

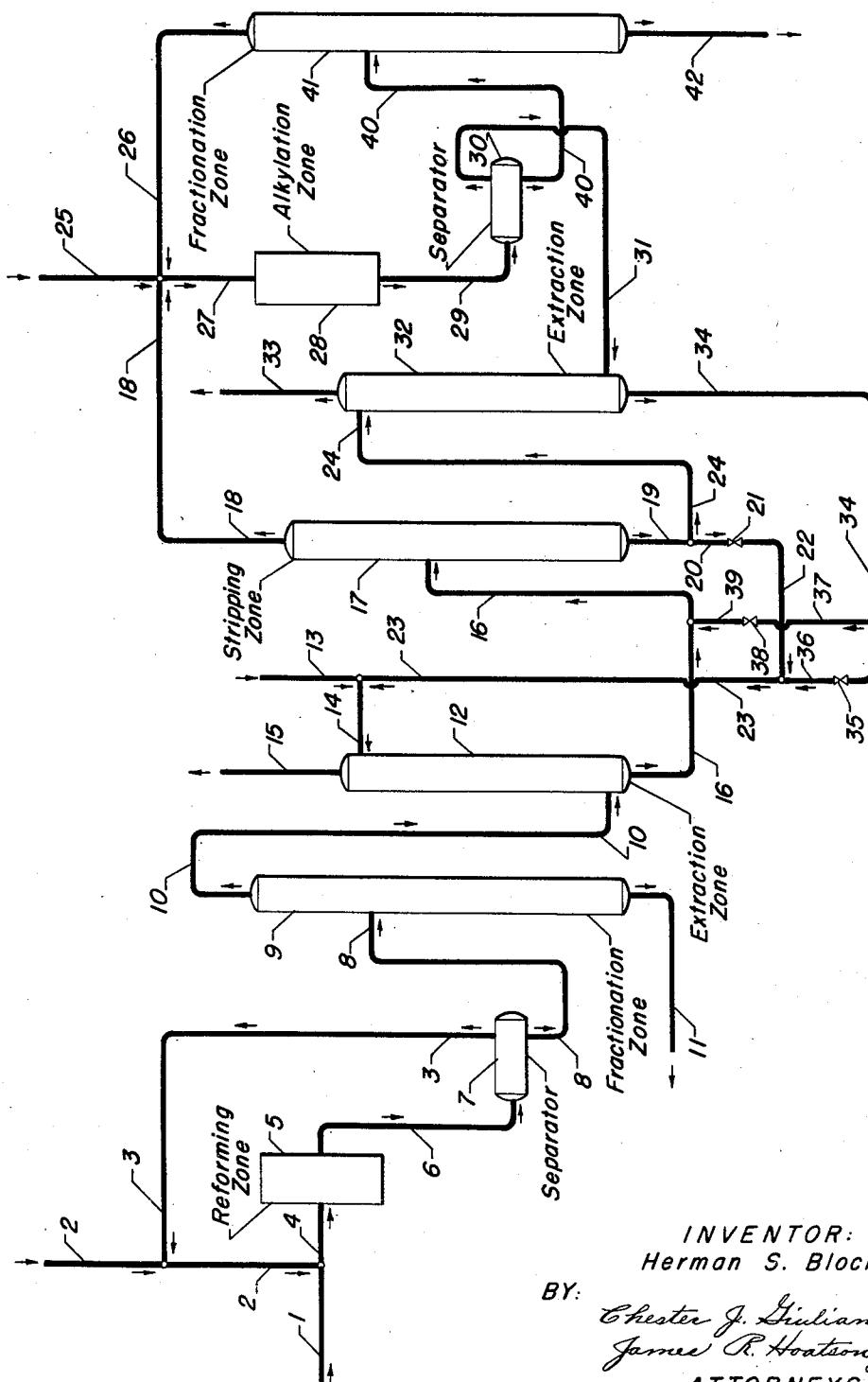
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ALKYLATION OF AROMATIC HYDROCARBONS

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ALKYLATION OF AROMATIC HYDROCARBONS

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This invention relates to a process for the alkylation of aromatic hydrocarbons, and more particularly relates to a process for the alkylation of an alkylatable benzene hydrocarbon with an olefin-acting compound. Still more particularly, this invention relates to a combination process including the steps of liquid-liquid extraction, alkylation, and recovery of excess aromatic hydrocarbon utilized by gas-liquid extraction.

