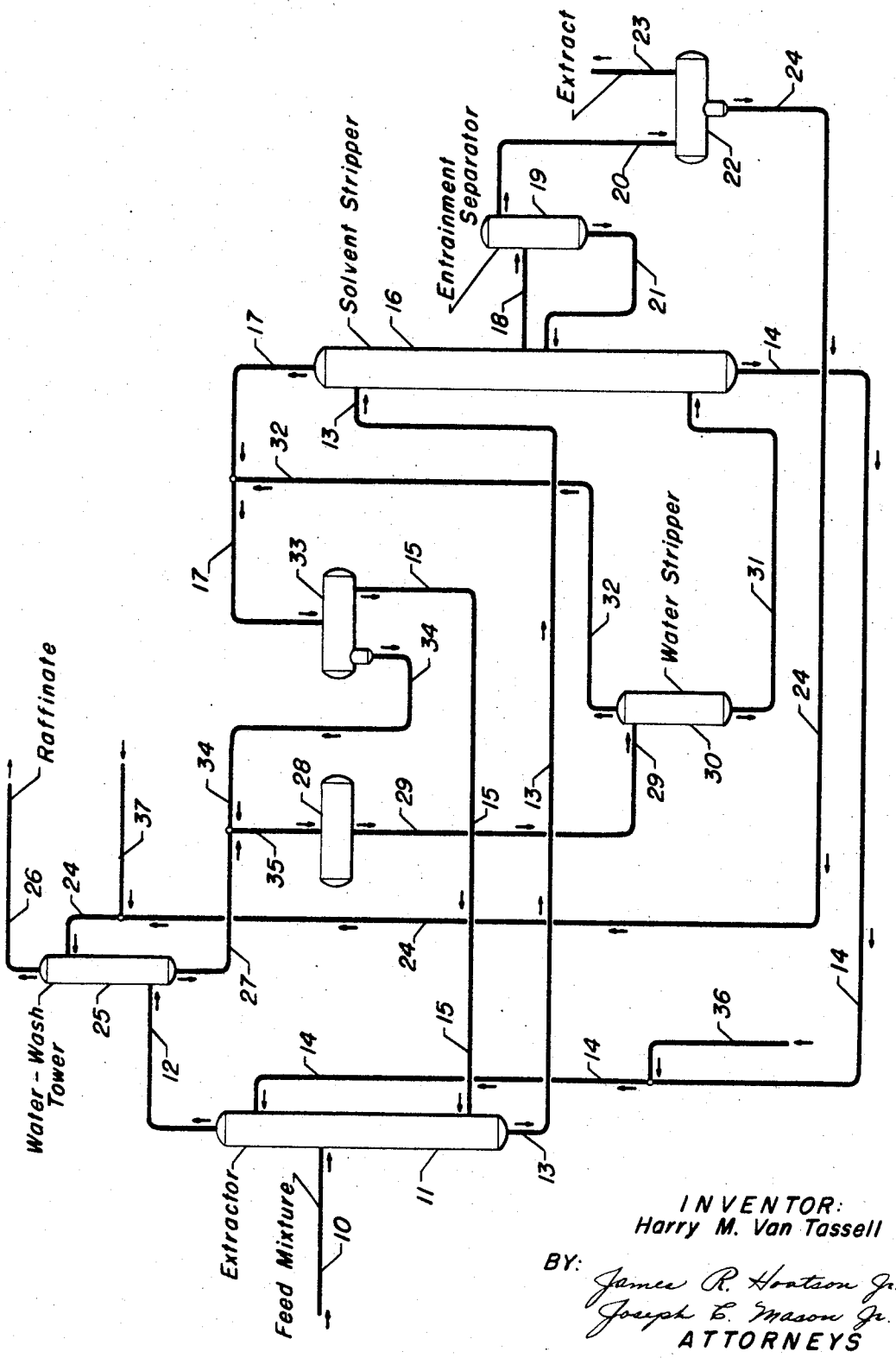
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RECOVERY OF AROMATICS

