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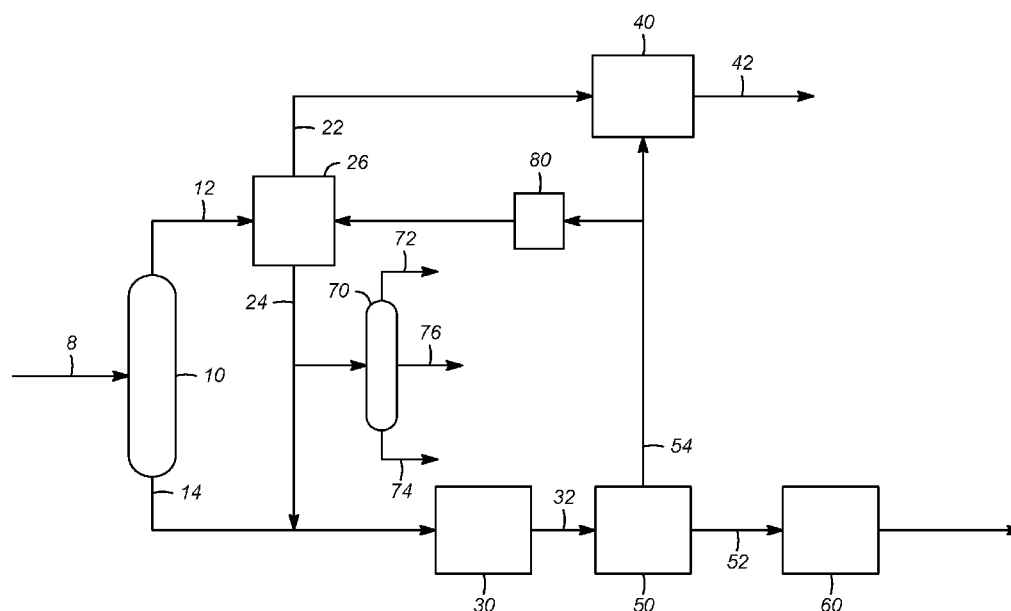
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(57) Abstract: A process is presented for improving the feed to a cracking unit and a reforming unit from a naphtha feedstock. The process includes the use of a separation unit to generate a light naphtha feed and a heavy naphtha feed. The process further includes separating the light naphtha feed into a light naphtha feed comprising normal hydrocarbons and a light naphtha feed comprising non-normal hydrocarbons. The light naphtha feed comprising normal hydrocarbon is passed to the cracking unit and the heavy naphtha feed is passed to the reforming unit.

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USE OF PLATFORMING PROCESS TO ISOMERIZE LIGHT PARAFFINS

STATEMENT OF PRIORITY

[0001] This application claims priority to U. S. Application No. 62/334,891 which
5 was filed May 11, 2016, the contents of which are hereby incorporated by reference in its
entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to a process for the production of light olefins from a
naphtha feed stream and the production of aromatics from a reformer. This invention also
10 relates to an improved process for increasing the yields of light olefins.

BACKGROUND OF THE INVENTION

[0003] Ethylene and propylene, light olefin hydrocarbons with two or three atoms per
molecule, respectively, are important chemicals for use in the production of other useful
materials, such as polyethylene and polypropylene. Polyethylene and polypropylene are two
15 of the most common plastics found in use today and have a wide variety of uses for both as a
material fabrication and as a material for packaging. Other uses for ethylene and propylene
include the production of vinyl chloride, ethylene oxide, ethylbenzene and alcohol. Steam
cracking or pyrolysis of hydrocarbons produces essentially all of the ethylene and propylene.
Hydrocarbons used as feedstock for light olefin production include natural gas, petroleum
20 liquids, naphtha, and carbonaceous materials including coal, recycled plastics or any organic
material.