An object of this invention is to produce alkylated aromatic hydrocarbons, and more particularly to produce alkylated benzene hydrocarbons. A specific object of this invention is to produce ethylbenzene, a desired chemical intermediate, which ethylbenzene is utilized in large quantities in dehydrogenation processes for the manufacture of styrene, one starting material for the production of some synthetic rubbers. Another specific object of this invention is to produce alkylated aromatic hydrocarbons within the gasoline boiling range having high antiknock values, which may be utilized as such or as components of gasoline suitable for use in airplane or automobile engines. A further specific object of this invention is the production of cumene by the reaction of benzene with propylene, which cumene product is then oxidized to form cumene hydroperoxide which is readily oxidatively decomposed into phenol and acetone. Another object of this invention is to provide a process for the introduction of alkyl groups into aromatic hydrocarbons of high vapor pressure at normal conditions with minimum loss of said high vapor pressure aromatic hydrocarbons. This and other objects of this invention will be set forth hereinafter as part of the accompanying specification.

In prior art process for the alkylation of aromatic hydrocarbons with olefin hydrocarbons, it has been disclosed that it is preferable to utilize molar excesses of aromatic hydrocarbons. In such processes it is generally preferred to utilize greater than 2 mols of aromatic hydrocarbon per mol of olefin hydrocarbon and in many cases for best reaction it is preferred to use greater than 3 mols of aromatic hydrocarbon per mol of olefin hydrocarbon. This has been found necessary to prevent polymerization of the olefin hydrocarbon from taking place prior to reaction of the olefin hydrocarbon with the aromatic hydrocarbon. While generally satisfactory processes have resulted from such molar excesses of aromatic hydrocarbon, a problem has arisen when these molar excesses are utilized in connection with the alkylation of aromatic hydrocarbons of high vapor pressure at normal conditions, particularly when the olefin hydrocarbon is a normally gaseous olefin hydrocarbon such as ethylene, propylene, 1-butene, 2-butene, or isobutylene. These olefin hydrocarbons are often present in various refinery gas streams containing major quantities of other low boiling hydrocarbons such as hydrogen, methane, ethane, propane, n-butane, and isobutane. When these gas streams are used as the source of olefin hydrocarbon, after reaction of the olefin hydrocarbon with the

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aromatic hydrocarbon it is necessary to vent or otherwise dispose of these unreactive gases. If at the same time the aromatic hydrocarbon utilized or alkylated is of a high vapor pressure at normal conditions, losses of said aromatic hydrocarbon occur due to vaporization thereof in these unreactive gases. As the molar quantity of aromatic hydrocarbon is increased to prevent polymerization of the olefin hydrocarbon reacted, this problem becomes more acute. By means of the process of the present invention, this and other disadvantages inherent in presently utilized processes can be overcome.

In one embodiment the present invention relates to a combination process which comprises separating an aromatic hydrocarbon from a mixture thereof with a non-aromatic hydrocarbon of similar boiling range by contacting said mixture with an immiscible organic solvent of higher boiling range in which said aromatic hydrocarbon selectively dissolves, recovering the thus purified aromatic hydrocarbon by fractionation from the higher boiling selective solvent, recycling lean solvent for reuse in the process, alkylating the aromatic hydrocarbon with a normally gaseous olefin hydrocarbon from a gas stream at alkylating conditions in the presence of an acid-acting alkylation catalyst, said aromatic hydrocarbon being present in a molar quantity greater than that stoichiometrically necessary for said alkylation reaction, separating unreactive gases containing a portion of the excess aromatic hydrocarbon from the alkylation zone effluent, contacting said gases with at least a portion of the lean solvent prior to its reuse as a selective solvent for an aromatic hydrocarbon as aforesaid, recovering another portion of excess aromatic hydrocarbon for reuse in the process from the alkylation zone normally liquid effluent, and recovering alkylated aromatic hydrocarbon product.

