf{H(1)}) + f_{\text{H}_2\text{O}}(\mathbf{H(2)}) + f_{\text{H}_2\text{O}}(\mathbf{M}) - f_{\text{H}_2\text{O}}(\mathbf{waste gas})$$

15 $f_{\text{H}_2\text{O}}(\mathbf{H(1)})$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\mathbf{H(2)})$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\mathbf{M})$ is the mass flow rate of water contained in the stream M:

$$5.5.1 \quad f_{\text{H}_2\text{O}}(\mathbf{H(1)}) = [(1 - C_{\text{NaOH}}) * f(\mathbf{H(1)})] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(\mathbf{H(1)})]$$

20

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg

$$5.5.2 \quad f_{\text{H}_2\text{O}}(\mathbf{H(2)}) = [(1 - C_{\text{KOH}}) * f(\mathbf{H(2)})] + [(M_{\text{H}_2\text{O}}/M_{\text{KOH}} * C_{\text{KOH}}) * f(\mathbf{H(2)})]$$

Molecular mass M / concentration c	values	units
M _{H2O}	18	kg/kmol
M _{KOH}	56	kg/kmol
c _{KOH} in H(2)	0.48	kg/kg

5.5.3 $f_{H_2O}(M) = 0.001 \cdot f(M)$

5.5.4 $f_{H_2O}(\text{waste gas}) = 0$ (neglected)

5

6. Example 4: (Based on Example 2) Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first and second compression units) for intermediate reboiler and bottom reboiler in rectification column D, use of the 2nd compression unit also for the bottom reboilers V_K(1) and V_K(2) of K(1) and K(2) with third condensate drum CD(3)

10

Fig. 12 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 6a below. Regarding the relative mass flow rates, reference is made to Table 6b below.

15

Table 6a

Operating conditions of the columns D, K(1) and K(2)

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of C _T (1) / bar(abs)	5
	Pressure at outlet of C _T (2) / bar(abs)	10
	Pressure in CD(3) / bar(abs)	2.2
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117

	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40

Table 6bRelationships between the mass flow rates f of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from CD(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water
Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G)^*$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G)^*$	< 0.0015
	$f(T(1)) / f(T(2))$	31
	Methanol to $C_T(1)$ / Methanol to $C_T(2)$	3.68
	Methanol to $V_k(1)$ / methanol to $V(1b)$	0.091
	Methanol to $V_k(2)$ / methanol to $V_k(1b)$	0.033
	$f(T(1)) / f(T(4))$	31.3

*) $f(G) = f(G(1)) + f(G(2))$

5

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{\text{MeOH}}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{\text{MeOH}}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1), $f_{\text{MeOH}}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{\text{MeOH}}(\text{water})$ is the mass

10

flow rate of MeOH contained in the water stream, and $f_{\text{MeOH}}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

$$f_{\text{MeOH}}(\text{M}) = f_{\text{MeOH}}(\text{P}(1)) + f_{\text{MeOH}}(\text{P}(2)) + f_{\text{MeOH}}(\text{water}) + f_{\text{MeOH}}(\text{waste gas})$$

5

6.1
$$f_{\text{MeOH}}(\text{P}(1)) = [(1 - C_{\text{NaOMe}}) * f(\text{P}(1))] + [(M_{\text{MeOH}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(\text{H}(1))]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg
C_{NaOMe} in P(1)	0.3	kg/kg

6.2
$$f_{\text{MeOH}}(\text{P}(2)) = [(1 - C_{\text{KOME}}) * f(\text{P}(2))] + [(M_{\text{MeOH}}/M_{\text{KOH}} * C_{\text{KOH}}) * f(\text{H}(2))]$$

10

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
C_{KOH} in H(2)	0.48	kg/kg
C_{KOME} in P(2)	0.32	kg/kg

6.3
$$f_{\text{MeOH}}(\text{water}) = 0.001 * f(\text{water}) \text{ (maximum value)}$$

6.4
$$f_{\text{MeOH}}(\text{waste gas}) = 0 \text{ (neglected)}$$

15

In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\text{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

20 6.5
$$f(\text{water}) = f_{\text{H}_2\text{O}}(\text{H}(1)) + f_{\text{H}_2\text{O}}(\text{H}(2)) + f_{\text{H}_2\text{O}}(\text{M}) - f_{\text{H}_2\text{O}}(\text{waste gas})$$

$f_{\text{H}_2\text{O}}(\text{H}(1))$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\text{H}(2))$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\text{M})$ is the mass flow rate of water contained in the stream M:

25

6.5.1
$$f_{\text{H}_2\text{O}}(\text{H}(1)) = [(1 - C_{\text{NaOH}}) * f(\text{H}(1))] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(\text{H}(1))]$$

Molecular mass M / concentration c	values	units
M _{H2O}	18	kg/kmol
M _{NaOH}	40	kg/kmol
c _{NaOH} in H(1)	0.5	kg/kg

6.5.2 $f_{H_2O}(H(2)) = [(1 - c_{KOH}) * f(H(2))] + [(M_{H_2O}/M_{KOH} * c_{KOH}) * f(H(2))]$

Molecular mass M / concentration c	values	units
M _{H2O}	18	kg/kmol
M _{KOH}	56	kg/kmol
c _{KOH} in H(2)	0.48	kg/kg

5

6.5.3 $f_{H_2O}(M) = 0.001 * f(M)$

6.5.4 $f_{H_2O}(\text{waste gas}) = 0$ (neglected)

10 Example 4 is based on Example 2 above. In Example 2 above, the stream T(1a), coming from the first compression unit C_T(1), is passed as a heating medium through an intermediate reboiler V(1a) of the rectification column D, obtaining a condensed stream T_c(1a). The stream T(1b) is split into two streams, wherein a first part of the resulting stream T(1b), i.e. T(1b.1), is fed to the bottom reboiler V(1b) of rectification column D, from which a condensed stream

15 T_c(1b.1) is obtained. A second part of the stream T(1b), i.e. T(1b.2), is fed to bottom reboilers V_K(1) and V_K(2), obtaining a condensed stream T_c(1b.2) after passing the reboilers V_K(1) and V_K(2). All the condensed streams T_c(1a), T_c(1b.1) and T_c(1b.2) are fed into a first condensate drum CD(1). Furthermore, a further stream T(2) is prepared from the vapor phase V and passed through a condenser V(2), obtaining a liquid stream T(2l) and a gas stream T(2g); the gas

20 stream T(2g) is in turn passed through a condenser V(3), obtaining a liquid stream T(2gl) and a waste gas stream T(2w). The liquid streams T(2l) and (T2gl) are combined in a second condensate drum CD(2) in depressurized form.

From the first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are re-

25 moved, said gas stream T(1g) being fed into a condenser V(2) together with stream T(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) in depressurized form in the second condensate drum CD(2), obtaining from said second condensate drum

CD(2) a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

Contrary to Example 2, from the condensed streams $T_c(1a)$, $T_c(1b.1)$ and $T_c(1b.2)$ only condensed stream $T_c(1a)$ is fed into a first condensate drum CD(1). Condensed streams $T_c(1b.1)$ and $T_c(1b.2)$ are combined in a third condensate drum CD(3) in depressurized form, wherein from said third condensate drum CD(3) a gaseous stream T(4) is obtained, which is fed into the top of the rectification column D. From said third condensate drum CD(3) further a liquid stream T(5) is obtained, which is combined with the liquid stream T(1l) and the liquid streams T(2l) and T(2gl) in depressurized form in the second condensate drum CD(2), obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

As in Example 2, the use of the second compression unit $C_T(2)$ combined with transfer of a first part of the resulting stream T(1b), i.e. T(1b.1), to the bottom reboiler V(1b) of rectification column D combined with transfer of a second part of the resulting T(1b), i.e. T(1b.2), to bottom reboilers $V_K(1)$ and $V_K(2)$ allowed a further reduction of heating steam ($H_2O_{gaseous}$) required. As in Example 2 (compared to Reference Example 1), no heating steam ($H_2O_{gaseous}$) is required (for operating bottom reboiler $V_K(1)$ of K(1) and bottom reboiler $V_K(2)$ of K(2)). Furthermore, in addition to Example 2, by feeding $T_c(1b.1)$ and $T_c(1b.2)$ into CD(3), the ratio $f(T(1)) / f(T(2))$ could be drastically reduced (from 2167 as in Example 2 to 31 only). This enabled for all operation conditions to have enough MeOH steam as stream T(1) for operating $C_T(1)$ and $C_T(2)$.