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INVENTOR:
Harry M. Van Tassell

BY: James R. Hoatson Jr.
Joseph E. Mason Jr.
ATTORNEYS

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RECOVERY OF AROMATICS

Harry M. Van Tassell, Arlington Heights, Ill., assignor to Universal Oil Products Company, Des Plaines, Ill., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

An improved solvent extraction method for the recovery of aromatic hydrocarbons using an aqueous solvent system whereby solvent losses are minimized. The preferred solvent composition comprises 75% to 98% by weight polyalkylene glycol and 2% to 25% by weight water. The preferred aromatic hydrocarbon which is recovered is benzene. The benefits of the invention are achieved by the expedient of placing a separation means in the sidecut aromatic withdrawal stream from the aromatic hydrocarbon distillation zone and by an integrated system for handling the water recycle streams.

This invention relates to a new and improved solvent extraction process for the recovery of aromatic hydrocarbons from feedstocks containing aromatic and nonaromatic hydrocarbons. It relates particularly to an improved method for the recovery of aromatic hydrocarbons using an aqueous solvent system whereby solvent losses are minimized. More specifically, this invention relates to an improved method for the operation of the solvent extraction process whereby highly selective aqueous solvents are employed and unusually high process selectivity is achieved.

A conventional process employed for the recovery of high purity aromatics from various feedstocks is liquid-liquid extraction using a solvent which has high selectivity for the aromatic components contained in the feedstock. Typically, in the practice of such prior art processes, a hydrocarbon feed mixture is contacted in an extraction zone with an aqueous solvent composition which selectively dissolves the aromatic component of the hydrocarbon feedstock, thereby forming a raffinate phase, comprising one or more nonaromatic hydrocarbons, and an extract phase containing dissolved aromatic components. The extract phase is then separately distilled yielding an overhead distillate containing only a portion of the extracted aromatic component, a sidecut comprising aromatic hydrocarbons and water, and a bottoms comprising lean solvent. Frequently, to prevent losses of the solvent, the raffinate phase is washed with water in a washing zone in order to remove solvent from the raffinate phase.

The prior art processes have been successful in producing high purity aromatics, but the solvent losses from the practice of such processes have been unsatisfactorily high. Since the solvent is a reasonably expensive raw material, it would be highly desirable to minimize solvent losses while maximizing both recovery and purity of aromatic hydrocarbons.

Additionally, the processing schemes heretofore employed utilize considerable quantities of water not only because an aqueous solvent has increased selectivity for aromatic hydrocarbons, but has utility in the form of stripping steam in the recovery of the aromatic hydrocarbons from the rich solvent stream. Accordingly, it would also be desirable to reuse within the processing scheme a maximum quantity of water thereby effecting further economies in the operation of the process. However, the recycle and reuse of the water within the processing scheme operates to decrease both the quantity and

purity of the aromatics obtainable from a given feedstock. Since water, per se, has some selectivity for the hydrocarbons contained in the feedstock, in addition to its miscibility with the organic solvent used, the reuse of the water causes contamination of the aromatic hydrocarbons with nonaromatic hydrocarbons and vice versa.

It is therefore an object of this invention to provide a simplified and highly economical method for the recovery of aromatic hydrocarbons from a hydrocarbon mixture containing aromatic and nonaromatic hydrocarbons. It is a further object of this invention to provide a method for reducing to a minimum the need for water from extraneous sources while recovering a substantially solvent-free aromatic extract and a substantially solvent-free nonaromatic raffinate. It is a specific object of this invention to provide a method for the recovery of aromatics in high concentration whereby solvent losses from the system are minimized.

The present invention is specifically described in connection with the accompanying diagram which illustrates a typical process flow in conformity with the invention.