[0004] An ethylene plant is a very complex combination of reaction and gas recovery
systems. The feedstock is charged to a cracking zone in the presence of steam at effective
thermal conditions to produce a pyrolysis reactor effluent gas mixture. The pyrolysis reactor
25 effluent gas mixture is stabilized and separated into purified components through a sequence
of cryogenic and conventional fractionation steps. A typical ethylene separation section of an
ethylene plant containing both cryogenic and conventional fractionation steps to recover an
ethylene product with a purity exceeding 99.5% ethylene is described in an article by V.
Kaiser and M. Picciotti, entitled, "Better Ethylene Separation Unit." The article appeared in

HYDROCARBON PROCESSING MAGAZINE, November 1988, pages 57-61 and is hereby incorporated by reference.

[0005] Methods are known for increasing the conversion of portions of the products of the ethylene production from a zeolitic cracking process to produce more ethylene and propylene by a disproportionation or metathesis of olefins. Such processes are disclosed in US 5,026,935 and 5,026,936 wherein a metathesis reaction step is employed in combination with a catalytic cracking step to produce more ethylene and propylene by the metathesis of C₄ and heavier molecules. The catalytic cracking step employs a zeolitic catalyst to convert a hydrocarbon stream having 4 or more carbon atoms per molecule to produce olefins having fewer carbon atoms per molecule. The hydrocarbon feedstream to the zeolitic catalyst typically contains a mixture of 40 to 95 wt-% paraffins having 4 or more carbon atoms per molecule and 5 to 60 wt-% olefins having 4 or more carbon atoms per molecule. In US 5,043,522, it is disclosed that the preferred catalyst for such a zeolitic cracking process is an acid zeolite, examples includes several of the ZSM-type zeolites or the borosilicates. Of the ZSM-type zeolites, ZSM-5 was preferred. It was disclosed that other zeolites containing materials which could be used in the cracking process to produce ethylene and propylene included zeolite A, zeolite X, zeolite Y, zeolite ZK-5, zeolite ZK-4, synthetic mordenite, dealuminized mordenite, as well as naturally occurring zeolites including chabazite, faujasite, mordenite, and the like. Zeolites which were ion-exchanged to replace alkali metal present in the zeolite were preferred. Preferred cation exchange cations were hydrogen, ammonium, rare earth metals and mixtures thereof.

[0006] European Patent No. 109,059B1 discloses a process for the conversion of a feedstream containing olefins having 4 to 12 carbon atoms per molecule into propylene by contacting the feedstream with a ZSM-5 or a ZSM-11 zeolite having a silica to alumina atomic ratio less than or equal to 300 at a temperature from 400 to 600°C. The ZSM-5 or ZSM-11 zeolite is exchanged with a hydrogen or an ammonium cation. The reference also discloses that, although the conversion to propylene is enhanced by the recycle of any olefins with less than 4 carbon atoms per molecule, paraffins which do not react tend to build up in the recycle stream. The reference provides an additional oligomerization step wherein the olefins having 4 carbon atoms are oligomerized to facilitate the removal of paraffins such as butane and particularly isobutane which are difficult to separate from C₄ olefins by conventional fractionation. In a related European Patent 109060B1, a process is disclosed for

the conversion of butenes to propylene. The process comprises contacting butenes with a zeolitic compound selected from the group consisting of silicalites, boralites, chromosilicates and those zeolites ZSM-5 and ZSM-11 in which the mole ratio of silica to alumina is greater than or equal to 350. The conversion is carried out at a temperature from 500 to 600°C. and at a space velocity of from 5 to 200 kg/hr of butenes per kg of pure zeolitic compound. The European Patent 109060B1 discloses the use of silicalite-1 in an ion-exchanged, impregnated, or co-precipitated form with a modifying element selected from the group consisting of chromium, magnesium, calcium, strontium and barium.

[0007] Generally, the heavier olefins having six or more carbon atoms per molecule which are produced in commercial ethylene plants are useful for the production of aromatic hydrocarbons. Portions of the olefin product include olefins with four carbon atoms per molecule. This portion includes both mono-olefins and di-olefins and some paraffins, including butane and iso-butane. Because the portion with four carbon atoms per molecule is generally less valuable and requires significant processing to separate di-olefins from the mono-olefins, processes are sought to improve the utilization of this portion of the ethylene plant product and enhancing the overall yield of ethylene and propylene.

