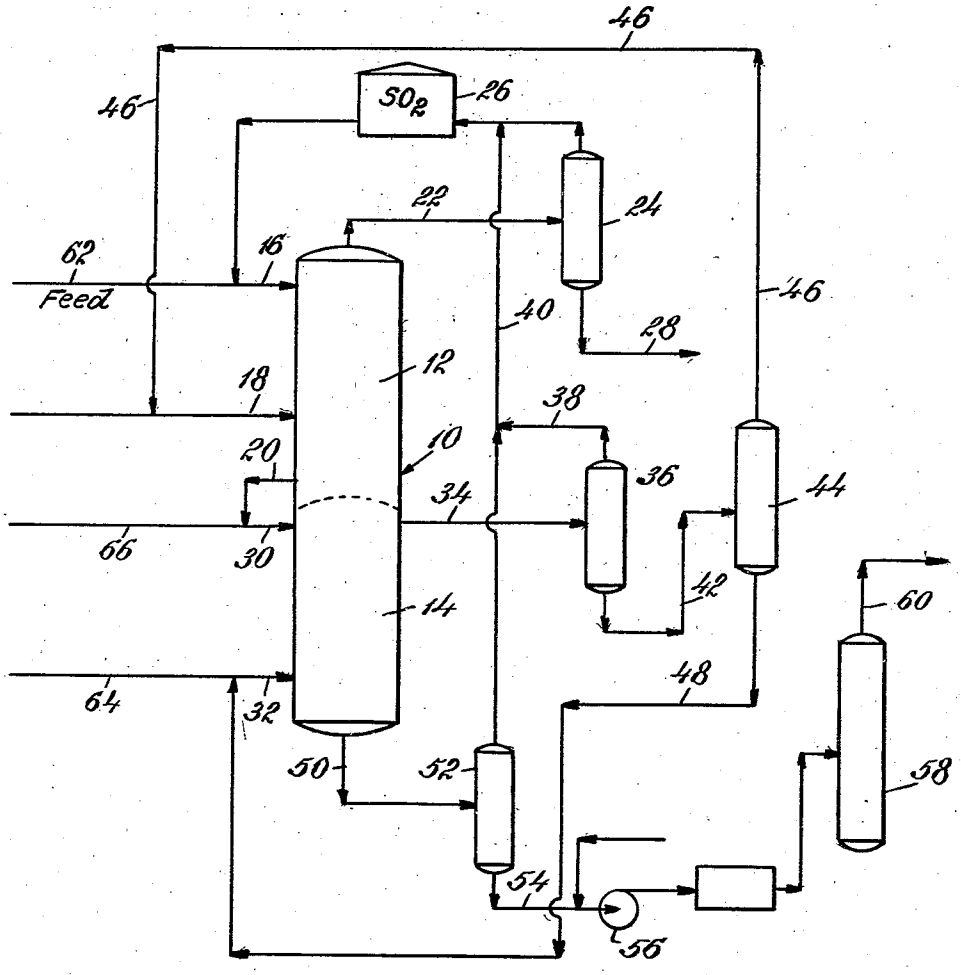
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PROCESS OF SEPARATING TOLUENE

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PROCESS OF SEPARATING TOLUENE

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This invention relates to improvements in the separation of toluene from paraffin hydrocarbons of similar boiling point, and to the production of quite pure toluene from its mixtures with paraffin hydrocarbons.

In the production of gasoline or other low boiling hydrocarbons from crude oil, there is produced, in admixture with paraffin hydrocarbons, substantial amounts of the aromatic hydrocarbon toluene. By fractional distillation, i. e., the production of a distilled fraction having a boiling point about that of toluene, it can be more or less concentrated, with the production of mixtures of toluene and paraffin hydrocarbons which may contain around 30–50% of toluene. Further concentration by distillation operations is impractical, and for this reason, further concentration of the toluene is accomplished by selective extraction with sulfur dioxide, which preferentially dissolves the toluene. In such operations, however, difficulties are encountered because of the distribution ratios between the extract and the raffinate layers.