Accordingly, the present invention is directed to a method for the solvent extraction of aromatic hydrocarbons from a hydrocarbon feed mixture containing aromatic hydrocarbons and nonaromatic hydrocarbons by contacting the feed mixture in an extraction zone with a solvent composition comprising water and an oxygen-containing organic compound which has high selectivity for aromatic hydrocarbons. A raffinate phase comprising nonaromatic hydrocarbons admixed with a minor proportion of the organic compound is separated from an extract phase comprising the solvent composition containing aromatic hydrocarbons dissolved therein. The extract phase is thereafter fractionated in a distillation zone to form a first vapor fraction comprising water, a second vapor fraction comprising the aromatic hydrocarbons admixed with water containing a minor proportion of the organic compound, and a third liquid fraction comprising a major proportion of the organic compound. The second vapor fraction is passed into first separation means under conditions sufficient to separate substantially all of the organic compound from the aromatic hydrocarbons and water. The separated organic compound is returned directly to the distillation zone. The separated aromatic hydrocarbons and water are passed into second separation means under conditions sufficient to separate the aromatic hydrocarbons from the water. The aromatic hydrocarbons are then withdrawn from the second separation means. The raffinate phase is washed in a washing zone with water comprising at least a portion of the water separated from the second separation means under conditions sufficient to remove substantially all of the organic compound therefrom. The raffinate phase, substantially free from the organic compound, is removed from the washing zone and recovered for further processing or use. A wash water stream containing the organic compound is also removed from the washing zone and is reused at least in part in the extraction zone. Finally, at least a major portion of the third fraction formed in the distillation zone is recycled to the extraction zone for reuse in the process.

It is known in the art that in the solvent extraction of aromatic hydrocarbons from a hydrocarbon mixture the solvents utilized for this purpose generally contain a definite proportion of water to thereby increase the selectivity of the solvent for the aromatic component of the feedstock and to increase the capacity of the solvent to reject the nonaromatic components in the feedstock. Thus, by virtue of such increase of water in the solvent composition, the solubility of aromatic hydrocarbons in the solvent remains high, although somewhat reduced in comparison with a nonaqueous solvent, the solubility of raffi-

nate in the solvent is decreased, and the solubility of solvent in the raffinate is also decreased.

Although the quantity of solvent in the raffinate at any instant is relatively small, the cumulative effect of such small amounts of solvent in a stream removed from the process flow and thus otherwise lost, greatly reduces the efficiency and economy of the solvent extraction process. Accordingly, it is desirable that the solvent dissolved in the raffinate stream be recovered therefrom. Such recovery is usually accomplished by countercurrently washing the raffinate with water in a separate washing zone from which a wash water stream is recovered containing dissolved therein the solvent recovered from the raffinate.

However, in the practice of the raffinate water washing step, a small proportion of the raffinate hydrocarbons are also contained in the wash water effluent either from solution or in entrainment. Thus, if such wash water were reused at any point in the aromatic recovery system, the purity of the recovered aromatics would of necessity be reduced.

On the other hand, in the fractionation of the aromatic extract, in order to remove the aromatic hydrocarbons from the solvent composition it is necessary to remove a sidecut stream from a distillation zone which contains not only the aromatic hydrocarbons, but also water which has been used as the stripping medium and which has entrained therewith a small quantity of the organic compound used in the solvent composition. Since it is desirable to reuse this water after separation from the aromatic hydrocarbons in the process, it is necessary that the separated water be further processed in order to recover the organic compound therefrom. Frequently this is accomplished by utilizing a series of settling vessels in conjunction with additional stripping means so that the water may be separated from the organic compound prior to use in the system. If such extraneous and auxiliary processing schemes were not practiced, the use of the organic compound containing water, for example, to water wash the raffinate, would not be practical since additional solvent losses would be encountered in the raffinate wash column either through entrainment into the raffinate phase or by lack of extraction efficiency due to a smaller concentration gradient within the water to absorb additional quantities of solvent from the raffinate hydrocarbons.

