paraffins takes place. Gas and liquid in the reactor effluent are separated in a product separator 212. Gas 214 from the product separator 212 is recycled back, using the RGC 204, to a reaction section after adding makeup hydrogen by using a makeup gas (MUG) compressor 216. Liquid, from the product separator 212, is routed to a stabilizer 218 for stabilization by removal of gas and liquefied petroleum gas (LPG) from the liquid. The stabilized isomerate is then split in a De-Iso-Hexanizer (DIH) column 220 to produce isomerate, meeting the specification of octane etc. Isomerate, thus produced, is a blend component of the refinery gasoline pool. The isomerization process flow scheme 200 produces only isomerate as the desired product.

SUMMARY

[0004a] In a first aspect, the present disclosure refers to a method of producing hexane, the method comprising producing, as a byproduct from a C_5-C_6-isomerization unit, hexane having a benzene content of < 3 ppm wt., a sulfur content of < 0.5 ppm wt. and an n-hexane content of > 40 wt%, wherein the method comprises:

producing a stable isomerate feed in a C_5-C_6-isomerization unit,

feeding said stable isomerate feed to the first side of a dividing wall column, said dividing wall column comprising a dividing wall that divides the dividing wall column at least partially into a first side and a second side, with one side of the first and second sides configured to operate as a deisohexanizer column and the other side of the first and second side configured to operate as a hexane column to produce hexane;

producing a hexane feed from the second side of the dividing wall column; and

feeding the hexane feed and hydrogen to a mixer of a benzene hydrogenation unit connected with the dividing wall column to form a hexane-hydrogen mixture,

preheating the hexane-hydrogen mixture,

feeding the preheated hexane-hydrogen mixture to a polishing reactor of the benzene hydrogenation unit, wherein the polishing reactor hydrogenates at least a part of the benzene included in the produced hexane, and

feeding an output stream from the polishing reactor to a stripper column for separating lights from the hexane, wherein the stripper column is arranged downstream of the hexane polishing reactor.

[0004b] In another aspect, the present disclosure refers to a dividing wall column system disclosed herein, wherein the dividing wall of the dividing wall column does not extend over the whole height of the dividing wall column, so that the dividing wall column comprises a

portion with the first side and the second side being divided by the dividing wall arranged therebetween, and one or two further portions being not divided by the dividing wall.

[0005] The present disclosure relates to a dividing wall column system for producing hexane, the dividing wall column system comprising:

a dividing wall column comprising a dividing wall that divides the dividing wall column at least partially into a first side and a second side, with one of the first and second sides preferably configured to operate as a deisohexanizer column and the other side of the first and second side preferably configured to operate as a hexane column to produce hexane.

[0006] Preferably, during operating this dividing wall column system, the production of high-purity hexane involves taking a narrow cut of a hexane rich stream (32-45 wt% n-C_6). Since the feed consists of a lot of components (e.g., C_5, C_6 paraffins, C_6 isoparaffins and C_6 naphthenes) with similar relative volatility, the process to produce high-purity hexane is quite energy intensive. The use of dividing wall column ("DWC") technology significantly improves the viability of this process by allowing the separation to take place in the same column shell by avoiding back mixing of the heaviest components with the middle boiling components. Due to the segregation of the column, an adequate number of trays are available on each side to facilitate an efficient separation of the components. As compared to a two column process scheme, the DWC scheme requires less energy and less equipment for the same separation. Hence, a DWC improves profitability for high-purity hexane production. In particular, the operating costs are about 20 to 70% lower than those of a solvent extraction process, such as one shown in FIG. 1.