In another embodiment, the present invention relates to a combination process which comprises separating benzene from a mixture thereof with a paraffin hydrocarbon of similar boiling range by contacting said mixture with a polyalkylene glycol solvent of higher boiling range in which said benzene selectively dissolves, recovering the thus purified benzene by fractionation from the polyalkylene glycol solvent, recycling the lean polyalkylene glycol solvent for reuse in the process, alkylating the benzene with ethylene from a gas stream containing minor quantities of ethylene at alkylating conditions in the presence of an acid-acting alkylation catalyst, said benzene being present in a molar quantity greater than that stoichiometrically necessary for said alkylation reaction, separating unreactive gases containing a portion of the excess benzene from the alkylation zone effluent, contacting said gases with at least a portion of the lean polyalkylene glycol solvent prior to its reuse as a selective solvent for benzene as aforesaid, recovering another portion of excess benzene for reuse in the process from the alkylation zone normally liquid effluent, and recovering ethylbenzene.

In still another embodiment, the present invention relates to a combination process which comprises separating toluene from a mixture thereof with a paraffin hydrocarbon of similar boiling range by contacting said mixture with a polyalkylene glycol solvent of higher boiling range in which said toluene selectively dissolves, recovering the thus purified toluene by fractionation from the polyalkylene glycol solvent, recycling the lean polyalkylene glycol solvent for reuse in the process, alkylating the toluene with ethylene from a gas stream containing minor quantities of ethylene at alkylating conditions in the presence of an acid-acting alkylation catalyst, said toluene being present in a molar quantity greater than that stoichiometrically necessary for said alkylation reaction, separating unreactive gases containing a portion of the excess toluene from the alkylation zone effluent, contacting said gases

with at least a portion of the lean polyalkylene glycol solvent prior to its reuse as a selective solvent for toluene as aforesaid, recovering another portion of excess toluene for reuse in the process from the alkylation zone normally liquid effluent, and recovering ethyltoluene.

In a further embodiment, the present invention relates to a combination process which comprises separating a xylene from a mixture thereof with a paraffin hydrocarbon of similar boiling range by contacting said mixture with a polyalkylene glycol solvent of higher boiling range in which said xylene selectively dissolves, recovering the thus purified xylene by fractionation from the polyalkylene glycol solvent, recycling the lean polyalkylene glycol solvent for reuse in the process, alkylating the xylene with ethylene from a gas stream containing minor quantities of ethylene at alkylating conditions in the presence of an acid-acting alkylation catalyst, said xylene being present in a molar quantity greater than that stoichiometrically necessary for said alkylation reaction, separating unreactive gases containing a portion of the excess xylene from the alkylation zone effluent, contacting said gases with at least a portion of the lean polyalkylene glycol solvent prior to its reuse as a selective solvent for xylene as aforesaid, recovering another portion of excess xylene for reuse in the process from the alkylation zone normally liquid effluent, and recovering an ethylxylene.

In a specific embodiment, the present invention relates to a combination process which comprises separating benzene from a mixture thereof with a paraffin hydrocarbon of similar boiling range by contacting said mixture with a diethylene glycol solvent of higher boiling range in which said benzene selectively dissolves, recovering the thus purified benzene by fractionation from the diethylene glycol solvent, recycling the lean diethylene glycol solvent for reuse in the process, alkylating the benzene with ethylene from a gas stream containing minor quantities of ethylene at alkylating conditions in the presence of an acid-acting alkylation catalyst, said benzene being present in a molar quantity greater than that stoichiometrically necessary for said alkylation reaction, separating unreactive gases containing a portion of the excess benzene from the alkylation zone effluent, contacting said gases with at least a portion of the lean diethylene glycol solvent prior to its reuse as a selective solvent for benzene as aforesaid, recovering another portion of excess benzene for reuse in the process from the alkylation zone normally liquid effluent, and recovering ethylbenzene.