[0008] It is difficult in naphtha cracking to obtain high selectivity to ethylene and propylene, while maintaining high conversion. Improvements in catalysts and processes that accomplish this are therefore desirable.

SUMMARY OF THE INVENTION

[0009] The present invention provides for a process to improve the yields of light olefins.

[0010] A first embodiment of the invention is a process for improved naphtha cracking and reforming, comprising passing a naphtha feedstream to a naphtha splitter to generate a light naphtha and a heavy naphtha; passing the light naphtha to a separation unit to generate an extract stream comprising normal hydrocarbons, and a raffinate stream comprising non-normal hydrocarbons; passing the heavy naphtha to a reforming unit to generate a reformed effluent comprising aromatics, naphthenes and paraffins; and passing the extract stream to a cracking unit to generate a light olefin stream. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the separation unit is an adsorption-separation unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in

this paragraph wherein the light naphtha comprises n-C6, methylcyclopentane and lighter hydrocarbons, and the heavy naphtha comprises C6 aromatics, cyclohexane and C7+ hydrocarbons. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the light naphtha

5 comprises iC6 and lighter hydrocarbons, and the heavy naphtha comprises C6 aromatics and C7+ hydrocarbons. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the reformed effluent to an aromatics extraction unit to generate an aromatics stream and an aromatics extraction raffinate stream comprising C5 and C6 paraffins. An

10 embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the aromatics extraction raffinate stream to the cracking unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the aromatics stream to an aromatics complex. An

15 embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the adsorption separation unit uses a light desorbent having a boiling point lower than the lightest component in the feed. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the light desorbent is normal butane,

20 normal pentane, propane or ethane. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the adsorption separation unit uses a heavy desorbent having a boiling point greater than the heaviest component in the feed. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the

25 heavy desorbent is normal heptane, normal octane, normal nonane, normal decane, normal undecane or normal dodecane. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the raffinate stream to the reforming unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first

30 embodiment in this paragraph further comprising passing a portion or all of the raffinate stream to a second fractionation column to generate a second overhead stream comprising iC5 and iC6, and a second bottoms stream comprising methyl cyclopentane, cyclohexane and

benzene. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the raffinate stream to a second fractionation column to generate a second overhead stream comprising iC5, iC6, methyl cyclopentane, cyclohexane and benzene, and a second bottoms stream comprising cyclohexane and benzene.

[0011] A second embodiment of the invention is a process for improved light olefin yields from naphtha, comprising passing a naphtha feedstream to a naphtha splitter to generate a light naphtha comprising C6 and lighter hydrocarbons and a heavy naphtha; passing the light naphtha to an adsorption separation unit to generate an extract stream comprising normal hydrocarbons, and a raffinate stream comprising non-normal hydrocarbons; passing the heavy naphtha to a reforming unit to generate a reformed effluent comprising aromatics; passing the extract stream to a cracking unit to generate a light olefin stream; and passing the heavy naphtha to the reforming unit to generate a reformate stream, comprising aromatics. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the aromatics stream to an aromatics extraction unit to generate an aromatics stream and an extraction raffinate. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the raffinate stream to the reforming unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the raffinate stream to a fractionation unit to generate an overhead stream comprising isoparaffins having 5 and 6 carbons, and a bottoms stream comprising methyl cyclopentane, cyclohexane and benzene. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the bottoms stream to the reforming unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the overhead stream to a gasoline blending stock or to a reformer. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph wherein the adsorption separation unit uses a light desorbent. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph wherein the fractionation

unit generates a bottoms stream, a side draw stream for passing to a gasoline blending stock, and an overhead stream for providing control over the Reid vapor pressure of the gasoline blending stock.

5 [0012] Other objects, advantages and applications of the present invention will become apparent to those skilled in the art from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0013] Figure 1 is a diagram of the process to improve the quality of the feeds to a cracking unit and a reforming unit.

