CLAIMS

What is claimed is:

1. A process for hydrocarbon distillation comprising:

providing a hydrocarbon feed stream (130) to a fractionation zone (125) at a first position;

fractionating the hydrocarbon feed stream (130) into an overhead stream (140) and a bottoms stream (145);

heating (200) a first portion of the overhead stream (190) to a temperature above a dew point temperature of the overhead stream (140);

compressing (205) the heated first overhead stream portion (190);

removing a portion of a stream (215) from the fractionation zone (135) at a second position below the first position;

heating (220) the removed stream portion (215) by indirectly contacting the removed stream portion (215) with the compressed first overhead stream portion (210);

returning the heated removed stream portion (215) to the fractionation zone (135) at a third position above the second position and below the first position;

reducing the pressure (235) of the compressed first overhead stream portion to form a reduced pressure overhead stream (240);

returning a portion (180) of the reduced pressure overhead stream to the top of the fractionation zone (135);

wherein heating (200) the first overhead stream portion (190) comprises indirectly contacting the first overhead stream portion (190) with the compressed first overhead stream portion (225) after indirectly contacting the removed stream portion (215) with the compressed first overhead stream portion (210).

2. The process of claim 1 further comprising removing a side cut (160) from the fractionation zone (135) at a fourth position below the first position, the side cut (135) having a boiling point between a boiling point of the overhead stream (140) and a boiling point of the bottoms stream (145).

3. The process of any of claims 1-2 further comprising combining the reduced pressure overhead stream (240) with a second overhead stream portion (195).

4. The process of any of claims 1-3 wherein indirectly contacting the removed stream portion (215) with the compressed first overhead stream portion (210) comprises heating the removed stream portion (215) in a heat exchanger.

5. The process of any of claims 1-4 wherein a temperature difference between the overhead stream (140) and the bottoms stream (145) is at least 38.9°C (70°F).

6. The process of any of claims 1-5 wherein the hydrocarbon feed stream (130) contains primarily C_5-C_6 hydrocarbons, wherein the overhead stream (140) contains primarily di-methyl butane and lighter hydrocarbons, and wherein the bottoms stream (145) contains primarily C_{7+} hydrocarbons.

7. The process of claim 6 further comprising removing a side cut (160) from the fractionation zone (135) at a fourth position below the first position and above the third position, the side cut (160) having a boiling point between a boiling point of the overhead stream (140) and a boiling point of the bottoms stream (145), and wherein the side cut (160) contains primarily methyl pentanes, normal hexane, and C_6 naphthenes.

8. The process of any of claims 1-5 wherein the hydrocarbon feed stream (130) contains primarily C_5-C_6 hydrocarbons with little to no C_{7+} hydrocarbons, wherein the overhead stream (140) contains primarily di-methyl butane and lighter hydrocarbons, and wherein the bottoms stream (145) contains primarily methyl pentanes, normal hexane, and C_6 naphthenes.

9. The process of claim 1 wherein the hydrocarbon feed stream (130) contains primarily C_4 hydrocarbons, wherein the overhead stream (140) contains primarily isobutane and lighter hydrocarbons, and wherein the bottoms stream (145) contains primarily C_{5+} hydrocarbons.

10. A distillation column and heat pump comprising:

the distillation column (135) having a feed inlet at a first position, an overhead outlet, and a bottoms outlet;

a reboiler (220) having an inlet and an outlet, the reboiler inlet in fluid communication with a second position below the first position, and the reboiler outlet being in fluid communication with a third position on the distillation column, the third position being above the second position and below the first position;

a heat exchanger (200) in heat exchange communication with at least a portion of the distillation column overhead outlet;

a compressor (205) having a compressor inlet in fluid communication with at least the portion of the distillation column overhead outlet and a compressor outlet in heat exchange communication with the reboiler and the heat exchanger; and

an expansion valve (235) having an expansion valve inlet in fluid communication with the compressor outlet and an expansion valve outlet in fluid communication with an inlet at a position above the first position and below the overhead outlet.

