

Description

The present invention relates to a vacuum distillation process for distilling a feed containing hydrocarbons, which feed has a temperature in the range of from 320 to 425 °C, at a subatmospheric pressure in the range of from 650 to 5 200 Pa. The feed is sometimes referred to as long residue.

Such a vacuum distillation process comprises introducing a feed which contains liquid and vapour into an inlet section of a distillation column operating at a subatmospheric pressure, removing liquid from a bottom section of the distillation column, allowing vapour to pass through at least two condensation sections arranged above each other in the distillation column between the inlet section and a top section, removing vapour from the top section, spraying into each condensation section cooled liquid, and removing liquid from each condensation section, wherein the cooled liquid which is sprayed into each condensation section comprises liquid removed from that condensation section.

The cooled liquid sprayed into each condensation section is sprayed into the vapour passing through the condensation section. As a result part of the vapour is condensed and this part is removed from the distillation column with the liquid removed from the condensation section.

The remaining vapour is removed from the top section by means of vacuum pump such as a steam ejector. It was found that this vapour still contained a considerable amount of valuable hydrocarbon components. The increase of the amount of valuable hydrocarbon components can be caused by higher feed inlet temperatures which are being applied. Such higher feed inlet temperatures are made possible by employing the vacuum distillation device as described in British patent application No. 89 03 007.6 filed on 10th February, 1989.

It is an object of the present invention to provide a vacuum distillation process wherein the vapour removed from the top section contains only a small amount of valuable hydrocarbon components.

To this end the vacuum distillation process according to the present invention comprises introducing a feed which contains liquid and vapour into an inlet section of a distillation column operating at a subatmospheric pressure, removing liquid from a bottom section of the distillation column, allowing vapour to pass through at least two condensation sections arranged above each other in the distillation column between the inlet section and a top section, removing vapour from the top section, spraying into each condensation section cooled liquid, and removing liquid from each condensation section, wherein the cooled liquid which is sprayed into each condensation section comprises liquid removed from that condensation section, and wherein the cooled liquid which is

sprayed in the uppermost condensation section further comprises liquid removed from the condensation section(s) arranged below the uppermost condensation section.

The invention will now be described by way of example in more detail with reference to the enclosed drawing which shows schematically a longitudinal section of a vacuum distillation column 1.

The vacuum distillation column includes an inlet section 3 into which feed supply conduit 4 debouches, a bottom section 6 provided with outlet conduit 7 and a top section 8 provided with top outlet conduit 9.

Three condensation sections arranged above each other in the vacuum distillation column 1 between the inlet section 3 and the top section 8. The uppermost condensation section is referred to with reference numeral 13, the first condensation section arranged below the uppermost condensation section 13 is referred to with reference numeral 13a, and the second condensation section arranged below the uppermost condensation section 13 is referred to with reference numeral 13b.

Each condensation section 13, 13a and 13b is provided with a draw-off tray referred to with reference numerals 15, 15a and 15b, a draw-off conduit 17, 17a and 17b, a sprayer 20, 20a and 20b, and an outlet conduit 23, 23a and 23b. Each draw-off conduit 17, 17a and 17b is provided with a cooler 24, 24a and 24b.

The uppermost condensation section 13 is furthermore provided with an additional sprayer 25. Connecting line 27 connects the additional sprayer 25 to the outlet conduit 23a pertaining to the first condensation section arranged below the uppermost condensation section 13a and connecting line 28 connects the additional sprayer 25 to the outlet conduit 23b pertaining to the second condensation section arranged below the uppermost condensation section 13b.

The top outlet conduit 9 is connected to a vacuum pump in the form of steam ejector 30 provided with a steam supply line 32 and an outlet line 36.

During normal operation, a feed which contains liquid hydrocarbons and vaporous hydrocarbons is introduced at a temperature in the range of from 380 to 425 °C through feed supply conduit 4 into the inlet section 3 of the distillation column 1. On entering the inlet section 3 liquid drops out of the stream and is collected in the bottom section 6 of the distillation column 1 from which it is removed through outlet conduit 7.

Vapour is allowed to pass through the three condensation sections 13b, 13a and 13.