DETAILED DESCRIPTION OF THE INVENTION

10 [0014] The present invention is a process that improves flexibility in the operation of a refinery, and enables the refiner to readily shift product with minimal additional equipment. The operation of the new and existing equipment allows for shifting of production to increase higher value products as the market shifts. Market shifts include the price of raw materials, or oil, and the demand for different products such as precursor materials to plastics, such as light
15 olefins or aromatics, or increased production of gasoline blending streams. Traditional processing of a naphtha feedstream is to only use the naphtha splitter, which segregates according to boiling point ranges. However, there are significant overlaps of boiling points of different hydrocarbons, wherein the operation of a cracking unit works most efficiently with normal hydrocarbons, and the reforming unit performs more efficiently on heavier
20 hydrocarbons and aromatic precursors such as methylcyclohexane and cyclohexane. It is also advantageous to remove normal C5 and C6 hydrocarbons from the feed to the reforming unit.

[0015] The present invention allows for increasing the normal hydrocarbon content to be passed to a cracking unit, while separating desirable aromatic to be passed to a reforming unit.

25 [0016] In a naphtha complex, the feed properties to reforming and steam cracking units have a large impact on the overall yields and efficiency of the complex. Due to close boiling points, it is not possible to direct the right molecules to the optimal process units which results in inefficiencies and overall lower profitability. One particular challenge is that n-hexane, which is preferred for the steam cracker, has a very close boiling point to the benzene
30 precursors (methylcyclohexane and cyclohexane) that are preferred for the reforming unit.

[0017] Instead of using fractionation alone, another separation technology such as adsorption or a series of fractionation columns can be used to separate the n-hexane before the fractionation unit so that it can be sent directly to the steam cracker. For this reason UOP has developed the LD MaxEne process. LD MaxEne has the additional advantage of
5 producing a iso-paraffin rich raffinate stream that can be used for gasoline blending, which eliminates the need for an isomerization unit. In addition, the need for iso-paraffins is limited for gasoline purposes due to the limitations imposed by regulations governing the Reid vapor pressure in gasolines. This is ameliorated by using a process to convert light iso-paraffins, such as isobutane and isopentane to n-paraffins.

10 [0018] The present invention is a process for improving the feeds to a naphtha cracking unit and a reforming unit, thereby increasing the efficiencies and yields of naphtha cracking units and reforming units. The process, as shown in Figure 1, includes passing a naphtha feedstream 8 to a naphtha splitter 10 to generate a light naphtha 12 and a heavy naphtha 14. The light naphtha 12 is passed to a separation unit 20 to generate an extract stream 22 and a
15 raffinate stream 24. The extract stream 22 comprises normal hydrocarbons, and the raffinate stream 24 comprises non-normal hydrocarbons. The heavy naphtha 14 is passed to a reforming unit 30 to generate a reformed effluent stream 32 comprising aromatics naphthenes and paraffins. The extract stream 22 is passed to a cracking unit 40 to generate a light olefin stream 42.

20 [0019] The process can further include passing the reformed effluent stream 32 to an aromatics extraction unit 50 to generate an aromatics stream 52 and an extraction raffinate stream 54. The extraction raffinate stream 54 includes C5 and C6 paraffins, and in particular, normal C5 and C6 paraffins. The aromatics stream 52 can be passed to an aromatics complex 60. In one embodiment, the extraction raffinate stream 54 is passed to the cracking unit 40. In
25 another embodiment, the extraction raffinate stream 54 is passed to the adsorption separation unit 20. When the raffinate stream 54 is passed to the separation unit 20, it may be first hydrotreated, or passed to a hydrotreatment unit 80, before being passed to the separation unit 20. The hydrotreatment unit 80 can be used to hydrogenate olefins, or facilitate the removal of any sulfur that is obtained from the aromatics recovery unit 50.

30 [0020] In a particular embodiment, the separation unit 20 comprises an adsorption-separation unit that includes an adsorbent for preferentially adsorbing normal hydrocarbons

to generate the extract stream 22 comprising normal hydrocarbons and the raffinate stream 24.