CLAIMS

1. A method for isomerization of paraffins, the method comprising the steps of:

separating an isomerization effluent (42) into a product stream (44) that comprises branched and un-branched paraffins and a stabilizer vapor stream (46) that comprises HCl, H_2, and C_6- hydrocarbons;

forming a net gas vapor that comprises HCl, H_2, and C_5- hydrocarbons using the stabilizer vapor stream (46);

separating the net gas vapor into a C_5- hydrocarbons-rich phase and a HCl and H_2-rich stream (62), and wherein forming the net gas vapor comprises separating the stabilizer vapor stream (46) and the C_5- hydrocarbons-rich phase into the net gas vapor and a liquid stream (54) that comprises C_2- and C_3^+ hydrocarbon;

activating an isomerization catalyst using at least a portion of the HCl and H_2-rich stream (62) to form a chloride-promoted isomerization catalyst; and

contacting a paraffin feed stream (22) with the chloride-promoted isomerization catalyst in the presence of hydrogen for isomerization of the paraffins.

2. The method of claim 1, wherein the step of forming the net gas vapor comprises separating the stabilizer vapor stream (46) and the C_5- hydrocarbons-rich phase at a separation temperature of from about 30 to about 60°C.

3. The method of claim 1, further comprising the step of:

dividing the HCl and H_2-rich stream (62) into a recycle portion (40) and a treatment portion (72), wherein the step of activating comprises activating the isomerization catalyst using the recycle portion (40) of the HCl and H_2-rich stream (62).

4. The method of claim 3, further comprising the step of:

neutralizing the treatment portion (72) of the HCl and H_2-rich stream (62) with a caustic (106).

5. A method of claim 4, further comprising the step of:

heating the treatment portion (72) of the HCl and H_2-rich stream (62) to a temperature of from about 30 to about 70°C prior to the step of neutralizing.

6. The method of claim 1, wherein the step of separating the net gas vapor comprises separating the net gas vapor at a separation temperature of from about -40 to about 5°C.

7. The method of claim 1, further comprising the step of:

separating at least a portion of the liquid stream (54) into a C_2- hydrocarbon-rich stream (80) and a LPG stream (81) that comprises C_3 and C_4 hydrocarbons.

8. The method of claim 7, wherein the step of separating the at least a portion of the liquid stream (54) comprises separating the at least the portion of the liquid stream (54) at a separation temperature of from about 65 to about 120°C.

9. The method of claim 7, further comprising the step of:

combining the C_2- hydrocarbon-rich stream (62) with the stabilizer vapor stream (46) to form a combined stream, and wherein the step of forming the net gas vapor comprises separating the combined stream and the C_5- hydrocarbons-rich phase into the net gas vapor and the liquid stream (54).

10. An apparatus for isomerization of paraffins, the apparatus comprising:

a stabilizer (20) configured to receive an isomerization effluent (42) and to operate at stabilization conditions effective to separate the isomerization effluent (42) into a product stream (44) that comprises branched and un-branched

paraffins and a stabilizer vapor stream (46) that comprises HCl, H_2, and C_6- hydrocarbons;

a separator (52) configured to receive the stabilizer vapor stream (46) and to operate at first separation conditions effective to form a net gas vapor that comprises HCl, H_2, and C_5- hydrocarbons using the stabilizer vapor stream (46);

a chiller (82) configured to receive the net gas vapor and to operate at second separation conditions effective to separate the net gas vapor into a C_5- hydrocarbons-rich phase and a HCl and H_2-rich stream (62), and wherein the separator is further configured to receive the C_5- hydrocarbons-rich phase and to separate the stabilizer vapor stream (46) and the C_5- hydrocarbons-rich phase at the first separation conditions into the net gas vapor and a liquid stream (54) that comprises C_2- and C_3^+ hydrocarbons;

a reaction zone (12) containing an isomerization catalyst and configured to receive at least a portion of the HCl and H_2-rich stream (62) and a paraffin feed stream (22) and to operate at isomerization conditions to activate the isomerization catalyst to form a chloride-promoted isomerization catalyst for contact with the paraffin feed stream (22) in the presence of hydrogen for isomcrization of thc paraffins; and

a LPG stripper (74) configured to receive at least a portion of the liquid stream (54) and to operate at third separation conditions effective to separate the at least the portion of the liquid stream (54) into a C_2- hydrocarbon-rich stream (80) and a LPG stream (81) that comprises C_3 and C_4 hydrocarbons.