It is noted from the hereinabove brief description of the present invention relative to the prior art that significant economies of operation are achieved by the novel and simple expedient of placing a separation means in the sidecut aromatic withdrawal stream from the distillation zone and by the unique system for handling the water recycle streams. The separator operates to return directly to the distillation zone the separated organic compound and to provide a water phase which is substantially free of solvent which can therefore be safely reused in the process without additional treatment. The function of the separator at this point unexpectedly removes solvent present in the water by mist or haze or entrainment, and unexpectedly breaks any foam formed in that stream. It was quite surprising to discover that this entrainment separator could effectively eliminate most of the prior art auxiliary equipment for purifying the wash water stream.

Therefore, a more specific embodiment of this invention concerns a method for recovering aromatic hydrocarbons from a hydrocarbon feed mixture containing aromatic hydrocarbons and nonaromatic hydrocarbons which comprises contacting the feed mixture in an extraction zone with a solvent composition comprising water and an organic compound selected from the group consisting of polyalkylene glycol and sulfolane, said composition being selective for aromatic hydrocarbons under extraction conditions; withdrawing from the extraction zone a raffinate phase comprising nonarmoatic hydrocarbons admixed with said organic compound, and an extract phase comprising said solvent composition containing aromatic hydrocarbons dissolved therein; separating the extract phase in a distillation zone into at least a first vapor fraction comprising water, a second vapor fraction comprising aromatic hydrocarbons admixed with water and said organic compound, and a third liquid fraction comprising said organic compound; passing said second vapor fraction into first separation means under conditions sufficient to form a vapor stream comprising aromatic hydrocarbons and water, and a liquid stream comprising said organic compound; returning said liquid stream directly to said distillation zone at a locus below the withdrawal locus for said second vapor fraction; passing said formed vapor stream into second separation means under conditions sufficient to form a first hydrocarbon stream comprising aromatic hydrocarbons and an aqueous stream comprising water substantially free of said organic compound; withdrawing said first hydrocarbon stream from said second separation means and recovering therefrom aromatic hydrocarbons in high concentration; washing said raffinate phase in a washing zone with said aqueous stream under conditions sufficient to form a second hydrocarbon stream comprising nonaromatic hydrocarbons substantially free of said organic compound, and a water phase containing said organic compound and a minor proportion of nonaromatic hydrocarbons; passing the water phase from the washing zone to stripping means; withdrawing from the stripping means an overhead fraction containing nonaromatic hydrocarbons and a bottoms fraction comprising water substantially free of nonaromatic hydrocarbons; recycling said third liquid fraction from the distillation zone to the extraction zone; and passing the bottoms fraction from the stripping means, at least in part, to the extraction zone.

The hydrocarbon feed mixture which may be separated by the improved process of the present invention comprises many different aromatic-nonaromatic mixtures. Typical feedstocks applicable to the present process include hydrocarbon distillate fractions (usually boiling within or near the gasoline boiling range) of natural gasoline or straight run petroleum distillates, and especially comprises reformed naphthas which are rich in aromatic hydrocarbons and which are particularly valuable as a source of such mononuclear aromatic hydrocarbons as benzene, toluene and xylene. Preferred hydrocarbon feed mixtures comprise nonaromatic hydrocarbons admixed with aromatic hydrocarbons which are selected from the group consisting of benzene, toluene, xylenes, mixtures of benzene and toluene, and mixtures of toluene and xylene. In each case, however, it is understood that the feedstock contains nonaromatic hydrocarbons as well as these enumerated aromatic hydrocarbons. The process of the present invention is specifically directed to the separation of hydrocarbon feed mixtures comprising benzene and toluene and to feed mixtures comprising toluene and xylene as the aromatic hydrocarbon. Typically, the feedstocks for the present invention will contain from 30% to about 60% by weight aromatic hydrocarbons, although aromatic hydrocarbon concentrations as high as 95% may be used in some cases.