7. Example 5: (Based on Example 4) Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first and second compression units) for intermediate reboiler and bottom reboiler in rectification column D, use of the 2nd compression unit also for the bottom reboilers $V_K(1)$ and $V_K(2)$ of K(1) and K(2) with third condensate drum CD(3) and additional further trans alcoholization unit TAU, with use of a part of stream T(1a) for heating TAU

Fig. 15 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH with an additional trans alcoholization unit (TAU), in which NaOMe is reacted with EtOH to NaOEt and MeOH. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 7a below. Regarding the relative mass flow rates, reference is made to Table 7b below.

Table 7a

Operating conditions of the columns D, K(1) and K(2) and TAU

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of C _T (1) / bar(abs)	5
	Pressure at outlet of C _T (2) / bar(abs)	10
	Pressure in CD(3) / bar(abs)	2.2
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40
TAU	Pressure at the top / bar(abs)	1
	Temperature at the top / °C	64.3
	Pressure at the bottom / bar(abs)	1.2
	Temperature at the bottom / °C	95.5
	Number of trays	80
	Feed to tray	40

Table 7b

Relationships between the mass flow rates *f* of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from CD(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water

Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G \text{ } ^*)$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G \text{ } ^*)$	< 0.0015
	$f(T(1)) / f(T(2))$	150
	Methanol to $C_T(1)$ / Methanol to $C_T(2)$	3.8
	Methanol to $V_K(1)$ / methanol to $V(1b)$	0.091
	Methanol to $V_K(2)$ / methanol to $V(1b)$	0.033
	$f(T(1)) / f(T(4))$	32.1
	$f(\text{Feed to TAU}) / f(P(1))$	0.0235
	Feed ethanol / $f(\text{Feed to TAU})$	1.68
	Reflux ratio of TAU	7
	$T(1b.2) / T(1b.1)$	0.134

$^*) f(G) = f(G(1)) + f(G(2))$

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

5 S(1): 21 weight-% of sodium ethoxide in ethanol, <100 ppm of methanol.

S(2): methanol, <1000 ppm of ethanol

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{MeOH}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{MeOH}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1), $f_{MeOH}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{MeOH}(\text{water})$ is the mass flow rate of MeOH contained in the water stream, and $f_{MeOH}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

15

$$f_{MeOH}(M) = f_{MeOH}(P(1)) + f_{MeOH}(P(2)) + f_{MeOH}(\text{water}) + f_{MeOH}(\text{waste gas})$$

$$7.1 \quad f_{MeOH}(P(1)) = [(1 - C_{NaOMe}) * f(P(1))] + [(M_{MeOH}/M_{NaOH} * C_{NaOH}) * f(H(1))]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg
c_{NaOMe} in P(1)	0.3	kg/kg

$$7.2 \quad f_{\text{MeOH}}(\mathbf{P(2)}) = [(1 - c_{\text{KOME}}) * f(\mathbf{P(2)})] + [(M_{\text{MeOH}}/M_{\text{KOH}} * c_{\text{KOH}}) * f(\mathbf{H(2)})]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg
c_{KOME} in P(2)	0.32	kg/kg

$$5 \quad 7.3 \quad f_{\text{MeOH}}(\mathbf{water}) = 0.001 * f(\mathbf{water}) \text{ (maximum value)}$$

$$7.4 \quad f_{\text{MeOH}}(\mathbf{waste gas}) = 0 \text{ (neglected)}$$

10 In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\mathbf{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

$$7.5 \quad f(\mathbf{water}) = f_{\text{H}_2\text{O}}(\mathbf{H(1)}) + f_{\text{H}_2\text{O}}(\mathbf{H(2)}) + f_{\text{H}_2\text{O}}(\mathbf{M}) - f_{\text{H}_2\text{O}}(\mathbf{waste gas})$$

15 $f_{\text{H}_2\text{O}}(\mathbf{H(1)})$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(\mathbf{H(2)})$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(\mathbf{M})$ is the mass flow rate of water contained in the stream M:

$$7.5.1 \quad f_{\text{H}_2\text{O}}(\mathbf{H(1)}) = [(1 - c_{\text{NaOH}}) * f(\mathbf{H(1)})] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * c_{\text{NaOH}}) * f(\mathbf{H(1)})]$$

20

Molecular mass M / concentration c	values	units
$M_{\text{H}_2\text{O}}$	18	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg

7.5.2 $f_{H_2O}(H(2)) = [(1 - c_{KOH}) * f(H(2))] + [(M_{H_2O}/M_{KOH} * c_{KOH}) * f(H(2))]$

Molecular mass M / concentration c	values	units
M_{H_2O}	18	kg/kmol
M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg

7.5.3 $f_{H_2O}(M) = 0.001 * f(M)$

7.5.4 $f_{H_2O}(\text{waste gas}) = 0$ (neglected)

Example 5 is based on Example 4 above. Contrary to Example 4, a part of the mixture P(1), removed from the column K(1), which comprises NaOMe and methanol is fed into the trans alcoholization unit, preferably into the middle section of the trans alcoholization unit TAU. A stream comprising ethanol, is fed into a bottom reboiler V_{TAU} of the trans alcoholisation unit TAU and therein combined with a part of the bottoms stream removed from TAU and fed into V_{TAU} of TAU, wherein the combined stream is reintroduced into the trans alcoholisation unit TAU. A stream S(2), which comprises MeOH, is removed from the upper section of the trans alcoholisation unit TAU, preferably as top stream, and a stream S(1) comprising NaOEt and ethanol, is removed as bottoms stream from the trans alcoholisation unit TAU.

Contrary to Example 4, Two streams are prepared from stream T(1a), i.e. streams T(1a.1) and (T1a.2), wherein a first part stream T(1a.1) is conducted as in Example 4, i.e. passed as a heating medium through the intermediate reboiler V(1a) of D and the resulting stream $T_c(1a.1)$ is fed to the first condensate drum CD(1). T(1a.2) is fed to the bottoms reboiler of trans alcoholization unit TAU and the condensed stream $T_c(1a.2)$ is fed to the first condensate drum CD(1). Using stream T(1a.2) as heating medium for the bottoms reboiler of trans alcoholization unit TAU V_{TAU} allows to operate TAU without need for further external heating medium.

8. Example 6: (Based on Example 4) Simultaneous production of sodium methoxide and potassium methoxide with top vapor recompression (first and second compression units) for intermediate reboiler and bottom reboiler in rectification column D, use of the 2nd compression unit also for the bottom reboilers $V_K(1)$ and $V_K(2)$ of K(1) and K(2) with third condensate drum CD(3) and additional further trans alcoholization unit TAU, with use of a part of stream T(1b) for heating TAU

Fig. 14 shows a process scheme for preparing a mixture P(1) comprising NaOMe and MeOH and a mixture P(2) comprising KOMe and MeOH with an additional trans alcoholization unit (TAU), in which NaOMe is reacted with EtOH to NaOEt and MeOH. Regarding the operating conditions of the rectification column D and of the reactive distillation columns K(1) and K(2), reference is made to Table 8a below. Regarding the relative mass flow rates, reference is made to Table 8b below.