In condensation section 13b cooled liquid having a temperature of from 200 to 280 °C is sprayed into the vapour passing through the condensation section 13b. As a result part of the vapour condenses and is collected on the draw-off tray 15b. The liquid is removed from the distillation column 1 through draw-off

conduit 13b and is cooled in cooler 24b. A first part of the removed liquid is supplied to sprayer 20b, a second part of the removed liquid is supplied through conduit 28 to sprayer 25 and the balance is removed as a product through conduit 35b.

In condensation section 13a cooled liquid having a temperature of from 150 to 230 °C is sprayed into the vapour, condensed vapour is collected on the draw-off tray 15a, is removed therefrom through draw-off conduit 13a and is cooled in cooler 24a. A first part of the removed liquid is supplied to sprayer 20a, a second part of the removed liquid is supplied through conduit 27 to sprayer 25 and the balance is removed as a product through conduit 35a.

In condensation section 13 cooled liquid having a temperature of from 60 to 150 °C is sprayed as well into the vapour, condensed vapour is collected on the draw-off tray 15, is removed therefrom through draw-off conduit 13 and is cooled in cooler 24. Part of the removed liquid is supplied to sprayer 20 and the balance is removed as a product through conduit 23.

In addition to the cooled liquid sprayed through sprayer 20 in the vapour passing through the uppermost condensation section 13, additional cooled liquid having a temperature of from 60 to 150 °C is sprayed therein through sprayer 25. The additional liquid together with vapour absorbed in it is removed from the column 1 through conduit 17, and part thereof is removed as a product through conduit 23.

The vapour fraction which is not removed in a condensed form from the condensation sections 13, 13a and 13b is removed from the top section 8 of the column 1 through top outlet conduit 9 by the action of steam ejector 30. In doing so the steam ejector maintains the pressure in the distillation column 1 at the subatmospheric pressure.

It was found that the additional cooled liquid sprayed through sprayer 25 absorbed hydrocarbon vapour which would otherwise be removed from the column 1 through outlet conduit 9.

The amount of additional liquid is so selected that the amount of valuable hydrocarbons in the vapour fraction which is removed by means of the vacuum pump is minimized. Suitably the cooled liquid sprayed into the uppermost condensation section comprises per kg of liquid removed from the uppermost condensation section between 0.5 and 1 kg of liquid removed from the condensation section(s) arranged below the uppermost condensation section.

In the process as described with reference to the drawing, additional cooled liquid was supplied through a separate sprayer 25. Alternatively this liquid can be supplied through sprayer 20 in addition to liquid supplied through conduit 17. In the latter case a separate sprayer is superfluous.

Claims

1. Vacuum distillation process comprising introducing a feed (4) which contains liquid and vapour into an inlet section (3) of a distillation column (1) operating at a subatmospheric pressure, removing liquid from a bottom section (6) of the distillation column (1), allowing vapour to pass through at least two condensation sections (13a, 13b) arranged above each other in the distillation column between the inlet section (3) and a top section (8), removing vapour from the top section (8), spraying into each condensation section (13, 13a, 13b) cooled liquid, and removing liquid from each condensation section (13, 13a, 13b), wherein the cooled liquid which is sprayed into each condensation section (13, 13a, 13b) comprises liquid removed from that condensation section (13, 13a, 13b), and wherein the cooled liquid which is sprayed in the uppermost condensation section (13) further comprises liquid removed from the condensation section or sections (13, 13a, 13b) arranged below the uppermost condensation section (13).
2. Vacuum distillation process as claimed in claim 1, wherein the vapour passes through three condensation sections (13, 13a, 13b), and wherein the cooled liquid which is sprayed in the uppermost condensation section (13) further includes liquid removed from the first (13b) and/or the second condensation section (13a) arranged below the uppermost condensation section (13).
3. Vacuum distillation process as claimed in any one of the claims 1-2, wherein the cooled liquid sprayed into the uppermost condensation section (13) comprises between 0.5 and 1 kg of liquid removed from the condensation section or sections (13a, 13b) arranged below the uppermost condensation section (13) per kg of liquid removed from the uppermost condensation section (13).