This invention can perhaps be best understood by reference to the attached drawing. While of necessity certain limitations must be present in such a schematic description, no intention is meant to limit the generally broad scope of this invention. As stated hereinabove, the first step of the combination process of the present invention comprises separating an aromatic hydrocarbon from a mixture thereof with a non-aromatic hydrocarbon of similar boiling range by contacting said mixture with an immiscible organic solvent of higher boiling range in which said aromatic hydrocarbon selectively dissolves. In the drawing, this first step is represented as taking place in extraction zone 12. However, the mixture of aromatic hydrocarbon and non-aromatic hydrocarbon of similar boiling range must be furnished to this extraction zone. In the drawing this is accomplished by the reforming of a gasoline or naphtha or a selected fraction thereof. Thus, a full boiling range gasoline, a naphtha, or a selected fraction thereof is passed through line 1 to which is added make-up hydrogen through line 2 and recycled hydrogen from line 3 and this hydrogen and hydrocarbon mixture then passes through line 4 to reforming zone 5. As usually operated the amount of hydrogen charged along with the hydrocarbons usually will be from 0.5 to about 15 mols per mol of hydrocarbon.

Reforming zone 5 is packed with a reforming catalyst such as a platinum-alumina-combined halogen catalyst. Such catalyst usually contain from about 0.01 to about

2 percent platinum, from about 0.1 to about 8 percent combined halogen, preferably fluorine and/or chlorine, and the remainder alumina. However, other catalysts such as platinum-silica-alumina, molybdena-alumina, etc. may be utilized. The reforming process will be effected at a temperature within the range of from about 600° F. to about 1000° F., a pressure within the range of from about 50 to about 500 p.s.i., and at a liquid hourly space velocity of from about 0.5 to about 10 or more. After reforming, the hydrocarbon mixture passes from reforming zone 5 through line 6 to high pressure separator 7 wherein hydrogen is separated from the hydrocarbon product via line 3 and recycled for further use in the reforming process. The reformatte passes from high pressure separator 7 through line 8 to fractionation zone 9. Fractionation zone 9 is merely schematic and may comprise one or more fractionation towers as may be necessary in any particular case. For example, if the feed to the reforming zone is a full boiling gasoline or naphtha fraction, it will be necessary to utilize several fractionation towers in order to separate the desired mixture of aromatic hydrocarbon and non-aromatic hydrocarbon of the same boiling range. In fractionation tower 9, the desired boiling range fraction is distilled overhead and passes through line 10 to extraction zone 12. The higher boiling fraction is removed from the process through line 11 for uses such as a blending stock for automobile and aviation gasoline.

While the above description is illustrative of the preparation of an aromatic hydrocarbon and non-aromatic hydrocarbon of similar boiling range by reforming, for use in the first step of the process of this invention, this mixture may also be provided from other sources, for example, as a selective fraction from the distillation of coal tar, as a selective fraction from the dehydrogenation of naphthenic hydrocarbons, as a selective fraction which has been distilled from cracked gasoline, etc. Thus, the mixture of aromatic hydrocarbon and non-aromatic hydrocarbon may be provided from various sources. Further, this mixture may be a close boiling fraction comprising mainly one aromatic hydrocarbon in admixture with non-aromatic hydrocarbons, such as a benzene-hexane fraction, or the mixture may be a wider boiling fraction containing more than one aromatic hydrocarbon and more than one paraffin hydrocarbon homolog. An example of such a latter fraction is one containing benzene, toluene, and xylenes in admixture with hexanes, heptanes, and octanes. The various mixtures of aromatic hydrocarbons and non-aromatic hydrocarbons of similar boiling range are well known to those skilled in the art.

As hereinabove set forth, the selected aromatic hydrocarbon and non-aromatic hydrocarbon mixture is passed through line 10 to extraction zone 12. Extraction zone 12 is a liquid-liquid type contacting zone of a type familiar to those skilled in the art. To this zone is fed an organic solvent for the aromatic hydrocarbon through lines 13 and 14. In addition, recycle solvent is fed to this zone through line 23 as hereinafter described. The preferred organic solvents are those which are immiscible with hydrocarbons, those in which aromatic hydrocarbons selectively dissolve, and those of higher boiling range than the aromatic hydrocarbon to be extracted therein. The solvent must not be completely miscible with hydrocarbons so that proper operation of the liquid-liquid countercurrent extraction zone can be realized. The solvent must have the property of selectively dissolving aromatic hydrocarbons for successful operation of the process. The solvent is preferably of higher boiling range than the aromatic hydrocarbon which is dissolved therein so that the aromatic hydrocarbon can be readily separated from the solvent by fractionation overhead. A solvent having these characteristics can be utilized economically in an isothermal extraction process, which is the most desirable type. Suitable solvents include particularly the polyalkylene glycols, preferably diluted with