Table 8a

Operating conditions of the columns D, K(1) and K(2) and TAU

Column D	Pressure at the top / bar(abs)	2.1
	Temperature at the top / °C	84
	Pressure at the bottom / bar(abs)	2.23
	Temperature at the bottom / °C	124
	Theoretical stages	50
	W(1), W(2) to theoretical stage from bottom	8th
	M fed to theoretical stage from bottom	42th
	Pressure at outlet of C _T (1) / bar(abs)	5
	Pressure at outlet of C _T (2) / bar(abs)	10
	Pressure in CD(3) / bar(abs)	2.2
Column K(1)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	117
	Number of trays	40
Column K(2)	Pressure at the top / bar(abs)	2.15
	Temperature at the top / °C	89
	Pressure at the bottom / bar(abs)	2.3
	Temperature at the bottom / °C	116
	Number of trays	40
TAU	Pressure at the top / bar(abs)	1
	Temperature at the top / °C	64.3
	Pressure at the bottom / bar(abs)	1.2
	Temperature at the bottom / °C	95.5
	Number of trays	80
	Feed to tray	40

Table 8bRelationships between the mass flow rates f of the different streams

Definition of streams	Specified:	H(1), H(2)
	M(1), M(2):	part of condensate from CD(2)
	H(1):	NaOH 50 weight-% in water
	H(2):	KOH 48 weight-% in water
Ratios of mass flow rates of streams	$f(G(1)) / f(H(1))$	13.3
	$f(G(2)) / f(H(2))$	9.03
	$f(M(1)) / f(H(1))$	0.55
	$f(M(2)) / f(H(2))$	0.40
	$f(T(3)) / f(G \text{ *)}$	1.0
	$f(P(1)) / f(H(1))$	2.25
	$f(P(2)) / f(H(2))$	1.86
	$f(\text{waste gas}) / f(G \text{ *)}$	< 0.0015
	$f(T(1)) / f(T(2))$	90
	Methanol to $C_T(1)$ / Methanol to $C_T(2)$	3.3
	Methanol to $V_K(1)$ / methanol to $V(1b)$	0.091
	Methanol to $V_K(2)$ / methanol to $V(1b)$	0.033
	$f(T(1)) / f(T(4))$	28.8
	$f(\text{Feed to TAU}) / f(P(1))$	0.0235
	Feed ethanol / $f(\text{Feed to TAU})$	1.68
	Reflux ratio of TAU	7
	$T(1b.2.2) / T(1b.1)$	0.130

*) $f(G) = f(G(1)) + f(G(2))$

5

P(1): 30 weight-% of sodium methoxide in methanol, < 1000 ppm of water.

P(2): 32 weight-% of potassium methoxide in methanol, < 1000 ppm of water.

S(1): 21 weight-% of sodium ethoxide in ethanol, <100 ppm of methanol.

S(2): methanol, <1000 ppm of ethanol

10

In the following, it is indicated how the mass flow rate of the methanol contained in the stream M (methanol balance, fresh methanol stream), $f_{MeOH}(M)$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected. According to this calculation, $f_{MeOH}(P(1))$ is the mass flow rate of MeOH contained in the stream P(1),

15 $f_{MeOH}(P(2))$ is the mass flow rate of MeOH contained in the stream P(2), $f_{MeOH}(\text{water})$ is the mass

flow rate of MeOH contained in the water stream, and $f_{\text{MeOH}}(\text{waste gas})$ is the mass flow rate of MeOH contained in the waste gas stream:

$$f_{\text{MeOH}}(M) = f_{\text{MeOH}}(P(1)) + f_{\text{MeOH}}(P(2)) + f_{\text{MeOH}}(\text{water}) + f_{\text{MeOH}}(\text{waste gas})$$

5

$$8.1 \quad f_{\text{MeOH}}(P(1)) = [(1 - C_{\text{NaOMe}}) * f(P(1))] + [(M_{\text{MeOH}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(H(1))]$$

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{NaOH}	40	kg/kmol
C_{NaOH} in H(1)	0.5	kg/kg
C_{NaOMe} in P(1)	0.3	kg/kg

$$8.2 \quad f_{\text{MeOH}}(P(2)) = [(1 - C_{\text{KOME}}) * f(P(2))] + [(M_{\text{MeOH}}/M_{\text{KOH}} * C_{\text{KOH}}) * f(H(2))]$$

10

Molecular mass M / concentration c	values	units
M_{MeOH}	32	kg/kmol
M_{KOH}	56	kg/kmol
C_{KOH} in H(2)	0.48	kg/kg
C_{KOME} in P(2)	0.32	kg/kg

$$8.3 \quad f_{\text{MeOH}}(\text{water}) = 0.001 * f(\text{water}) \text{ (maximum value)}$$

$$8.4 \quad f_{\text{MeOH}}(\text{waste gas}) = 0 \text{ (neglected)}$$

15

In the following, it is indicated how the mass flow rate of the water contained in the stream water (bottom stream of D, waste water stream), $f(\text{water})$, is calculated. In this calculation, the water contents of P(1) and P(2), both being less than 1000 weight-ppm, are neglected.

$$20 \quad 8.5 \quad f(\text{water}) = f_{\text{H}_2\text{O}}(H(1)) + f_{\text{H}_2\text{O}}(H(2)) + f_{\text{H}_2\text{O}}(M) - f_{\text{H}_2\text{O}}(\text{waste gas})$$

$f_{\text{H}_2\text{O}}(H(1))$ is the mass flow rate of water contained in the stream H(1) and $f_{\text{H}_2\text{O}}(H(2))$ is the mass flow rate of water contained in the stream H(2) and $f_{\text{H}_2\text{O}}(M)$ is the mass flow rate of water contained in the stream M:

25

$$8.5.1 \quad f_{\text{H}_2\text{O}}(H(1)) = [(1 - C_{\text{NaOH}}) * f(H(1))] + [(M_{\text{H}_2\text{O}}/M_{\text{NaOH}} * C_{\text{NaOH}}) * f(H(1))]$$

Molecular mass M / concentration c	values	units
M_{H_2O}	18	kg/kmol
M_{NaOH}	40	kg/kmol
c_{NaOH} in H(1)	0.5	kg/kg

$$8.5.2 \quad f_{H_2O}(H(2)) = [(1 - c_{KOH}) * f(H(2))] + [(M_{H_2O}/M_{KOH} * c_{KOH}) * f(H(2))]$$

Molecular mass M / concentration c	values	units
M_{H_2O}	18	kg/kmol
M_{KOH}	56	kg/kmol
c_{KOH} in H(2)	0.48	kg/kg

5

$$8.5.3 \quad f_{H_2O}(M) = 0.001 * f(M)$$

$$8.5.4 \quad f_{H_2O}(\text{waste gas}) = 0 \text{ (neglected)}$$

- 10 Example 6 is based on Example 4 above. Contrary to Example 4, a part of the mixture P(1), removed from the column K(1), which comprises NaOMe and methanol is fed into the trans alcoholization unit, preferably into the middle section of the trans alcoholization unit TAU. A stream comprising ethanol, is fed into a bottom reboiler V_{TAU} of the trans alcoholisation unit TAU and therein combined with a part of the bottoms stream removed from TAU and fed into V_{TAU} of
- 15 TAU, wherein the combined stream is reintroduced into the trans alcoholisation unit TAU. A stream S(2), which comprises MeOH, is removed from the upper section of the trans alcoholisation unit TAU, preferably as top stream, and a stream S(1) comprising NaOEt and ethanol, is removed as bottoms stream from the trans alcoholisation unit TAU.
- 20 As in Example 4, two streams are prepared from stream T(1b), i.e. streams T(1b.1) and T(1b.2), wherein stream T(1b.1) is conducted as in Example 4. Contrary to Example 4, stream T(1b.2) is split into 2 streams T(1b.2.1), T(1b.2.2). T(1b.2.1) is again split into two streams, wherein T(1b.2.1) –after splitting into T(1b.2.1.1) and T(1b.2.1.2) is passed as a heating medium through the bottom reboilers $V_K(1)$ and $V_K(2)$ of reactive distillation columns K(1) and K(2). The resulting
- 25 condensed streams after $V_K(1)$ and $V_K(2)$ are combined and fed as condensed stream $T_c(1b.2.1)$ into the third condensate drum CD(3). T(1b.2.2) is fed to the bottoms reboiler of trans alcoholization unit TAU and the condensed stream $T_c(1b.2.2)$ is fed to the third condensate drum CD(3).

Using a part of stream T(1b.2), i.e. stream T(1b.2.2), as heating medium for the bottoms reboiler of trans alcoholization unit TAU V_{TAU} allows to operate TAU without need for further external heating medium.