Patentansprüche

1. Vakuumdestillationsverfahren, umfassend das Einführen einer Zuspelung (4), welche Flüssigkeit und Dampf enthält, in eine Einlaßzone (3) einer Destillationssäule (1), die bei unteratmosphärischem Druck betrieben wird, das Abziehen von Flüssigkeit von einer Bodenzone (6) der Destillationssäule (1), das Passierenlassen von Dampf durch mindestens zwei Kondensationszonen (13a, 13b), die in der Destillationssäule zwischen der Einlaßzone (3) und einer Kopfzone (8) übereinander angeordnet sind, das Abziehen von



conduit 13b and is cooled in cooler 24b. A first part of the removed liquid is supplied to sprayer 20b, a second part of the removed liquid is supplied through conduit 28 to sprayer 25 and the balance is removed as a product through conduit 35b.

In condensation section 13a cooled liquid having a temperature of from 150 to 230 °C is sprayed into the vapour, condensed vapour is collected on the draw-off tray 15a, is removed therefrom through draw-off conduit 13a and is cooled in cooler 24a. A first part of the removed liquid is supplied to sprayer 20a, a second part of the removed liquid is supplied through conduit 27 to sprayer 25 and the balance is removed as a product through conduit 35a.

In condensation section 13 cooled liquid having a temperature of from 60 to 150 °C is sprayed as well into the vapour, condensed vapour is collected on the draw-off tray 15, is removed therefrom through draw-off conduit 13 and is cooled in cooler 24. Part of the removed liquid is supplied to sprayer 20 and the balance is removed as a product through conduit 23.

In addition to the cooled liquid sprayed through sprayer 20 in the vapour passing through the uppermost condensation section 13, additional cooled liquid having a temperature of from 60 to 150 °C is sprayed therein through sprayer 25. The additional liquid together with vapour absorbed in it is removed from the column 1 through conduit 17, and part thereof is removed as a product through conduit 23.

The vapour fraction which is not removed in a condensed form from the condensation sections 13, 13a and 13b is removed from the top section 8 of the column 1 through top outlet conduit 9 by the action of steam ejector 30. In doing so the steam ejector maintains the pressure in the distillation column 1 at the subatmospheric pressure.

It was found that the additional cooled liquid sprayed through sprayer 25 absorbed hydrocarbon vapour which would otherwise be removed from the column 1 through outlet conduit 9.

The amount of additional liquid is so selected that the amount of valuable hydrocarbons in the vapour fraction which is removed by means of the vacuum pump is minimized. Suitably the cooled liquid sprayed into the uppermost condensation section comprises per kg of liquid removed from the uppermost condensation section between 0.5 and 1 kg of liquid removed from the condensation section(s) arranged below the uppermost condensation section.

In the process as described with reference to the drawing, additional cooled liquid was supplied through a separate sprayer 25. Alternatively this liquid can be supplied through sprayer 20 in addition to liquid supplied through conduit 17. In the latter case a separate sprayer is superfluous.

Claims

1. Vacuum distillation process comprising introducing a feed (4) which contains liquid and vapour into an inlet section (3) of a distillation column (1) operating at a subatmospheric pressure, removing liquid from a bottom section (6) of the distillation column (1), allowing vapour to pass through at least two condensation sections (13a, 13b) arranged above each other in the distillation column between the inlet section (3) and a top section (8), removing vapour from the top section (8), spraying into each condensation section (13, 13a, 13b) cooled liquid, and removing liquid from each condensation section (13, 13a, 13b), wherein the cooled liquid which is sprayed into each condensation section (13, 13a, 13b) comprises liquid removed from that condensation section (13, 13a, 13b), and wherein the cooled liquid which is sprayed in the uppermost condensation section (13) further comprises liquid removed from the condensation section or sections (13, 13a, 13b) arranged below the uppermost condensation section (13).
2. Vacuum distillation process as claimed in claim 1, wherein the vapour passes through three condensation sections (13, 13a, 13b), and wherein the cooled liquid which is sprayed in the uppermost condensation section (13) further includes liquid removed from the first (13b) and/or the second condensation section (13a) arranged below the uppermost condensation section (13).
3. Vacuum distillation process as claimed in any one of the claims 1-2, wherein the cooled liquid sprayed into the uppermost condensation section (13) comprises between 0.5 and 1 kg of liquid removed from the condensation section or sections (13a, 13b) arranged below the uppermost condensation section (13) per kg of liquid removed from the uppermost condensation section (13).