varying amounts of water, say up to about 20 percent by volume of water. Typical polyalkylene glycols which can be utilized successfully in the present process are diethylene glycol, triethylene glycol, tetraethylene glycol, dipropylene glycol, tripropylene glycol, mixtures of diethylene glycol and dipropylene glycol, etc. Another suitable class of solvents which may be utilized include higher boiling nitriles such as oxydipropionitrile. Other selective solvents, such as, for example, phenylethanamine, dimethylformamide, and the like, may also be used, either by themselves or in combination with one or more of the other named solvent components.

As stated hereinabove the selective solvent is added to the upper section of extraction zone 12 through line 14 and passes downwardly therethrough in liquid-liquid contact with the mixture of aromatic hydrocarbon and non-aromatic hydrocarbon. The aromatic hydrocarbon selectively dissolves in the solvent and passes from extraction zone 12 through line 16 to stripping zone 17. The portion of the feed stock to the extraction zone which is not dissolved by the selective solvent is removed overhead from the extraction zone through line 15. This fraction, normally termed raffinate, is suitable for various uses such as stove oil, jet fuel, etc. The extraction zone is usually maintained at somewhat elevated temperatures, say 200–500° F. and under slight pressure so that some flashing of the aromatic hydrocarbon from the selective solvent takes place in the stripping zone. The stripping zone 17 is normally operated at about atmospheric pressure so that pressures in the extraction zone will range from about atmospheric to about 200 p.s.i. The rates of addition of the feed stock and the selective solvent to extraction zone 12 will be varied depending upon the aromatic hydrocarbon to be extracted, upon the particular solvent utilized, and upon the temperature of this portion of the isothermal process. However, the feed rates will be adjusted so that substantially all of the aromatic hydrocarbon is extracted by the selective solvent.

The mixture of selective solvent and aromatic hydrocarbon, as hereinabove stated, passes from extraction zone 12 through line 16 to stripping zone 17. Stripping zone 17 maintained at approximately atmospheric pressure is heated by a solvent reboiler not shown. The aromatic hydrocarbon in extremely pure form passes overhead from stripping zone 17 through line 18. The selective solvent which does not need to be fractionated because of its higher boiling range than the extracted aromatic hydrocarbon passes as a bottoms fraction from stripping zone 17 through lines 19 and 20, valve 21, and line 22 back through line 23 for recycle to the extraction zone as hereinabove described. Valve 21 is adjusted so that at least a portion of the recycle solvent passes through line 24 to extraction zone 32 which will be described hereinafter. It can be seen that full closure of valve 21 will result in passage of all of this recycle solvent through line 24 to extraction zone 32. Such valve adjustment is seldom necessary and valve 21 is usually cracked in a manner to allow passage of some of the recycle solvent to extraction zone 12.

The thus purified aromatic hydrocarbons from stripping zone 17 are passed through line 18 and line 27 to alkylation zone 28. Recycle aromatic hydrocarbon produced as hereinafter described passes through line 26 and line 27 to alkylation zone 28. The gas stream containing the olefin hydrocarbon is introduced to the aromatic hydrocarbon via line 25 and passes therewith through line 27 to alkylation zone 28. As stated hereinabove, it is preferred to utilize a molar ratio of aromatic hydrocarbon to olefin hydrocarbon of greater than 2, and preferably of greater than 3 to preclude olefin polymerization prior to alkylation. As stated hereinabove, various aromatic hydrocarbons can be utilized within the generally broad scope of this invention. Of these aromatic hydrocarbons, benzene hydrocarbons are preferred, and of these, those which are particularly preferred include ben-