The present invention is directed to improvements in the sulfur dioxide extraction of toluene-containing naphtha to separate the toluene from the paraffin hydrocarbons.

In accordance with the present invention, a mixture of toluene with paraffin hydrocarbons of similar boiling point is subjected to extraction, usually countercurrent, with sulfur dioxide, and after separation of the extract from the raffinate, the extract, with or without the addition of more sulfur dioxide, is washed or counter-currently extracted with a kerosene or other paraffin hydrocarbon oil of substantially higher boiling point than toluene. This washing or countercurrent extraction of the naphtha extract with kerosene or other relatively high boiling, paraffin hydrocarbon, causes the replacement, to a substantial extent, of the light paraffin hydrocarbons carried by the extract with heavier paraffin hydrocarbons, and results in two products, one being a sulfur dioxide extract containing most of the toluene, a small proportion of paraffin hydrocarbons of boiling point close to that of toluene and a substantial proportion of paraffin hydrocarbons of higher boiling point, and the second being a raffinate containing kerosene or other wash oil, the light paraffin hydrocarbons extracted from the sulfur dioxide extract and a small proportion of toluene and sulfur dioxide.

The first product is subjected to distillation to remove the sulfur dioxide, which is recycled, and then is subjected to treatment to separate

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the toluene from the high boiling paraffin hydrocarbons, i. e., the kerosene or the like, a relatively simple distillation operation in view of the substantial difference in boiling points. Substantially all of the toluene may thus be recovered in quite pure form, e. g., 98% or better.

The second product, the kerosene or wash oil raffinate, is subjected to distillation to remove the sulfur dioxide it contains, which is recycled, and then is fractionated to separate the kerosene or other high boiling hydrocarbon from the low boiling paraffin hydrocarbons and toluene which it contains, the lighter fraction being returned to the feed to the system if its toluene content is sufficient to warrant this, and the heavier fraction being recycled.

Operation in accordance with the invention has important advantages in providing inexpensive yet quite complete recovery of toluene in highly purified form from admixture with paraffin hydrocarbons of similar boiling point. The final distillation for the separation of the toluene from kerosene or the like is easily carried out because of the wide difference in boiling points. Similarly, the separation of the kerosene or the like from light hydrocarbons in the kerosene raffinate is simple because of the relatively small proportion of light boiling hydrocarbons in this mixture. In addition, because of this small volume of the light hydrocarbons in this mixture, they may be recycled to the feed, for recovery of the toluene therein.

The invention will be further described in connection with the appended drawing, which illustrates in a diagrammatic manner, apparatus suitable for the practice of the invention.

In the apparatus illustrated, there is provided a tower 10 divided into two sections 12 and 14, packed in the usual fashion for countercurrent extraction of one liquid by another immiscible in it. Liquid sulfur dioxide is supplied toward the top of the upper section 12 through the inlet 16, while the feed, containing toluene and paraffin hydrocarbons of similar boiling point is supplied somewhat below the middle of the upper section through the line 18.

The sulfur dioxide passes downwardly through the tower countercurrent to the hydrocarbon feed, and extracts from the hydrocarbon substantially all of the toluene which it contains. The sulfur dioxide extract is removed from the bottom of the upper section through the line 20, and as removed, it contains the sulfur dioxide, nearly all of the toluene and a substantial amount of paraffin hydrocarbons having a boil-

ing point about the same as that of toluene. The naphtha raffinate taken from the top of the tower through the line 22 contains most of the paraffin hydrocarbon together with small amounts of sulfur dioxide and toluene. It is introduced into the sulfur dioxide still 24 in which the sulfur dioxide is removed for recycling through the storage tank 26 while the hydrocarbon bottoms are led through the line 28 for use in gasoline.

The sulfur dioxide extract removed from the bottom of the upper section through the line 20 is supplied through the line 30 to the upper part of the lower section of the tower. Kerosene or other hydrocarbon oil having a boiling point substantially higher than toluene, for example, having a boiling range of 363–490° F. is supplied to the lower portion of this section through the line 32. The kerosene and sulfur dioxide pass through the tower countercurrently and in intimate contact, with replacement of most of the light paraffin hydrocarbons in the extract by heavier paraffin hydrocarbons from the kerosene.