[0021] In one embodiment, the light naphtha 12 comprises n-C6 and lighter hydrocarbons, and the heavy naphtha 14 comprises C6 aromatics, cyclohexane, and C7+ hydrocarbons. The naphtha splitter 12 can have the operating conditions altered to shift the separation, or split, of the naphtha feedstream 8. In one operation, the naphtha splitter 10 is operated to generate a light naphtha 12 comprising iC6 and lighter hydrocarbons, and a heavy naphtha 14 comprises C6 aromatics and C7+ hydrocarbons.

[0022] When the separation unit 20 is an adsorption-separation unit, the adsorption-separation unit can use a light desorbent, or a heavy desorbent. With a light desorbent, the light desorbent is chosen to have a boiling point lower than the lightest component in the feed to the adsorption-separation unit 20. For a naphtha feedstream splitting to a light naphtha and a heavy naphtha, the desorbent has a boiling point lower than the lightest component in the light naphtha. Preferred desorbents for the light desorbent include normal butane, normal pentane, propane, or ethane, or even a mixture of light normal paraffins.

[0023] With a heavy desorbent, the heavy desorbent is chosen to have a boiling point greater than the heaviest component in the light naphtha feed to the adsorption-separation unit 20. Preferred desorbents for the heavy desorbent include normal heptane, normal octane, normal nonane, normal decane, normal undecane or normal dodecane, or even a mixture of heavy normal paraffins.

[0024] The process can further include passing the raffinate stream 24 to the reforming unit 30. While the raffinate stream 24 can contain lighter hydrocarbons, such as iC4, iC5 and iC6s, the reforming unit 30 will isomerize a portion of the lighter hydrocarbons to normal hydrocarbons, and these normal hydrocarbons can be sent to the cracking unit. By separating the light iso-paraffins from the normal paraffins in the light naphtha stream 12, one can improve the quality of the feed to the cracking unit and thereby improve the operating parameters.

[0025] In one embodiment, the raffinate stream 24 is passed to a second fractionation column 70. The second fractionation column 70 can be a fractionation column to generate a second overhead stream 72 and a second bottoms stream 74. The second fractionation column can be operated to generate a second overhead stream 72 comprising iC5 and iC6

hydrocarbons, and a second bottoms stream having methyl cyclopentane, cyclohexane and benzene.

[0026] In an alternate operation, the second fractionation column 70 can be operated to send methyl cyclopentane and some of the cyclohexane and benzene into the second overhead stream 72, with the second bottoms stream comprising cyclohexane and benzene in the bottoms stream 74. In one embodiment, the second bottoms stream 74 can be passed to the reforming unit 30.

[0027] In an alternate embodiment, the process is for improved light olefin yields from a naphtha feedstream. The naphtha feedstream is passed to a naphtha splitter to generate a light naphtha stream and a heavy naphtha stream. The heavy naphtha stream is passed to a reforming unit to generate a reformat stream, comprising aromatics. The light naphtha stream is passed to an adsorption separation unit to generate an extract stream and a raffinate stream. The extract stream comprises normal hydrocarbons and is passed to a cracking unit to generate light olefins. The cracking unit can be a steam cracking unit or a catalytic cracking unit.

[0028] In one embodiment, the raffinate stream is passed to the reforming unit. In the reforming unit, the isoparaffins can isomerize to normal paraffins, and the unaromatized paraffins can be recovered and recycled for passing to the cracking unit.

[0029] In another embodiment, the raffinate stream can be passed to a fractionation unit. The fractionation unit can generate an overhead stream, a bottoms stream and a side draw stream 76. In one embodiment, the fractionation column can be a divided wall column.

[0030] From the fractionation unit, the overhead stream can comprises isoparaffins having 5 and 6 carbon atoms, and the bottoms stream can comprise methyl cyclopentane, cyclohexane and benzene. The overhead stream can be passed to a gasoline blending stock, or to the reformer to isomerizes the isoparaffins to normal paraffins.