5

Short description of the Figures

Fig. 1 shows a schematic overview of a process according to the present invention wherein a vapor phase V comprising methanol is obtained at the top of the rectification column D. From said vapor phase V, three (dry) methanol streams are prepared, said at least three streams comprising a vapor stream G and two streams T(1a) and T(1b), wherein initially, from vapor phase V a vapor stream G and a vapor stream T(1) are prepared, followed by preparation of T(1a) and T(1b) from stream T(1). For preparing the streams T(1a) and T(1b), a first compression unit $C_T(1)$ and a second compression unit $C_T(2)$ are employed. At least a part of the stream T(1a) obtained from $C_T(1)$ is then passed as a heating medium through an intermediate reboiler V(1a) of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_c(1a)$ and at least a part of the stream T(1b) obtained from $C_T(2)$ is passed as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_c(1b)$. The gas stream G, exhibiting a flow rate $f(G)$, is passed through a compressor C_G , and the thus compressed stream is then divided into two compressed streams G(1) and G(2), both having the same composition as G. The stream G(1) exhibits a flow rate $f(G(1))$, the stream G(2) exhibits a flow rate $f(G(2))$, wherein $f(G(1)) + f(G(2)) = f(G)$. The compressed stream G(1) is fed into the lower part of reactive distillation column K(1), wherein into the upper part of K(1), a liquid aqueous stream H(1) comprising a dissolved alkali metal hydroxide $A(1)OH$ is fed. A part of the bottoms stream removed from the column K(1) is fed into the reboiler $V_K(1)$ of K(1), the other part of the bottoms stream is the mixture P(1) comprising alkali metal methoxide $A(1)OMe$ and methanol. From the top of the column K(1), which is operated without reflux, a gas stream W(1) essentially consisting of methanol and water is removed, wherein W(1) is fed into a lower part of the rectification column D. The compressed stream G(2) is then fed into the lower part of reactive distillation column K(2), wherein into the upper part of K(2), a liquid aqueous stream H(2) comprising a dissolved alkali metal hydroxide $A(2)OH$ is fed. A part of the bottoms stream removed from the column K(2) is fed into the reboiler $V_K(2)$ of K(2), the other part of the bottoms stream is the mixture P(2) comprising alkali metal methoxide $A(2)OMe$ and methanol. From the top of the column K(2), which is operated without reflux, a gas stream W(2) essentially consisting of methanol and water is removed, wherein W(2) is fed, together with W(1), into a lower part of the rectification column D. The realization of the reflux ratio for rectification column D is shown in the upper part of Fig. 1, wherein realizing the reflux ratio comprises preparing from the vapor phase V a further vapor stream T(2), passing said stream T(2) through a condenser V(2),

obtaining a liquid stream T(3) and a waste gas stream T(2w), and feeding the liquid stream T(3) into the top of the rectification column D. Additionally, T_c(1a) and/or T_c(1b), preferably T_c(1a) and T_c(1b), each at least partially, is/are fed to a first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream T(1l) are removed, said
5 gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) in a second condensate drum CD(2) in depressurized form, obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

- 10 **Fig. 2** shows a schematic overview of a process according to the present invention wherein a vapor phase V comprising methanol is obtained at the top of the rectification column D. From said vapor phase V, three (dry) methanol streams are prepared, said at least three streams comprising a vapor stream G and two streams T(1a) and T(1b), wherein initially, from vapor phase V a vapor stream G and a vapor stream T(1) are preparing, followed by prepara-
15 tion of T(1a) and T(1b) from stream T(1). For preparing the streams T(1a) and T(1b), a first compression unit C_T(1) and a second compression unit C_T(2) are employed, wherein stream T(1) is initially fed to the first compression unit C_T(1) and the resulting stream after CT(1) is then split into two streams, wherein a first part stream thereof T(1a) is fed a heating medium through an intermediate reboiler V(1a) of the rectification column D, wherein the stream condensates,
20 thereby obtaining a stream T_c(1a). A second part stream thereof is fed to the second compression unit CT(2), and at least a part of the stream T(1b) obtained from C_T(2) is passed as a heating medium through a bottom reboiler V(1b) of the rectification column D, wherein the stream condensates, thereby obtaining a stream T_c(1b). The gas stream G, exhibiting a flow rate f(G), is passed through a compressor C_G, and the thus compressed stream is then divided into two
25 compressed streams G(1) and G(2), both having the same composition as G. The stream G(1) exhibits a flow rate f(G(1)), the stream G(2) exhibits a flow rate f(G(2)), wherein $f(G(1)) + f(G(2)) = f(G)$. The compressed stream G(1) is fed into the lower part of reactive distillation column K(1), wherein into the upper part of K(1), a liquid aqueous stream H(1) comprising a dissolved alkali metal hydroxide A(1)OH is fed. A part of the bottoms stream removed from the
30 column K(1) is fed into the reboiler V_K(1) of K(1), the other part of the bottoms stream is the mixture P(1) comprising alkali metal methoxide A(1)OMe and methanol. From the top of the column K(1), which is operated without reflux, a gas stream W(1) essentially consisting of methanol and water is removed, wherein W(1) is fed into a lower part of the rectification column D. The compressed stream G(2) is then fed into the lower part of reactive distillation column K(2), wherein
35 into the upper part of K(2), a liquid aqueous stream H(2) comprising a dissolved alkali metal hydroxide A(2)OH is fed. A part of the bottoms stream removed from the column K(2) is fed into the reboiler V_K(2) of K(2), the other part of the bottoms stream is the mixture P(2) comprising al-

kali metal methoxide A(2)OMe and methanol. From the top of the column K(2), which is operated without reflux, a gas stream W(2) essentially consisting of methanol and water is removed, wherein W(2) is fed, together with W(1), into a lower part of the rectification column D. The realization of the reflux ratio for rectification column D is as described in Fig. 1 above.

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Fig. 3 shows a schematic overview of a process according to the present invention as in Fig. 1 with an additional third compression unit $C_T(3)$. A vapor phase V comprising methanol is obtained at the top of the rectification column D. From said vapor phase V, four (dry) methanol streams are prepared, said at least four streams comprising vapor stream G, stream T(1a), stream T(1b), and a further stream T(1c), said stream T(1c) having a pressure $p_{T(1c)}$ and a temperature $T_{T(1c)}$ with $p_{T(1c)} > p_V$ and $T_{T(1c)} > T_V$. Initially, from vapor phase V a vapor stream G and a vapor stream T(1) is prepared, followed by preparation of T(1a) and T(1b) from stream T(1). For preparing the streams T(1a) and T(1b), a first compression unit $C_T(1)$ and a second compression unit $C_T(2)$ are employed, wherein a first part of T(1) is passed through $C_T(1)$ obtaining T(1a) and a second part of T(1) is passed through $C_T(2)$ obtaining T(1b). At least a part of the stream T(1a) obtained from $C_T(1)$ is then passed as a heating medium through an intermediate reboiler V(1a) of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_C(1a)$ and at least a part of the stream T(1b) obtained from $C_T(2)$ is passed as a heating medium through a bottom reboiler V(1b) of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_C(1b)$. For preparing the stream T(1c), the third compression unit $C_T(3)$ is employed, wherein a further part of T(1a) is passed through the third compression unit $C_T(3)$, obtaining T(1c). At least a part of T(1c) ($T(1c.1)$) is then passed as a heating medium through reboiler $V_K(1)$ of K(1), wherein the stream condensates, thereby obtaining a stream $T_C(1c.1)$ at least another part of T(1c) ($T(1c.2)$) is then passed as a heating medium through reboiler $V_K(2)$ of K(2) wherein the stream condensates, thereby obtaining a stream $T_C(1c.2)$. The realization of the reflux ratio for rectification column D is as described in Fig. 1 above, wherein additionally, $T_C(1c.1)$ and $T_C(1c.2)$ are combined and fed as $T_C(1c)$ into the first condensate drum.

Fig. 4 shows a schematic overview of a process according to the present invention as in Fig. 2 with an additional third compression unit $C_T(3)$. A vapor phase V comprising methanol is obtained at the top of the rectification column D. From said vapor phase V, four (dry) methanol streams are prepared, said at least four streams comprising vapor stream G, stream T(1a), stream T(1b), and a further stream T(1c), said stream T(1c) having a pressure $p_{T(1c)}$ and a temperature $T_{T(1c)}$ with $p_{T(1c)} > p_V$ and $T_{T(1c)} > T_V$. For preparing the streams T(1a) and T(1b), a first compression unit $C_T(1)$ and a second compression unit $C_T(2)$ are employed, wherein stream T(1) is initially divided into at least two streams, wherein a first part of stream of T(1) is passed through $C_T(1)$, obtaining T(1a), and a second part stream of T(1) is passed through the third

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compression unit $C_T(3)$, obtaining $T(1c)$. $T(1a)$ obtained from $C_T(1)$ is divided into at least two streams and a part stream of $T(1a)$ is fed as a heating medium through an intermediate reboiler $V(1a)$ of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_c(1a)$. A second part stream of $T(1a)$ is fed to the second compression unit $C_T(2)$, and at least
 5 a part of the stream $T(1b)$ obtained from $C_T(2)$ is passed as a heating medium through a bottom reboiler $V(1b)$ of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_c(1b)$.