[0007] In accordance with a particular preferred example of the present disclosure, the dividing wall column system further comprises a hexane polishing unit connected with the dividing wall column so that the hexane produced in the dividing wall column is transferred

into the hexane polishing unit, wherein the hexane polishing unit comprises a hexane polishing reactor for hydrogenating at least a part of the benzene included in the produced hexane. A hexane polishing unit means in accordance with the present disclosure any unit being configured to hydrogenate at least a part of the benzene included in the hexane being produced in the dividing wall column so as to reduce the benzene content of the hexane to a desired value. Thus, the hexane polishing unit may also be designated as benzene saturation unit or benzene hydrogenation unit. The hydrogenation itself takes place in the hexane polishing reactor, whereas the hexane polishing unit preferably comprises in addition to the hexane polishing reactor devices for feeding hydrogen into the unit, for mixing the hydrogen with the hexane being produced in the dividing wall column, for preheating this mixture before being fed into the hexane polishing reactor and the like.

[0008] In view of this, it is preferred that the hexane polishing unit further comprises a mixer for mixing the hexane being produced in the dividing wall column and hydrogen, wherein the mixer is arranged upstream of the hexane polishing reactor.

[0009] In a further development of the idea of the present disclosure, it is proposed that the hexane polishing unit further comprises a stripper column for separating lights from the hexane, wherein the stripper column is preferably arranged downstream of the hexane polishing reactor.

[0010] In order to adjust an optimal temperature for the hexane/hydrogen-mixture introduced into the hexane polishing reactor, it is proposed that the hexane polishing unit further comprises one or more heat exchangers.

[0011] In accordance with a further preferred example of the present disclosure, the dividing wall of the dividing wall column does not extend over the whole height of the dividing wall column, so that the dividing wall column comprises a portion with the first side and the second side being divided by the dividing wall arranged therebetween, and one or two further portions being not divided by the dividing wall. Each of the first side and the second side preferably comprises, independently from each other, 10 to 70 theoretical stages, wherein the one or two further portions preferably comprise in sum 10 to 50 theoretical stages. Preferably, the dividing wall is arranged vertically in the dividing wall column.

[0012] More preferably, each of the first side and the second side comprises, independently from each other, 30 to 60 theoretical stages and the one or two further portions comprise in sum 30 to 40 theoretical stages.

[0013] In accordance with one variant of the present disclosure, the number of theoretical stages of the first side and the number of theoretical stages of the second side are the same.

[0014] In accordance with an alternative variant of the present disclosure, the number of theoretical stages of the first side and the number of theoretical stages of the second side are the different. It is preferred in this example that one of the first and second side has 20 to 30 theoretical stages more than the other of the two sides. For instance, good results are obtained, when the first side has 10 to 80 theoretical stages and the right side has 10 to 40 theoretical stages or vice versa.

[0015] The dividing wall can be located anywhere in the column, such as, for example, in a top section (FIG. 6), a bottom section (FIG. 7), or a middle section (FIG. 8). During operation, the process uses the DWC to produce a light isomerate fraction and a heavy isomerate fraction as the top and bottom products, respectively. A high-purity n-C_6 product may be withdrawn as the middle cut. As set out above, the process produces similar product specifications with much lower energy costs as compared to a two-column distillation process scheme for the same feed.

[0016] In accordance with a first particular preferred example of the present disclosure, the dividing wall column is a DWC with a top dividing wall configuration, i.e. the dividing wall is a (preferably vertically arranged) top dividing wall positioned in the top portion of the dividing wall column, with the first side being a first fractionation section and the second side being a second fractionation section. Due to the presence of a dividing wall in the top of the column, the top portion of the column has two independent rectifying sections (i.e., on either side of the dividing wall) with a common stripping section. Each rectifying section is preferably equipped with an independent overhead system. Similarly, the stripping section (i.e., the bottom section below the dividing wall) is preferably equipped with a thermosiphon reboiler. The present disclosure is similar in operation to a two-column separation sequence comprising a DIH column and a hexane column in which high-purity hexane is the middle cut. In the rectifying zone on the feed side, due to pre-fractionation the lightest boiling components are collected as lights at the top. The middle boiling components (mainly a mix of C_{6s}) and the heaviest components (mainly i-C_6 and heavier) move towards the bottom of the column. The heating duty provided by the reboiler helps to move the middle boiling components up the other side of the top dividing wall. The middle boiling components are eventually concentrated at the top on this side of the DWC. , Preferably, the DWC that includes a top wall, the DWC has two independent overhead systems, one on either side.