Patentansprüche

1. Vakuumdestillationsverfahren, umfassend das Einführen einer Zusp eisung (4), welche Flüssigkeit und Dampf enthält, in eine Einlaßzone (3) einer Destillationssäule (1), die bei unteratmosphärischem Druck betrieben wird, das Abziehen von Flüssigkeit von einer Bodenzone (6) der Destillationssäule (1), das Passierenlassen von Dampf durch mindestens zwei Kondensationszonen (13a, 13b), die in der Destillationssäule zwischen der Einlaßzone (3) und einer Kopfzone (8) übereinander angeordnet sind, das Abziehen von



Dampf aus der Kopfzone(8), das Einsprühen von gekühlter Flüssigkeit in jede Kondensationszone (13,13a, 13b) und das Abziehen von Flüssigkeit aus jeder Kondensationszone (13,13a,13b), wobei die gekühlte Flüssigkeit, die in jede Kondensationszone eingesprüht wird, Flüssigkeit enthält, die von der betreffenden Kondensationszone(13,13a, 13b) abgezogen worden ist, und wobei die gekühlte Flüssigkeit, die in die oberste Kondensationszone (13) eingesprüht wird, zusätzlich Flüssigkeit enthält, die von der Kondensationszone oder den Kondensationszonen abgezogen worden ist, die unterhalb der obersten Kondensationszone(13) angeordnet ist(sind).

2. Vakuum-Destillationsverfahren nach Anspruch 1, in welchem der Dampf durch 3 Kondensationszonen (13,13a,13b) hindurchgeht und in welchem die gekühlte Flüssigkeit, die in die oberste Kondensationszone (13) eingesprüht wird, zusätzlich Flüssigkeit enthält, die von der ersten (13b) und/oder der zweiten Kondensationszone (13a), die unterhalb der obersten Kondensationszone angeordnet sind, abgezogen worden ist.
3. Vakuum-Destillationsverfahren nach Anspruch 1 oder 2, in welchem die gekühlte Flüssigkeit, die in die oberste Kondensationszone(13) eingesprüht wird, zwischen 0,5 und 1 kg der Flüssigkeit enthält, die von den Kondensationszonen (13a,13b) abgezogen worden ist, die unterhalb der obersten Kondensationszone (13) angeordnet sind, und zwar je kg der Flüssigkeit, die von der obersten Kondensationszone abgezogen worden ist.
4. Vakuumdestillationsverfahren nach Anspruch 1, wie es in der Beschreibung in bezug auf die anliegende Zeichnung beschrieben ist.

Revendications

1. Procédé de distillation sous vide, comprenant les étapes selon lesquelles on introduit une charge (4) qui contient du liquide et de la vapeur dans une colonne de distillation (1) fonctionnant sous pression réduite, on enlève le liquide d'une section de fond (6) de la colonne de distillation (1), on laisse passer la vapeur à travers au moins deux sections de condensation (13a, 13b) disposées l'une au-dessus de l'autre dans la colonne de distillation entre la section d'entrée (3) et une section de tête (8), on évacue la vapeur de la section de tête (8), on pulvérise du liquide refroidi dans chaque section de condensation (13, 13a, 13b) et on enlève du liquide de chaque section de condensation (13, 13a, 13b), où le liquide refroidi qui est pulvérisé dans chaque section de condensation

(13, 13a, 13b) comprend du liquide enlevé de cette section de condensation (13, 13a, 13b) et où le liquide refroidi qui est pulvérisé dans la section de condensation supérieure (13) comprend aussi du liquide enlevé de la section ou des sections de condensation disposées au-dessous de la section de condensation supérieure (13).

2. Procédé de distillation sous vide selon la revendication 1, dans lequel la vapeur passe à travers trois sections de condensation (13, 13a, 13b) et le liquide refroidi qui est pulvérisé dans la section de condensation supérieure (13) comprend aussi du liquide enlevé de la première (13b) et/ou de la seconde section de condensation (13a) situées au-dessous de la section de condensation supérieure (13).
3. Procédé de distillation sous vide selon l'une quelconque des revendications 1-2, dans lequel le liquide refroidi pulvérisé dans la section de condensation supérieure (13) comprend entre 0,5 et 1 kg de liquide enlevé de la section ou des sections de condensation (13a, 13b) situées au-dessous de la section de condensation supérieure (13) par kg de liquide enlevé de la section de condensation supérieure (13).
4. Procédé de distillation sous vide selon la revendication 1, substantiellement tel que décrit dans la description en référence au dessin annexé.