At least a part of $T(1c)$ ($T(1c.1)$) is then passed as a heating medium through reboiler $V_k(1)$ of $K(1)$, wherein the stream condensates, thereby obtaining a stream $T_c(1c.1)$ at least another part
 10 of $T(1c)$ ($T(1c.2)$) is then passed as a heating medium through reboiler $V_k(2)$ of $K(2)$ wherein the stream condensates, thereby obtaining a stream $T_c(1c.2)$. The realization of the reflux ratio for rectification column D is as described in Fig. 1 above, wherein additionally, $T_c(1c.1)$ and $T_c(1c.2)$ are combined and fed as $T_c(1c)$ into the first condensate drum.

15 **Fig. 5** shows a schematic overview of a process according to the present invention as in Fig. 1 with an additional third compression unit $C_T(3)$. A vapor phase V comprising methanol is obtained at the top of the rectification column D. From said vapor phase V, four (dry) methanol streams are prepared, said at least four streams comprising vapor stream G, stream $T(1a)$, stream $T(1b)$, and a further stream $T(1c)$, said stream $T(1c)$ having a pressure $p_{T(1c)}$ and a tem-
 20 perature $T_{T(1c)}$ with $p_{T(1c)} > p_v$ and $T_{T(1c)} > T_v$. Initially, from vapor phase V a vapor stream G and a vapor stream $T(1)$ is prepared, followed by preparation of $T(1a)$, $T(1b)$ and $T(1c)$ from stream $T(1)$. For preparing the streams $T(1a)$ and $T(1b)$, a first compression unit $C_T(1)$ and a second compression unit $C_T(2)$ are employed, wherein a first part of $T(1)$ is passed through $C_T(1)$ obtaining $T(1a)$ and a second part of $T(1)$ is passed through $C_T(2)$ obtaining $T(1b)$. A third part of
 25 $T(1)$ is passed through $C_T(3)$ obtaining $T(1c)$. At least a part of the stream $T(1a)$ obtained from $C_T(1)$ is then passed as a heating medium through an intermediate reboiler $V(1a)$ of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_c(1a)$ and at least a part of the stream $T(1b)$ obtained from $C_T(2)$ is passed as a heating medium through a bottom reboiler $V(1b)$ of the rectification column D, wherein the stream condensates, thereby
 30 obtaining a stream $T_c(1b)$.

At least a part of $T(1c)$ ($T(1c.1)$) is then passed as a heating medium through reboiler $V_k(1)$ of $K(1)$, wherein the stream condensates, thereby obtaining a stream $T_c(1c.1)$ at least another part
 of $T(1c)$ ($T(1c.2)$) is then passed as a heating medium through reboiler $V_k(2)$ of $K(2)$ wherein the stream condensates, thereby obtaining a stream $T_c(1c.2)$. The realization of the reflux ratio for
 35 rectification column D is as described in Fig. 1 above, wherein additionally, $T_c(1c.1)$ and $T_c(1c.2)$ are combined and fed as $T_c(1c)$ into the first condensate drum.

Fig. 6 shows a schematic overview of a process according to the present invention as in Fig. 2 with an additional third compression unit $C_T(3)$. A vapor phase V comprising methanol is obtained at the top of the rectification column D. From said vapor phase V, four (dry) methanol streams are prepared, said at least four streams comprising vapor stream G, stream T(1a), stream T(1b), and a further stream T(1c), said stream T(1c) having a pressure $p_{T(1c)}$ and a temperature $T_{T(1c)}$ with $p_{T(1c)} > p_V$ and $T_{T(1c)} > T_V$. For preparing the streams T(1a), T(1b) and T(1c), a first compression unit $C_T(1)$, a second compression unit $C_T(2)$, and a third compression unit $C_T(3)$ are employed, wherein stream T(1) is initially passed through $C_T(1)$, obtaining T(1a). T(1a) is split into at least three part streams, wherein a part stream thereof is fed as a heating medium through an intermediate reboiler V(1a) of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_C(1a)$, while another part thereof is passed through $C_T(2)$, obtaining T(1b) and still another part thereof is passed through $C_T(3)$, obtaining T(1c). At least a part of the stream T(1b) obtained from $C_T(2)$ is passed as a heating medium through a bottom reboiler V(1b) of the rectification column D, wherein the stream condensates, thereby obtaining a stream $T_C(1b)$. At least a part of T(1c) (T(1c.1)) is then passed as a heating medium through reboiler $V_K(1)$ of K(1), wherein the stream condensates, thereby obtaining a stream $T_C(1c.1)$ at least another part of T(1c) (T(1c.2)) is then passed as a heating medium through reboiler $V_K(2)$ of K(2) wherein the stream condensates, thereby obtaining a stream $T_C(1c.2)$. The realization of the reflux ratio for rectification column D is as described in Fig. 1 above, wherein additionally, $T_C(1c.1)$ and $T_C(1c.2)$ are combined and fed as $T_C(1c)$ into the first condensate drum.

Fig. 7 shows a schematic overview of a comparative process, without compression units as used in Reference Example 1.

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Fig. 8 shows a schematic overview of a comparative process, with only a first compression unit $C_T(1)$ as used in Reference Example 2.

Fig. 9 shows a schematic overview of a process according to the present invention as in Fig. 1 with first and second compression units $C_T(1)$, $C_T(2)$ and as used in Example 1, supplemented with methanol addition shown for rectification column D and reactive columns K(1) and K(2) as well as with realization of the reflux ratio for rectification column D as in Fig. 1. Contrary to Fig. 1, the stream G is not compressed in a compressor CG but rather separated into two streams G(1) and G(2), wherein each of G(1), G(2) is passed through a compressor $C_G(1)$, $C_G(2)$ before being passed into the respective reactive distillation column K(1), K(2).

Fig. 10 shows a schematic overview of a process according to the present invention as in Fig. 1 with first and second compression units $C_T(1)$, $C_T(2)$ as used in Example 2, supplemented

with methanol addition shown for rectification column D and reactive columns K(1) and K(2) as well as with realization of the reflux ratio for rectification column D as in Fig. 1. Contrary to Fig. 1, the stream G is not compressed in a compressor CG but rather separated into two streams G(1) and G(2), wherein each of G(1), G(2) is passed through a compressor C_G(1), C_G(2) before
 5 being passed into the respective reactive distillation column K(1), K(2). Furthermore, stream T(1b) from C_T(2) is split into two streams, wherein a first part of the stream T(1b) (T(1b.1)) is passed as a heating medium through a bottom reboiler V(1b) of the rectification column D, wherein the stream condensates, thereby obtaining a stream T_c(1b.1) having a temperature T_{Tc(1b.1)} with $T_{Tc(1b.1)} < T_{T(1b)}$; and a second part of stream T(1b) (T(1b.2)) is, after further division
 10 into substreams T(1b.2.1) and T(1b.2.2) passed as a heating medium through the bottom reboilers V_K(1) and V_K(2) of reactive distillation columns K(1) and K(2). The resulting condensed streams after V_K(1) and V_K(2) are combined and fed as condensed stream T_c(1b.2) into the first condensate drum CD(1), into which also T_c(1a), T_c(1b.1) are fed.

Fig. 11 shows a schematic overview of a process according to the present invention as in Fig. 5 with first, second and third compression units C_T(1), C_T(2) and C_T(3) as used in Example 3, supplemented with methanol addition shown for rectification column D and reactive columns K(1) and K(2) as well as with realization of the reflux ratio for rectification column D as described above. Contrary to Fig. 5, the stream G is not compressed in a compressor CG but rather separated into two streams G(1) and G(2), wherein each of G(1), G(2) is passed through a compressor C_G(1), C_G(2) before being passed into the respective reactive distillation column K(1), K(2). Furthermore, stream T(1c) from C_T(3) is divided into two streams T(1c.1) and T(1c.2), wherein T(1c.1) passed as a heating medium through the bottom reboiler V_K(1) of reactive distillation column K(1) and T(1c.2) is passed as heating medium through the bottom reboiler V_K(2) of reactive distillation column K(2). The resulting condensed streams after V_K(1) and V_K(2) are combined and fed as condensed stream T_c(1c) into the first condensate drum CD(1), into which also T_c(1a), T_c(1b) are fed.