[0017] Moreover, it is preferred that the dividing wall is placed in this example between the first and second side, seen from top to bottom of the dividing wall column, between the theoretical stage 1 (i.e. the uppermost part of the dividing wall column, which is the first stage of the dividing wall column) and the theoretical stage 100 of the dividing wall column in the first side, i.e. the dividing wall extends from the top of the dividing wall column to the last theoretical stage of the first side, which is preferably theoretical stage 100 seen from the first side of the dividing wall column. If the second side of the dividing wall column comprises the same number of theoretical stages as the first side, this corresponds to the theoretical stage 100 seen from the second side of the dividing wall column. However, if the second side of the dividing wall column comprises a different number of theoretical stages as the first side, this corresponds to whatever is the last theoretical stage of the second side.

[0018] Preferably, the feed is placed in the top column example on the first side between the theoretical stage 20 and the theoretical stage 60 of the first side. Since the dividing wall extends from the uppermost part of the dividing wall column until the last theoretical stage of the first side, this corresponds to between the theoretical stage 20 and the theoretical stage 60 of the dividing wall column.

[0019] Moreover, it is preferred in this example that the dividing wall column system further comprises a first overhead condenser in fluid communication with the first fractionation section and a second overhead condenser in fluid communication with the second fractionation section.

[0020] It is also preferred that the dividing wall column system further comprises a reboiler in fluid communication with the bottoms section of the dividing wall column.

[0021] In accordance with a second particular preferred example of the present disclosure, the dividing wall column is a DWC with a bottom dividing wall, i.e. the dividing wall is a (preferably vertically arranged) bottom dividing wall positioned in the bottom portion of the dividing wall column, with the first side being a first fractionation section and the second side being a second fractionation section. Unlike a DWC with a top dividing wall, a DWC with a bottom dividing wall has two independent stripping sections (i.e., on either side of the dividing wall) with a common rectifying section (i.e., the top section above the dividing wall). The feed is introduced on a pre-fractionation side of the DWC, wherein the heaviest boiling components are separated at a bottom of the DWC. The lightest boiling components are recovered at a top

of the DWC. The middle boiling components are concentrated at the bottom on the other stripping section and removed as a separate product. Preferably, in the DWC with a bottom dividing wall, each stripping section is equipped with a thermosiphon reboiler. The DWC has a common rectifying zone with a single overhead system.

[0022] Preferably, the dividing wall is placed in this example between the first and second side, seen from top to bottom of the dividing wall column, between the theoretical stage 20 and the last theoretical stage (i.e. the lowermost part) of the dividing wall column.

[0023] It is further preferred that the dividing wall column system further comprises a first reboiler in fluid communication with the first fractionation section, and a second reboiler in fluid communication with the second fractionation section. Good results are in particular obtained, when the first reboiler is a thermosiphon reboiler and/or the second reboiler is a thermosiphon reboiler.

[0024] In addition, it is preferred that the dividing wall column system further comprises a common rectifying section in fluid communication with the top portion of the dividing wall column.

[0025] In accordance with a third particular preferred example of the present invention, the dividing wall column is a DWC with a middle dividing wall configuration, i.e. the dividing wall is a (preferably vertically arranged) middle dividing wall positioned in the middle portion of the dividing wall column, with the first side being a first fractionation section and the second side being a second fractionation section. Due to the presence of a dividing wall in the middle of the column, the middle of the column has two independent sections (i.e., on either side of the dividing wall) with common top and bottom sections (i.e., the sections above and below the middle dividing wall). The top and bottom sections are equipped with an overhead system and a reboiler, respectively.

[0026] Preferably, the dividing wall is placed in this example between the first and second side, seen from top to bottom of the dividing wall column, between the theoretical stage 20 of the dividing wall column and the last theoretical stage of the first side of the dividing wall column.

[0027] Moreover, it is preferred that the feed is placed in this example on the first side between the theoretical stage 30 of the dividing wall column and the theoretical stage 60 of the

dividing wall column. The hexane stream outlet is preferably placed on the second side between the theoretical stage 40 of the dividing wall column and the theoretical stage 60 of the dividing wall column.