zene, toluene, o-xylene, m-xylene, p-xylene, and ethylbenzene. However, other aromatic hydrocarbons are operable including n-propylbenzene, iso-propylbenzene, butylbenzenes, naphthalene, α -methyl-naphthalene, β -methyl-naphthalene, etc. The gas stream containing the olefin hydrocarbon, such as ethylene or propylene may be any refinery gas stream. Such refinery gas streams have in the past often been burned since an economical process for their utilization as alkylating agents has not been available. Such a typical gas is known as refinery off-gas. These refinery off-gases in addition to containing varying amounts of ethylene, propylene, and the various butenes, depending on their source, contain varying quantities of paraffinic hydrocarbons, nitrogen, hydrogen, etc. Thus, a refinery off-gas ethylene stream may contain varying quantities of methane and ethane while a refinery off-gas propylene stream is normally diluted with propane and a butylene stream is normally diluted with butanes. Typical analysis for a refinery gas from a catalytic cracking unit in mol per cent is as follows: nitrogen, 4.0%; carbon monoxide, 0.2%; hydrogen, 5.4%; methane, 37.8%; ethylene, 10.3%; ethane, 24.7%; propylene, 6.4%; propane, 10.7%; and C₄ hydrocarbons, 0.4%.

Thus, the aromatic hydrocarbon and the normally gaseous olefin hydrocarbon from a gas stream are passed through line 27 to alkylation zone 28. Alkylation zone 28 will contain an acid-acting alkylation catalyst and the alkylating conditions utilized will depend upon the particular acid-acting alkylation catalyst selected. The acid-acting alkylation catalyst may be selected from diverse materials including sulfuric acid, phosphoric acid, hydrogen fluoride, aluminum chloride, aluminum bromide, boron trifluoride, ferric chloride, zinc chloride, synthetically prepared silica-alumina, silica-zirconia, and various acid-acting aluminas including activated alumina of commerce, Tonsil, Porocel, etc. With the utilization of such diverse materials as alkylation catalysts, the temperature utilized in the alkylation zone will range from about 0° C. or lower to about 250° C. or higher and the pressure may vary from about atmospheric to about 500 p.s.i. or more. In a batch type process, the amount of catalyst in the alkylation zone may vary from about 1 percent by weight based on the reactants to about 500 percent by weight or more. If the alkylation catalyst is a solid, such as solid phosphoric acid, or silica-alumina, the amount of catalyst utilized is ordinarily designated by means of hourly liquid space velocity which may vary from about 0.1 to about 10 or more. When the alkylation reaction has proceeded to the desired extent, the products from the alkylation zone, termed alkylation zone effluent, are withdrawn from alkylation zone 28 through line 29 to separator 30, also the alkylation zone effluent receiver. From this separator or receiver is withdrawn overhead the unreactive gases introduced with the olefin hydrocarbon gas stream and which merely pass through the reactor unchanged.

Since the aromatic hydrocarbon was utilized in molar excess in the alkylation zone, the excess aromatic hydrocarbon will be present in separator 30 and a portion thereof will be vaporized overhead along with the unreactive gases. To prevent loss of this excess aromatic hydrocarbon vaporized along with the unreactive gases, these gases and vaporized aromatic hydrocarbon are directed via line 31 to extraction zone 32.

Extraction zone 32 is a gas-liquid countercurrent contacting zone, the size of which is varied depending upon the quantity of aromatic hydrocarbon in the unreactive gases and the particular liquid solvent utilized. In extraction zone 32 at least a portion of the recycle selective solvent passes into the upper portion thereof through line 24 in countercurrent flow to the unreactive gases containing vaporized aromatic hydrocarbon. The vaporized aromatic hydrocarbon is selectively dissolved in the selective solvent and the unreactive gases free from

aromatic hydrocarbon are vented through line 33. This extraction zone 32 is preferentially maintained at the same temperature as extraction zone 12 and stripping zone 17. In other words, these three pieces of apparatus are utilized in an isothermal operation which results in added advantage for the process. This added advantage is that there is no heat input to these vessels so that the operating cost is minimized.

The selective solvent containing dissolved aromatic hydrocarbon is withdrawn from extraction zone 32 through line 34 and passes through valve 35 and line 36 to line 23 for reuse in the extraction zone. In some cases it may be desirable to direct all or a portion of selective solvent containing dissolved aromatic hydrocarbon from extraction zone 32 through line 37, valve 38, and lines 39 and 16 to stripping zone 17 for direct recovery of the aromatic hydrocarbon from the selective solvent. In another case, valves 38 and 35 may be adjusted so as to direct a desired portion of this selective solvent back to extraction zone 12 and to direct another portion to stripping zone 17.