Fig. 12 shows a schematic overview of a process according to the present invention as in Fig. 10 with first and second compression units C_T(1), C_T(2) and as used in Example 4, supplemented with methanol addition shown for rectification column D and reactive columns K(1) and K(2) as well as with realization of the reflux ratio for rectification column D as in Fig. 10. Contrary to Fig. 10 (and to Fig. 1), the streams T_c(1b.1) and T_c(1b.2) are not combined with T_c(1a) and fed to CD(1) but are rather fed separately to a third condensation drum CD(3), from which a stream T(4) is obtained and fed into the top of rectification column D and a further stream T(5) is obtained from CD(3), which is fed to CD(2). T_c(1a) is conducted alone as described for Fig. 10 and for Fig. 1 respectively, i.e. T_c(1a) at least partially, is/are fed to the first condensate drum CD(1), wherein from said first condensate drum CD(1), a gas stream T(1g) and a liquid stream

T(1l) are removed, said gas stream T(1g) being fed into the condenser V(2) and said liquid stream T(1l) being combined with the liquid streams T(2l) and (T2gl) and with T(5) in a second condensate drum CD(2) in depressurized form, obtaining a combined liquid stream which is fed as the stream T(3) into the top of the rectification column D.

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Fig. 13 shows a schematic overview of a process according to the present invention as in Fig. 12 with an additional trans alcoholization unit TAU, wherein three streams are prepared from stream T(1b), i.e. streams T(1b.1), (T1b.2) and T(1b.3), wherein streams T(1b.1), (T1b.2) are conducted as in Fig. 12, wherein stream (T(1b.2)) is, after further division into sub-streams T(1b.2.1) and T(1b.2.2) passed as a heating medium through the bottom reboilers $V_K(1)$ and $V_K(2)$ of reactive distillation columns K(1) and K(2). The resulting condensed streams after $V_K(1)$ and $V_K(2)$ are combined and fed as condensed stream $T_c(1b.2)$ into the third condensate drum CD(3). Stream T(1b.3) is fed to the bottoms reboiler of trans alcoholization unit TAU and the condensed stream $T_c(1b.3)$ is fed to the third condensate drum CD(3). A part of the mixture P(1), removed from the column K(1), which comprises alkali metal methoxide A(1)OMe and methanol is fed into the trans alcoholization unit TAU, preferably into the middle section of the trans alcoholization unit TAU. A stream comprising an alcohol XOH, with X being a C2 to C10 alkyl group, preferably an ethyl group (XOH = ethanol), is fed into a bottom reboiler V_{TAU} of the trans alcoholisation unit TAU and therein combined with a part of the bottoms stream removed from the TAU and fed into V_{TAU} of TAU, wherein the combined stream is reintroduced into the trans alcoholisation unit TAU. A stream S(0), which comprises MeOH, is removed from the upper section of the trans alcoholisation unit TAU, preferably as top stream, and condensed to give a stream S(2), and a stream S(1) comprising alcohol XOH and A(1)OX with X being a C2 to C10 alkyl group, preferably A(1)OEt, is removed as bottoms stream from the trans alcoholisation unit TAU.

Fig. 14 shows a schematic overview of a process according to the present invention as in Fig. 12 with additional trans alcoholization unit, wherein two streams are prepared from stream T(1b), i.e. streams T(1b.1) and (T1b.2), wherein stream T(1b.1) is conducted as in Fig. 12, while stream T(1b.2) is split into two streams T(1b.2.1) and T(1b.2.2). T(1b.2.1) is, after further division into substreams T(1b.2.1.1) and T(1b.2.1.2) passed as a heating medium through the bottom reboilers $V_K(1)$ and $V_K(2)$ of reactive distillation columns K(1) and K(2). The resulting condensed streams after $V_K(1)$ and $V_K(2)$ are combined and fed as condensed stream $T_c(1b.2.1)$ into the third condensate drum CD(3). T(1b.2.2) is fed to the bottoms reboiler of trans alcoholization unit and the condensed stream $T_c(1b.2.2)$ is fed to the third condensate drum CD(3). A part of the mixture P(1), removed from the column K(1), which comprises alkali metal methoxide A(1)OMe and methanol is fed into the trans alcoholization unit, preferably into the middle section of the trans alcoholization unit. A stream comprising an alcohol XOH, with X being a C2 to C10 alkyl

group, preferably an ethyl group ($\text{XOH} = \text{ethanol}$), is fed into a bottom reboiler V_{TAU} of the trans alcoholisation unit TAU and therein combined with a part of the bottoms stream removed from the TAU and fed into V_{TAU} of TAU, wherein the combined stream is reintroduced into the trans alcoholisation unit TAU. A stream $S(0)$, which comprises MeOH , is removed from the upper section of the trans alcoholisation unit TAU, preferably as top stream, and condensed to give a stream $S(2)$, and a stream $S(1)$ comprising alcohol XOH and $\text{A}(1)\text{OX}$ with X being a C2 to C10 alkyl group, preferably $\text{A}(1)\text{OEt}$, is removed as bottoms stream from the trans alcoholisation unit TAU.

- Fig. 15 shows a schematic overview of a process according to the present invention as in Fig. 12 with additional trans alcoholization unit, wherein two streams are prepared from stream $T(1b)$, i.e. streams $T(1b.1)$ and $T(1b.2)$, wherein stream $T(1b.1)$ is conducted as in Fig. 12, while stream $T(1b.2)$ is, after further division into substreams $T(1b.2.1)$ and $T(1b.2.2)$ passed as a heating medium through the bottom reboilers $V_K(1)$ and $V_K(2)$ of reactive distillation columns $K(1)$ and $K(2)$. The resulting condensed streams after $V_K(1)$ and $V_K(2)$ are combined and fed as condensed stream $T_c(1b.2)$ into the third condensate drum $CD(3)$.

Furthermore, two streams are prepared from stream $T(1a)$, i.e. streams $T(1a.1)$ and $T(1a.2)$, wherein stream $T(1a.1)$ is conducted as in Fig. 12, i.e. passed as a heating medium through the intermediate reboiler $V(1a)$ of D and the resulting stream $T_c(1a.1)$ is fed to the first condensate drum $CD(1)$. $T(1a.2)$ is fed to the bottoms reboiler of trans alcoholization unit and the condensed stream $T_c(1a.2)$ is fed to the first condensate drum $CD(1)$. A part of the mixture $P(1)$, removed from the column $K(1)$, which comprises alkali metal methoxide $\text{A}(1)\text{OMe}$ and methanol is fed into the trans alcoholization unit, preferably into the middle section of the trans alcoholization unit. A stream comprising an alcohol XOH , with X being a C2 to C10 alkyl group, preferably an ethyl group ($\text{XOH} = \text{ethanol}$), is fed into a bottom reboiler V_{TAU} of the trans alcoholisation unit TAU and therein combined with a part of the bottoms stream removed from the TAU and fed into V_{TAU} of TAU, wherein the combined stream is reintroduced into the trans alcoholisation unit TAU. A stream $S(0)$, which comprises MeOH , is removed from the upper section of the trans alcoholisation unit TAU, preferably as top stream, and condensed to give a stream $S(2)$, and a stream $S(1)$ comprising alcohol XOH and $\text{A}(1)\text{OX}$ with X being a C2 to C10 alkyl group, preferably $\text{A}(1)\text{OEt}$, is removed as bottoms stream from the trans alcoholisation unit TAU.

- Fig. 16 For simplification, the preparation of the at least three streams from the vapor phase V , said at least three streams comprising a vapor stream G and $T(1)$ and streams $T(1a)$ and $T(1b)$ respectively as well as $T(2)$ is shown in Figures 1 to 15 above in that each of these streams G , $T(1)$ and $T(2)$ is taken directly from the top of the rectification column D . However, it is a preferred set-up to take of vapor phase V via a single line from the top of the rectification

column D and to take therefrom streams G, T(1) and T(2) via split-of lines. This preferred set-up is schematically shown in Fig. 16 and is applicable for each of Figures 1 to 15.