[0031] The fractionation unit can be operated to control for the production of the side draw stream, where the side draw stream can be passed to a gasoline blending stock. The overhead stream can be used to control the hydrocarbon compositions of the gasoline blending stock to provide control over the Reid vapor pressure.

[0032] The aromatics stream from the reforming unit can be passed to an aromatics extraction unit to generate an aromatics product stream and an aromatics extraction raffinate.

The aromatics extraction raffinate can be passed to the adsorption separation column to separate the normal paraffins from the non-normal hydrocarbons.

[0033] While the invention has been described with what are presently considered the preferred embodiments, it is to be understood that the invention is not limited to the disclosed
5 embodiments, but it is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

SPECIFIC EMBODIMENTS

10 [0034] While the following is described in conjunction with specific embodiments, it will be understood that this description is intended to illustrate and not limit the scope of the preceding description and the appended claims.

[0035] A first embodiment of the invention is a process for improved naphtha cracking and reforming, comprising passing a naphtha feedstream to a naphtha splitter to generate a
15 light naphtha and a heavy naphtha; passing the light naphtha to a separation unit to generate an extract stream comprising normal hydrocarbons, and a raffinate stream comprising non-normal hydrocarbons; passing the heavy naphtha to a reforming unit to generate a reformed effluent comprising aromatics, naphthenes and paraffins; and passing the extract stream to a cracking unit to generate a light olefin stream. An embodiment of the invention is one, any
20 or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the separation unit is an adsorption-separation unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the light naphtha comprises n-C6 and lighter hydrocarbons, and the heavy naphtha comprises C6 aromatics, cyclohexane and C7+
25 hydrocarbons. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the light naphtha comprises iC6 and lighter hydrocarbons, and the heavy naphtha comprises C6 aromatics and C7+ hydrocarbons. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising
30 passing the reformed effluent to an aromatics extraction unit to generate an aromatics stream and an extraction raffinate stream comprising C5 and C6 paraffins. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first

embodiment in this paragraph further comprising passing the extraction raffinate stream to the cracking unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the aromatics stream to an aromatics complex. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the adsorption separation unit uses a light desorbent having a boiling point lower than the lightest component in the feed. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the light desorbent is normal butane, normal pentane, propane or ethane. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the adsorption separation unit uses a heavy desorbent having a boiling point greater than the heaviest component in the feed. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph wherein the heavy desorbent is normal heptane, normal octane, normal nonane, normal decane, normal undecane or normal dodecane. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the raffinate stream to the reforming unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the raffinate stream to an second fractionation column to generate a second overhead stream comprising iC5 and iC6, and a second bottoms stream comprising methyl cyclopentane, cyclohexane and benzene. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the first embodiment in this paragraph further comprising passing the raffinate stream to an second fractionation column to generate a second overhead stream comprising iC5, iC6, methyl cyclopentane, cyclohexane and benzene, and a second bottoms stream comprising cyclohexane and benzene.

[0036] A second embodiment of the invention is a process for improved light olefin yields from naphtha, comprising passing a naphtha feedstream to a naphtha splitter to generate a light naphtha comprising C6 and lighter hydrocarbons and a heavy naphtha; passing the light naphtha to an adsorption separation unit to generate an extract stream comprising normal hydrocarbons, and a raffinate stream comprising non-normal

hydrocarbons; passing the heavy naphtha to a reforming unit to generate a reformed effluent comprising aromatics; passing the extract stream to a cracking unit to generate a light olefin stream; and passing the heavy naphtha to the reforming unit to generate a reformate stream.

An embodiment of the invention is one, any or all of prior embodiments in this paragraph up
5 through the second embodiment in this paragraph further comprising passing the reformate stream to an aromatics extraction unit to generate an aromatics stream and an extraction raffinate. An embodiment of the invention is one, any or all of prior embodiments in this

paragraph up through the second embodiment in this paragraph further comprising passing the raffinate stream to the reforming unit. An embodiment of the invention is one, any or all

10 of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the raffinate stream to a fractionation unit to generate an overhead stream comprising isoparaffins having 5 and 6 carbons, and a bottoms stream comprising methyl cyclopentane, cyclohexane and benzene. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this

15 paragraph further comprising passing the bottoms stream to the reforming unit. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph further comprising passing the overhead stream to a gasoline blending stock or to a reformer. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this
20 paragraph wherein the adsorption separation unit uses a light desorbent. An embodiment of the invention is one, any or all of prior embodiments in this paragraph up through the second embodiment in this paragraph wherein the fractionation unit generates a bottoms stream, a side draw stream for passing to a gasoline blending stock, and an overhead stream for providing control over the Reid vapor pressure of the gasoline blending stock.