The kerosene raffinate is removed from the top of this section through the line 34, and introduced into the sulfur dioxide still 36, where the sulfur dioxide which it contains is removed and returned to the sulfur dioxide tank through the lines 38 and 40. The kerosene raffinate containing light hydrocarbons is then passed through the line 42 to the splitter or still 44 in which the light hydrocarbons are removed from the kerosene. The light hydrocarbons are passed through the line 46 and introduced with the original feed to the upper section 12 of the column 10, if it contains sufficient toluene to warrant further processing for its recovery. The kerosene fraction is recycled through the line 48 to the lower section of the column 10.

The kerosene washed extract is removed from the bottom of the section 14 through the line 50, and introduced into the sulfur dioxide still 52. The sulfur dioxide removed in this still is recycled through the line 40, while the hydrocarbon fraction containing kerosene and nearly all of the toluene is removed through the line 54, treated with acid in the acid treater 56 and then subjected to distillation in the still 58 to separate the toluene from the kerosene and any heavier products that may have been formed. The toluene is removed from the top of the tower through the line 60 as a relatively pure product which may contain 98.5% or more toluene.

Sulfur dioxide and kerosene to replace losses may be supplied through the lines 62 and 64 respectively.

In operation, for each 100 parts of a hydrocarbon fraction containing about 40% toluene, about 100 parts of sulfur dioxide and 50 parts of kerosene may be used, with recovery of substantially all of the toluene as a 98.5% product.

If desired, to reduce the amount of toluene removed through the line 34, additional sulfur dioxide may be supplied through the line 66, but this is not necessary, particularly if the light hydrocarbon separated from the kerosene in the still 44 is recycled to the feed.

I claim:

1. The process of separating toluene from a mixture of toluene and paraffin hydrocarbons of similar boiling point which comprises intimately contacting said mixture with sulphur dioxide in an extracting treatment, separating the composite mixture into two component parts consisting of a raffinate phase and a primary extract phase, bringing said primary extract phase without removal of sulphur dioxide therefrom into intimate contact with a paraffin hydrocarbon having a boiling point substantially higher than that of toluene in a washing treatment, separating the products of said washing treatment into two component parts consisting of a washed extract component and a spent wash oil component, separating hydrocarbons having boiling points similar to toluene from said spent wash oil component by distillation, and recovering toluene from said washed extract component by distillation.

2. The process of separating toluene from a mixture of toluene and paraffin hydrocarbons of similar boiling point which comprises intimately contacting said mixture with sulphur dioxide in an extracting treatment, separating the composite mixture into two component parts consisting of a raffinate phase and a primary extract phase, bringing said primary extract phase without removal of sulphur dioxide therefrom into intimate contact with a paraffin hydrocarbon having a boiling point substantially higher than that of toluene in a washing treatment, separating the products of said washing treatment into two component parts consisting of a washed extract component and a spent wash oil component, separating hydrocarbons having boiling points similar to toluene from said spent wash oil component by distillation and returning the thus separated hydrocarbons to the first-mentioned extracting treatment, and recovering toluene from said washed extract component by distillation.

3. The process of separating toluene from a mixture of toluene and paraffin hydrocarbons of similar boiling point which comprises intimately contacting said mixture with sulphur dioxide in an extracting treatment, separating the composite mixture into two component parts consisting of a raffinate phase and a primary extract phase, bringing said primary extract phase without removal of sulphur dioxide therefrom and in the absence of additional sulphur dioxide from an extraneous source into intimate contact with a paraffin hydrocarbon having a boiling point substantially higher than that of toluene in a washing treatment, separating the products of said washing treatment into two component parts consisting of a washed extract component and a spent wash oil component, separating hydrocarbons having boiling points similar to toluene from said spent wash oil component by distillation and returning the thus separated hydrocarbons to the first-mentioned extracting treatment, and recovering toluene from said washed extract component by distillation.

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