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Claims

1. An integrated process for simultaneously preparing n mixtures $P(i)$ comprising alkali metal methoxide and methanol, comprising
 - 5 providing n reactive distillation columns $K(i)$;
 - providing n aqueous liquid streams $H(i)$, a given stream $H(i)$ comprising a dissolved alkali metal hydroxide $A(i)OH$, wherein n is an integer with $n \geq 2$ and $i = 1 \dots n$; and
 - providing a rectification column D comprising at least one intermediate reboiler $V(1a)$ and at least one bottom reboiler $V(1b)$;
 - 10 providing a first compression unit $C_T(1)$, a second compression unit $C_T(2)$ and at least one further compression unit C_G ;
 - wherein the process comprises preparing the one or more alkali metal methoxides in the n reactive distillation column $K(i)$ under reactive distillation conditions from the n streams $H(i)$ and n streams $G(i)$ comprising methanol, thereby obtaining n top streams $W(i)$ comprising methanol and water; and obtaining n bottoms streams $P(i)$ comprising alkali metal methoxide $A(i)OMe$ and methanol;
 - 15 the process further comprising
 - (a) obtaining a vapor phase V comprising methanol at the top of the rectification column D , said vapor phase V having a pressure p_V and a temperature T_V ;
 - 20 (b) preparing at least three streams from the vapor phase V , said at least three streams comprising a vapor stream G having a pressure p_G and a temperature T_G with $p_G = p_V$ and $T_G = T_V$, and further comprising two streams $T(1a)$ and $T(1b)$, said stream $T(1a)$ having a pressure $p_{T(1a)}$ and a temperature $T_{T(1a)}$ with $p_{T(1a)} > p_V$ and $T_{T(1a)} > T_V$ and said stream $T(1b)$ having a pressure $p_{T(1b)}$ and a temperature $T_{T(1b)}$ with $p_{T(1b)} > p_V$ and $T_{T(1b)} > T_V$, wherein for preparing the streams $T(1a)$ and $T(1b)$, the first compression unit $C_T(1)$ and the second compression unit $C_T(2)$ are employed;
 - 25 (c) preparing n streams $G(i)$ from the vapor stream G , each of the streams $G(i)$ having a pressure $p_{G(i)}$ and a temperature $T_{G(i)}$ with $p_{G(i)} > p_G$ and $T_{G(i)} > T_G$ for each stream $G(i)$, and feeding each stream $G(i)$ into the respective reactive distillation column $K(i)$, wherein for preparing the n streams $G(i)$, the at least one compression unit C_G is employed;
 - 30 (d) passing at least a part of the stream $T(1a)$ as a heating medium through an intermediate reboiler $V(1a)$ of the rectification column D , obtaining a stream $T_c(1a)$ having a temperature $T_{T_c(1a)}$ with $T_{T_c(1a)} < T_{T(1a)}$;
 - 35 (e) passing at least a part of the stream $T(1b)$ as a heating medium through a bottom reboiler $V(1b)$ of the rectification column D , obtaining a stream $T_c(1b)$ having a temperature $T_{T_c(1b)}$ with $T_{T_c(1b)} < T_{T(1b)}$;
 - (f) feeding one or more of

- (f.1) at least a part of one or more of the top streams $W(i)$,
 - (f.2) at least a part of the stream $T_c(1a)$, and
 - (f.3) at least a part of the stream $T_c(1b)$
- into the rectification column D.

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2. The process of claim 1, wherein preparing the at least three streams according to (b) comprises

- (b.1) splitting the vapor phase V into at least two vapor streams comprising the stream G and a vapor stream $T(1)$ having a pressure $p_{T(1)}$ and a temperature $T_{T(1)}$ with $0.95 \leq p_{T(1)}/p_V \leq 1.00$;
- (b.2) preparing at least the two streams $T(1a)$ and $T(1b)$ from the vapor stream $T(1)$.

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3. The process of claim 2, wherein (b.2) comprises splitting vapor stream $T(1)$ into at least two streams and passing a first part stream of $T(1)$ through the first compression unit $C_{T(1)}$, obtaining $T(1a)$, and passing a second part stream of $T(1)$ through the second compression unit $C_{T(2)}$, obtaining $T(1b)$.

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4. The process of claim 2, wherein (b.2) comprises passing vapor stream $T(1)$ through the first compression unit $C_{T(1)}$, obtaining $T(1a)$; and passing a part of $T(1a)$ through the second compression unit $C_{T(2)}$, obtaining $T(1b)$.

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5. The process of any one of claims 1 to 4, wherein a further stream $T(2)$ is prepared from the vapor phase V and said stream $T(2)$ is passed through the condenser $V(2)$, obtaining a liquid stream $T(2l)$ and a gas stream $T(2g)$; wherein the gas stream $T(2g)$ is passed through a condenser $V(3)$, obtaining a liquid stream $T(2gl)$ and a waste gas stream $T(2w)$; and the liquid streams $T(2l)$ and $T(2gl)$ are combined in a second condensate drum $CD(2)$ in depressurized form.

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6. The process of any one of claims 1 to 5, wherein $T_c(1a)$ at least partially is fed to a first condensate drum $CD(1)$, wherein from said first condensate drum $CD(1)$, a gas stream $T(1g)$ and a liquid stream $T(1l)$ are removed, said gas stream $T(1g)$ being fed into the condenser $V(2)$ and said liquid stream $T(1l)$ being combined with the liquid streams $T(2l)$ and $T(2gl)$ in depressurized form; and $T_c(1b)$ at least partially is fed to a third condensate drum $CD(3)$, wherein from said third condensate drum $CD(3)$ a gaseous stream $T(4)$ is obtained, which is fed into the top of the rectification column D and/or into the vapor phase V and/or into the stream G and/or into the stream $T(1)$, preferably into the top of the rectification column D or into the vapor

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phase V or into the stream G or into the stream T(1), more preferably into the top of the rectification column D or into the vapor phase V, and from said condensate drum CD(3) further a liquid stream T(5) is obtained, which is fed to the second condensate drum CD(2), wherein T(5) is combined with the liquid streams T(2l) and (T2gl) in CD(2) in de-
 5 pressurized form,
 obtaining a combined liquid stream from the second condensate drum CD(2), which is fed as the stream T(3) into the top of the rectification column D.

7. The process of any one of claims 3 to 6, wherein the n reactive columns K(i) have each a
 10 reboiler, preferably bottom reboiler, $V_{K(i)}$ and wherein (e) comprises
 - (e.1) passing at least a first part of the stream T(1b) (T(1b.1)) as a heating medium through a bottom reboiler V(1b) of the rectification column D, obtaining a stream $T_{C(1b.1)}$ having a temperature $T_{T_{C(1b.1)}}$ with $T_{T_{C(1b.1)}} < T_{T(1b)}$;
 - (e.2) passing at least a second part of stream T(1b) (T(1b.2)) as a heating medium
 15 through at least one bottom reboiler $V_{K(i)}$ of one of the n reactive distillation column K(i), obtaining a stream $T_{C(1b.2)}$ having a temperature $T_{T_{C(1b.2)}}$ with $T_{T_{C(1b.2)}} < T_{T(1b)}$.
8. The process of any one of embodiments 1 to 7, wherein at least one of the n bottoms
 20 streams P(i) comprising alkali metal methoxide A(i)OMe and methanol is at least partially fed to a trans alcoholisation unit TAU, wherein
 - (x) the (part)stream comprising alkali metal methoxide A(i)OMe and methanol is con-
 25 tacted in the trans alcoholisation unit TAU with an alcohol HOX, wherein X repre-
 sents an alkyl residue selected from the group consisting of C2 to C10 alkyl, prefera-
 bly C2 alkyl, thereby obtaining a stream S(1) comprising alkali metal alkoxide A(i)OX
 and alcohol XOH and a stream S(2) comprising methanol;
 - (y) removing the stream S(2) comprising methanol from the trans alcoholisation unit
 TAU, preferably as a liquid stream, more preferably as a liquid top stream; and re-
 moving the stream S(1) comprising alkali metal alkoxide A(i)OX and alcohol XOH
 30 from the trans alcoholisation unit TAU, preferably as a liquid stream, more preferably
 as a liquid stream from the lower part of TAU, more preferably as a liquid bottoms
 stream.
9. The process of any one of claims 1 to 8, comprising providing a third compression unit
 35 $C_T(3)$, wherein (b) comprises preparing at least four streams from the vapor phase V, said
 at least four streams comprising vapor stream G, stream T(1a), stream T(1b), and a fur-
 ther stream T(1c), said stream T(1c) having a pressure $p_{T(1c)}$ and a temperature $T_{T(1c)}$ with

$p_{T(1c)} > p_v$ and $T_{T(1c)} > T_v$, wherein for preparing the stream $T(1c)$, the third compression unit $C_T(3)$ is employed.