The remaining alkylation zone effluents are withdrawn from separator 30 through line 40 to fractionation zone 41. In fractionation zone 41 the remainder of the excess aromatic hydrocarbon utilized in the alkylation zone 28 is fractionated overhead and recycled by means of lines 26 and 27, hereinabove described. The desired product is separated as a bottoms fraction from fractionation zone 41 and if further purification is desired may be passed to another fractionation zone not shown, via line 42.

The following example is introduced for the purpose of illustration but with no intention of unduly limiting the generally broad scope of this invention. In this example, 10,000 barrels per day of a full boiling range naphtha is introduced to the reforming zone. This naphtha has a boiling range of 125°–400° F. The reforming zone is packed with a platinum-alumina-combined halogen catalyst and reforming of the naphtha is accomplished at a pressure of 500 p.s.i., a temperature of 925° F., an hourly liquid space velocity of 4.0, and a hydrogen to hydrocarbon ratio of 6:1. From the reforming zone, the reformed naphtha is separated from the recycled hydrogen and is passed to a series of fractionation zones. The naphtha is debutanized and a C₅ to 190° F. cut is isolated therefrom as an overhead fraction in a quantity of 2000 barrels per day. By analysis, this fraction is found to contain 18% by volume of benzene, amounting to 360 barrels per day.

This C₅ to 190° F. fraction in the quantity of 2000 barrels per day is passed to a liquid-liquid extraction zone utilizing a solvent comprising 94% diethylene glycol and 6% water. This extraction zone is maintained at a temperature of 260° F., a pressure of 90 p.s.i.g., and a 7:1 solvent to feed ratio (by volume). Thus, if extraction zone 12 in Figure I represents the solvent extraction zone, 2000 barrels per day of benzene containing hydrocarbons pass thereto through line 10 and 14,000 barrels per day of solvent is circulated thereto through line 14. After extraction and recovery of benzene in a fractionation or stripping zone, there is obtained 360 barrels per day of benzene or aromatic concentrate.

This 360 barrels per day of benzene, equivalent to 27,000 gram mols per hour is passed, for example, through line 18 wherein it is combined with 79,800 gram mols per hour of recycle benzene from line 26. In addition to this 106,800 gram mols per hour of benzene, there is provided an additional recycle of 1200 gram mols of benzene per hour as hereinafter described. This total quantity of benzene in the amount of 108,000 gram mols per hour is combined with 234,500 gram mols per hour of a gas stream containing 12.5 mol percent ethylene or 29,310 gram mols per hour of ethylene to give an aromatic to olefin ratio of 3.8/1. This combined feed passes through line 27 to alkylation zone 28 containing what is known in the art as solid phosphoric acid catalyst. This

solid phosphoric acid catalyst is a calcined mixture of phosphoric acid and kieselguhr. Alkylation zone 28 is maintained at a temperature of 575° F., a pressure of 600 p.s.i., and the liquid hourly space velocity based on the benzene is 2.0. From this alkylation there is obtained 25,320 gram mols per hour of ethylbenzene, 1050 gram mols per hour of diethylbenzene, and 630 gram mols per hour of triethylbenzene. In the alkylation zone, 100 percent of the ethylene charged, or 29,310 gram mols per hour is converted to alkylaromatic hydrocarbons. These alkylaromatic hydrocarbons along with excess benzene and the unreactive gases pass from alkylation zone 28 to separator 30. The unreactive gases comprising nitrogen, hydrogen, methane, and ethane in the quantity of 205,190 gram mols per hour are discharged from separator 30 which is maintained at 100° F. and a pressure of 600 p.s.i. Along with these unreactive gases, due to its own vapor pressure, passes 1200 gram mols per hour of benzene. This quantity of benzene would be lost from the process in these vent gases were it not for the presence of extraction zone 32 wherein this quantity of benzene is recovered by gas-liquid contact with a portion of the lean solvent from the bottom of stripping zone 17. This 1200 gram mols per hour is equivalent to a 4.5% loss based on the benzene charged to the process and would be equal to 16 barrels per day in a plant of the indicated size.