25 [0037] Without further elaboration, it is believed that using the preceding description that one skilled in the art can utilize the present invention to its fullest extent and easily ascertain the essential characteristics of this invention, without departing from the spirit and scope thereof, to make various changes and modifications of the invention and to adapt it to various usages and conditions. The preceding preferred specific embodiments are, therefore, to be
30 construed as merely illustrative, and not limiting the remainder of the disclosure in any way whatsoever, and that it is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

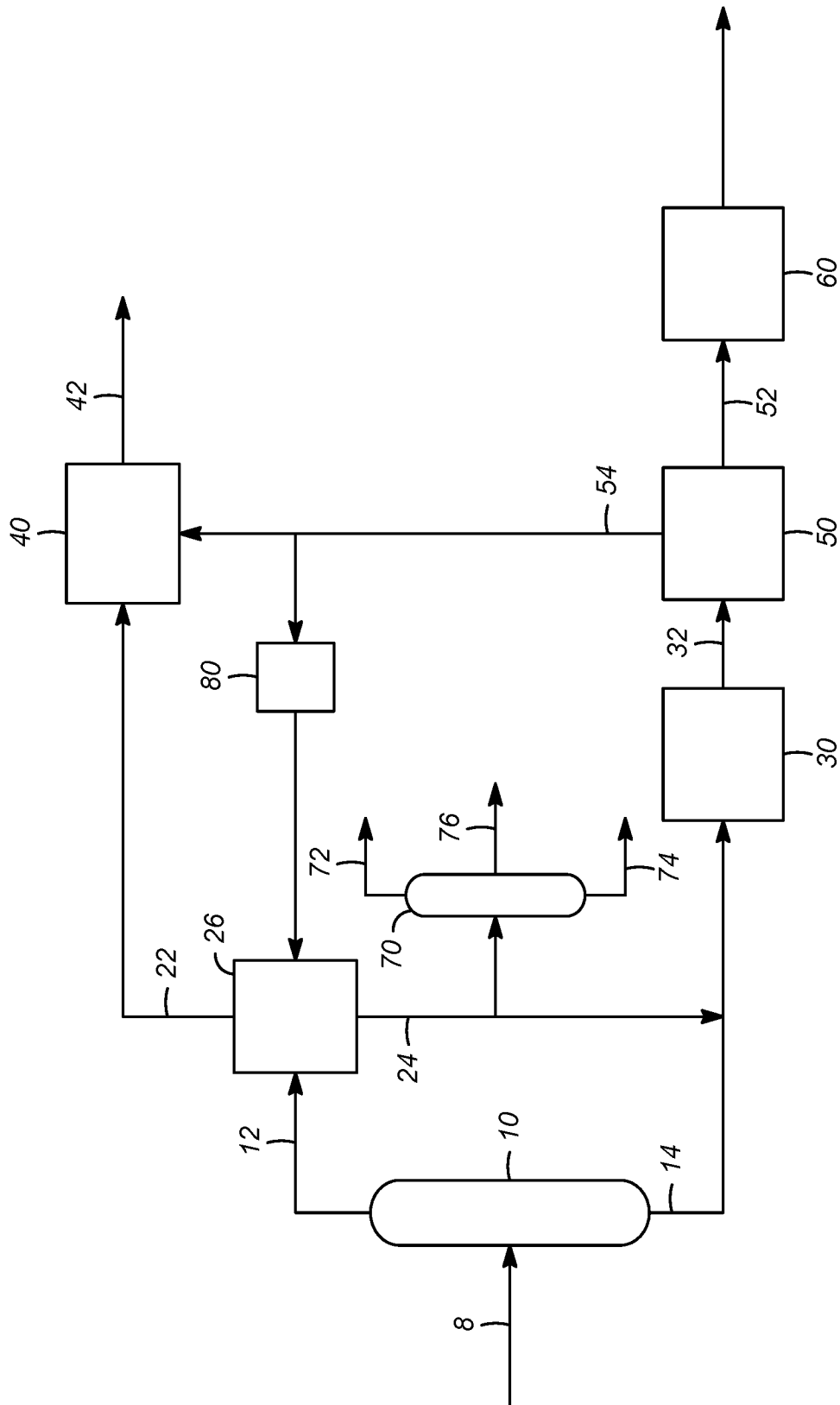
[0038] In the foregoing, all temperatures are set forth in degrees Celsius and, all parts and percentages are by weight, unless otherwise indicated.