10. The process of claim 9, wherein the n reactive columns $K(i)$ have each a reboiler, preferably bottom reboiler, $V_{K(i)}$ and wherein at least a part of $T(1c)$ is passed as heating medium through at least one bottom reboiler $V_{K(i)}$ of one of the n reactive distillation column $K(i)$, obtaining a stream $T_c(1c)$ having a temperature $T_{Tc(1c)}$ with $T_{Tc(1c)} < T_{T(1c)}$.
11. The process of any one of claims 1 to 10, wherein a stream $T(Di)$ having a temperature $T_{T(Di)}$ is taken from the rectification column D at an intermediate position and passed for heating purpose through the intermediate reboiler $V(1a)$ of the rectification column D , obtaining a heated stream $T_h(Di)$ having a temperature $T_{Th(Di)}$ with $T_{Th(Di)} > T_{T(Di)}$, wherein heated stream $T_h(Di)$ is reintroduced into rectification column D ; and
- wherein a stream $T(Db)$ having a temperature $T_{T(Db)}$ is taken from the rectification column D at a bottom position and passed for heating purpose through the bottom reboiler $V(1b)$ of the rectification column D , obtaining a stream $T_h(Db)$ having a temperature $T_{Th(Db)}$ with $T_{Th(Db)} > T_{T(Db)}$, wherein heated stream $T_h(Db)$ is reintroduced into rectification column D ; and/or, preferably and;
- wherein a bottom stream $T(Ki)$ having a temperature $T_{T(Ki)}$ is taken from the bottom of the n reactive columns $K(i)$ and passed for heating purpose through a bottom reboiler $V_{K(i)}$, thereby obtaining a heated stream $T_h(Ki)$ having a temperature $T_{hT(Ki)}$ and wherein $T_{hT(Ki)} > T_{T(Ki)}$; wherein heated stream $T_h(Ki)$ is reintroduced into rectification column D .
12. The process of any one of claims 1 to 11, further comprising
- (g) feeding a stream M comprising methanol into the rectification column D at a position $I(M)$.
13. The process of any one of claims 1 to 12, wherein a stream $H(1)$ comprises dissolved sodium hydroxide and a stream $H(2)$ comprises dissolved potassium hydroxide, wherein sodium methoxide is prepared in the reactive distillation column $K(1)$ from which the stream $W(1)$ is obtained and potassium methoxide is prepared in the reactive distillation column $K(2)$ from which the stream $W(2)$ is obtained.
14. The process of any one of claims 1 to 13, wherein (f.1) comprises
- (f.1.1) feeding at least a part of the top stream $W(1)$ into the lower part of the rectification column D at a position $I(1)$;

(f.1.2) feeding at least a part of the top stream $W(2)$ into the lower part of the rectification column D at a position $I(2)$, wherein the position $I(2)$ is located below the position $I(1)$;

wherein between the positions $I(1)$ and $I(2)$, the rectification column D is equipped with internals.

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15. The process of any one of claims 1 to 13, wherein (f) comprises

(f.1) feeding at least a part of the top stream $W(1)$ into the lower part of the rectification column D at a position $I(1)$;

10 (f.2) at least partially condensing at least a part of the top stream $W(2)$, obtaining an at least partially condensed stream $W_C(2)$, and feeding at least a part of the stream $W_C(2)$ into the rectification column at a position $I(2)$

(f.3) feeding at least a part of the stream $T_C(1a)$ into the rectification column D.

15 16. The process of claim 15,

wherein (f.2') comprises passing the top stream $W(2)$ having a temperature $T_{W(2)}$ through at least one heat exchanger E, obtaining an at least partially condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$, and feeding at least a part of the at least partially condensed stream $W_C(2)$ into the rectification column D at the position $I(2)$; and

20 wherein (g) comprises passing the stream M having a temperature T_{M1} through one or more of said at least one of heat exchangers E, obtaining a stream M having a temperature T_{M2} with $T_{M2} > T_{M1}$, and feeding the stream M having the temperature T_{M2} into the rectification column D at the position $I(M)$;

or

25 wherein (f.2) and (g) comprise passing the top stream $W(2)$ having a temperature $T_{W(2)}$ through at least one heat exchanger E(2), obtaining an at least partially, preferably essentially completely, condensed stream $W_C(2)$ having a temperature $T_{WC(2)}$ with $T_{WC(2)} < T_{W(2)}$; and admixing the stream M, prior to feeding it into the rectification column D at the position $I(M)$, with at least a part of the stream $W_C(2)$, wherein $I(M)$ is preferably above $I(1)$;

30 or

wherein (f.2) and (g) comprise admixing the top stream $W(2)$ having a temperature $T_{W(2)}$ with the stream M having a temperature T_{M1} with $T_{W(2)} > T_{M1}$, thereby at least partially, preferably only partially, condensing the stream $W(2)$, and feeding the stream obtained from mixing into the rectification column D at the position $I(M)$, wherein $I(M)$ is preferably above $I(1)$.

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17. A chemical production unit for carrying out the process according to any one of claims 1 to 16, comprising

- a rectification column D comprising
 - in its lower part, inlet means for feeding streams $W(i)$ or one or more combined stream thereof into D;
 - in its upper part, outlet means for removing a vapor stream V or divided streams thereof, comprising at least a gaseous stream G and at a stream T(1), from the top of D;
 - an intermediate reboiler V(1a);
 - a bottom reboiler V(1b);
 - optionally a stream dividing device S_o for dividing T(1) into sub streams thereof;
 - a first compressor $C_T(1)$ for compressing T(1) or a part thereof;
 - a second compressor $C_T(2)$ for compressing a part stream of T(1) and/or for compressing a compressed sub stream of T(1) or a part thereof;
 - means for passing compressed sub streams of T(1) from $C_T(1)$ and/or $C_T(2)$ as heating medium through intermediate reboiler V(1a) and bottom reboiler V(1b);
 - a stream dividing device S for dividing the stream G into n streams $G(i)$;
 - means for passing the stream G to said stream dividing device S;
 - n reactive distillation columns $K(i)$, $n \geq 2$ and $i = 1 \dots n$; said reactive distillation columns $K(i)$ being arranged in parallel, each reactive distillation column $K(i)$ comprising
 - in its upper part, preferably in its top, inlet means for feeding a stream $H(i)$ into $K(i)$;
 - in its lower part, inlet means for feeding a stream $G(i)$ into $K(i)$;
 - outlet means for removing a stream $W(i)$ from the top of $K(i)$;
 - bottom reboilers $V_K(i)$;
 - outlet means for removing a bottoms stream from $K(i)$;
 - a stream dividing means for separating a stream $P(i)$ from the bottoms stream removed from $K(i)$;
 - means for passing the streams $G(i)$ to the reactive distillation columns $K(i)$;
 - means for passing the streams $W(i)$ to the rectification column D;
 - one or more compressors $C_G(i)$ for compressing either the stream G and/or the streams $G(i)$ and/or the streams $W(i)$.
18. Use of a chemical production unit according to claim 17 or of a process according to any one of claims 1 to 16 for simultaneously producing n mixtures $P(i)$ comprising alkali metal methoxide and methanol, n being an integer with $n \geq 2$ and $i = 1 \dots n$, wherein either at least 2 of the mixtures $P(i)$ comprise different alkali metal methoxides $A(i)OMe$,

and/or at least 2 of the mixtures P(i) comprise the same alkali metal alkoxide A(i)OMe at different concentrations.