As stated hereinabove, the products and 79,800 gram mols of excess benzene are removed from separator 30 to a fractionation zone and the excess benzene is recycled to the process.

I claim as my invention:

1. A process for producing alkylated aromatic hydrocarbon from a mixture of an aromatic hydrocarbon with a non-aromatic hydrocarbon of similar boiling point, which comprises contacting said mixture in an extraction zone with an immiscible organic solvent of higher boiling point than and in which said aromatic hydrocarbon is selectively soluble, fractionating the resultant solution of aromatic hydrocarbon and solvent in a stripping zone to separate the aromatic hydrocarbon from lean higher boiling solvent, subjecting the thus separated aromatic hydrocarbon to catalytic alkylation with a gas stream containing a normally gaseous olefin in admixture with other gases while maintaining a molar excess of said aromatic hydrocarbon over said normally gaseous olefin, separating from the resultant alkylation effluent unreacted gases containing excess aromatic hydrocarbon, contacting said unreacted gases with lean solvent from said stripping zone to dissolve therein excess aromatic hydrocarbon which would otherwise be vented and lost from the process in the unreacted gases, and introducing thus enriched solvent to one of said zones whereby recovered excess aromatic hydrocarbon is separated from the solvent in the stripping zone and subsequently supplied to the alkylating step.

2. The process of claim 1 further characterized in that said enriched solvent is first introduced to said extraction zone and thence passed to said stripping zone.

3. The process of claim 1 further characterized in that said enriched solvent is introduced directly to said stripping zone.

4. A process for producing alkylated aromatic hydrocarbon from a mixture of a benzene hydrocarbon with a paraffinic hydrocarbon of similar boiling point, which comprises contacting said mixture in an extraction zone with an immiscible organic solvent of higher boiling point than and in which said benzene hydrocarbon is selectively soluble, fractionating the resultant solution of benzene hydrocarbon and solvent in a stripping zone to separate the benzene hydrocarbon from lean higher boiling solvent, subjecting the thus separated benzene hydrocarbon to catalytic alkylation with a gas stream containing a normally gaseous olefin in admixture with other gases while maintaining a molar excess of said benzene hydrocarbon

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over said normally gaseous olefin, separating from the resultant alkylation effluent unreacted gases containing excess benzene hydrocarbon, contacting said unreacted gases with lean solvent from said stripping zone to dissolve therein excess benzene hydrocarbon which would otherwise be vented and lost from the process in the unreacted gases, and fractionating thus enriched solvent in said stripping zone whereby recovered excess benzene hydrocarbon is separated from the solvent and subsequently supplied to the alkylating step.

5. A process for producing alkylating aromatic hydrocarbon from a mixture of a benzene hydrocarbon with a paraffinic hydrocarbon of similar boiling point, which comprises contacting said mixture in an extraction zone with a polyalkylene glycol solvent of higher boiling point than and in which said benzene hydrocarbon is selectively soluble, fractionating the resultant solution of benzene hydrocarbon and solvent in a stripping zone to separate the benzene hydrocarbon from lean higher boiling solvent, subjecting the thus separated benzene hydrocarbon to catalytic alkylation with a gas stream containing a normally gaseous olefin in admixture with other gases while maintaining a molar excess of said benzene hydrocarbon over said normally gaseous olefin, separating from the resultant alkylation effluent unreacted gases containing excess benzene hydrocarbon, contacting said unreacted gases with at least a portion of the lean solvent from said stripping zone to dissolve therein excess benzene hydro-

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carbon which would otherwise be vented and lost from the process in the unreacted gases, and fractionating thus enriched solvent in said stripping zone whereby recovered excess benzene hydrocarbon is separated from the solvent and subsequently supplied to the alkylating step.

6. The process of claim 5 further characterized in that said enriched solvent is first introduced to said extraction zone and thence supplied to the stripping zone for fractionation in the latter.

7. The process of claim 5 further characterized in that said enriched solvent is introduced directly to the stripping zone for fractionation therein.

8. The process of claim 5 further characterized in that said normally gaseous olefin is ethylene.

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