CLAIMS

1. A process for improved naphtha cracking and reforming, comprising:
passing a naphtha feedstream to a naphtha splitter to generate a light naphtha and a
heavy naphtha;
5 passing the light naphtha to a separation unit to generate an extract stream comprising
normal hydrocarbons, and a raffinate stream comprising non-normal
hydrocarbons;
passing the heavy naphtha to a reforming unit to generate a reformed effluent
comprising aromatics, naphthenes and paraffins; and
10 passing the extract stream to a cracking unit to generate a light olefin stream.
2. The process of claim 1 wherein the separation unit is an adsorption-separation unit
using a desorbent of normal butane, normal pentane, propane, ethane, normal heptane,
normal octane, normal nonane, normal decane, normal undecane, or normal dodecane.
3. The process of claim 1 wherein the light naphtha comprises n-C6 and lighter
15 hydrocarbons, and the heavy naphtha comprises C6 aromatics, cyclohexane and C7+
hydrocarbons.
4. The process of claim 1 wherein the light naphtha comprises iC6 and lighter
hydrocarbons, and the heavy naphtha comprises C6 aromatics and C7+ hydrocarbons.
5. The process of claim 1 further comprising passing the reformed effluent to an
20 aromatics extraction unit to generate an aromatics stream and an extraction raffinate stream
comprising C5 and C6 paraffins.
6. The process of claim 5 further comprising passing the extraction raffinate stream
to the cracking unit.
7. The process of claim 5 further comprising passing the aromatics stream to an
25 aromatics complex.
8. The process of claim 1 further comprising passing the raffinate stream to the
reforming unit.
9. The process of claim 1 further comprising passing the raffinate stream to an
second fractionation column to generate a second overhead stream comprising iC5 and iC6,
30 and a second bottoms stream comprising methyl cyclopentane, cyclohexane and benzene.
10. The process of claim 1 further comprising passing the raffinate stream to an
second fractionation column to generate a second overhead stream comprising iC5, iC6,

methyl cyclopentane, cyclohexane and benzene, and a second bottoms stream comprising cyclohexane and benzene.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2017/030949

A. CLASSIFICATION OF SUBJECT MATTER <i>C10G 63/08 (2006.01)</i> <i>C10G 35/04 (2006.01)</i> <i>C10G 21/14 (2006.01)</i> According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) C10G 21/14, 35/04, 63/08 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSearch, esp@cenet, USPTO, Google		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/36716 A1 (UOP LLC et al.) 10.05.2002, p. 9 lin. 12-15, claims, fig. 1	1-4
Y		5-10
Y	WO 2014/197205 A1 (UOP LLC) 11.12.2014, paragraph [0030], claims 1, 7	5-8
Y	US 2015/0045598 A1 (UOP LLC) 12.02.2015, paragraphs [0028], [0031]	9-10
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family	
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Date of the actual completion of the international search	Date of mailing of the international search report	
17 July 2017 (17.07.2017)	14 August 2017 (14.08.2017)	
Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37	Authorized officer I. Zaikina Telephone No. 8 (495)-531-64-81	