[0028] Good results are in particular obtained, when the dividing wall column system further comprises a thermosiphon reboiler configured to receive a bottoms product from the dividing wall column and an overhead system configured to receive a lights product from the dividing wall column.

[0029] In accordance with a further example, the present invention relates to a method of producing hexane, wherein the method comprises producing, as a byproduct from a $C_{5/6}$-isomerization unit, hexane using a dividing wall column system as described above. Byproduct means in this connection less than 20 vol.-% of the sum of all product streams.

[0030] In particular, it is preferred that the method comprises the steps of feeding a stable isomerate feed to the first side of the dividing wall column; of producing a hexane feed from the second side of the dividing wall column; feeding the hexane feed to the hexane polishing unit. More specifically, the hexane feed and hydrogen are preferably fed to a mixer of the hexane polishing unit to form a hexane-hydrogen mixture.

[0031] Preferably, the feed is the isomerate stream produced in an isomerization unit and preferably a C_5-C_6-isomerization unit. The feed may e.g. comprise mainly C_4-C_7-hydrocarbons, such as C_4-C_7-n-paraffins, isoparaffins, naphthenes and aromatics. However, it may also be a narrow C_5-C_6-cut, such as one comprising C_5-C_6-n-paraffins, isoparaffins, naphthenes and aromatics.

[0032] In accordance with a further preferred example of the present invention, the method further comprises the steps of preheating the hexane-hydrogen mixture; and of feeding the preheated hexane-hydrogen mixture to a polishing reactor of the hexane polishing unit.

[0033] Good results are in particular obtained, when the method further comprises the step of feeding an output stream from the polishing reactor to a stripper column of the hexane polishing unit for separating lights from the hexane, wherein the stripper column is preferably arranged downstream of the hexane polishing reactor.

[0034] In order to further increase the efficiency of the method, it is proposed in a further development of the present invention that in the method the preheating comprises the steps of exchanging heat between the hexane-hydrogen mixture and the feed from the stripper column in a first heat exchanger; and exchanging heat between the hexane-hydrogen mixture and the output stream from the polishing reactor in a second heat exchanger.

[0035] An exemplary system and process, according to examples of the present disclosure, is directed to the production of SBP (55 – 115°C) as a blend of the side cut of the DWC with light isomerate and a heavier naphtha cut from the isomerization feed splitter.

[0036] An exemplary system and process, according to examples of the present disclosure, is directed to the variable operating cost for the production of hexane, as a byproduct, from an isomerization unit. The operating cost, per ton of hexane produced, from isomerization unit is 20 to 70% or even 90% lower than the cost of hexane produced by a solvent extraction process, thereby appreciably reducing CO2 emissions. Moreover, preferably the hexane has an improved quality (such as improved with respect to sulfur, benzene and n-hexane content) compared to a quality of hexane produced by a solvent extraction process and/or the hexane meets specifications for use in food, pharmaceutical, and polymer processes.

[0037] In all examples of the present disclosure, a column overhead pressure on either side of the dividing wall of the DWC is maintained via a pressure controller on the respective overhead vapor product lines. The overhead vapor (on each side in a top DWC) is condensed using air-cooled exchangers and collected in an overhead receiver.

[0038] An exemplary system and process, according to examples of the present disclosure, includes a DWC with a top dividing wall. The two top halves on either side of the top dividing wall of the DWC receive reflux from respective overhead condensers. Preferably, the temperature in the top of the DWC is cascaded to a reflux flow control loop to allow control over a quality of the product. This control philosophy prevents the heavier components from going to the top of the DWC. Similarly, the heaviest bottom product flow rate (on each side in a bottom DWC) is controlled by cascading with a level control loop in the lower section.

[0039] An exemplary system and process, according to examples of the present disclosure, is directed toward production of high purity hexane as a byproduct from an isomerization unit. Stabilized isomerate is split in the DWC to co-produce hexane from the second side of the column. The hexane, so produced, is treated in a polishing unit comprising of an adsorbent