Solvent compositions which may be utilized in the practice of the present invention generally contain one or more organic compounds containing in the molecule at least one polar group such as a hydroxyl, amino, cyano, carboxyl, or nitro radical. In order to be effective, the organic compound of the solvent composition having the polar radical must have a boiling point substantially greater than the boiling point of water which is included in the solvent composition for enhancing its selectivity; and, in general, must also have a boiling point substantially greater than the end boiling point of the aromatic component to be extracted from the hydrocarbon feed mixture.

Organic compounds suitable for use as part of the solvent composition preferably are selected from the group of those oxygen-containing compounds which

include the aliphatic and cyclic alcohols, cyclic monomeric sulfones, the glycols and glycol ethers as well as the glycol esters and glycol ether esters. The mono- and polyalkylene glycols in which the alkylene group contains from 2 to 3 carbon atoms, such as ethylene glycol, diethylene glycol, triethylene glycol, and tetraethylene glycol, propylene glycol, dipropylene glycol, and tripropylene glycol, as well as the methyl, ethyl, propyl and butyl ethers of the glycol hydroxyl groups and the acetic acid esters thereof, constitute a particularly preferred class of organic solvents useful in admixture with water as the solvent composition for use in the present process. A particularly preferred glycol comprises triethylene glycol.

Additionally, excellent results may be obtained utilizing the cyclic monomeric sulfone, such as tetrahydrotriophene-1,1-dioxide. Still further, an organic compound particularly useful in the practice of this invention is a sulfolane which may be made by condensing a conjugated diolefin with sulfur dioxide and then subjecting the resulting product to hydrogenation, alkylation, hydration and/or other substitution or addition reactions. Typically, organic compounds belonging to the sulfolane class are 2-sulfolene, 2-methylsulfolane, 2,4-dimethylsulfolane, 2,4-dimethyl-4-sulfolane, methyl-3-sulfonyl ether, ethyl-3-sulfonyl sulfide, and others.

The preferred organic compounds which are utilized in the solvent composition of the present process are admixed with from 2% to 25% by weight water. Thus, the preferred solvent composition comprises 75% to 98% by weight polyalkylene glycol, e.g., triethylene glycol, and 2% to 25% by weight water.

The apparatus embodied in the practice of the present invention may be any conventional or convenient type known to those skilled in the art. Also, the operation conditions suitable for the practice of this invention are conventional and well known to those skilled in the art. The amount of solvent composition should be at least sufficient to dissolve the constituent to be extracted. It may be desirable to use a considerable excess over the theoretical amount of solvent composition necessary especially when maximum purity and maximum recovery are desired. Usually the solvent composition to feed ratios in the extraction zone will range from about 1:1 to about 20:1 by volume, preferably from about 5:1 to about 15:1 by volume.

Referring to the accompanying diagram, an aromatic hydrocarbon-containing feedstock, such as the product of a gasoline reforming process containing benzene, toluene and xylenes as the aromatic components, is fractionated in a distillation column to produce a hydrocarbon feed mixture containing benzene and toluene as the aromatic components and another fraction containing toluene and xylenes as the aromatic components, each fraction also containing nonaromatic hydrocarbons. The present invention will be specifically illustrated hereinafter utilizing the hydrocarbon feed mixture containing benzene and toluene as the aromatic components and generally having the following composition:

	Volume percent
C_6 paraffins	27.8
C_6 naphthenes	2.8
C_6 aromatics	20.7
C_7 paraffins	19.7
C_7 naphthenes	3.2
C_7 aromatics	21.8
C_8 paraffins	3.2
C_8 naphthenes	0.7
C_8 aromatics	0.1
	100.0

Such a feed mixture is introduced into the process flow of the present invention through line **10** at a superatmospheric pressure, e.g., 135 p.s.i.g., which is sufficient to maintain the charge in substantially liquid phase at the particular pressure maintained within the extraction zone and which may be in the range from about 10 to about 300 pounds per square inch or higher. Depending upon the water content of the solvent composition, the temperature of the extraction may be varied to increase or decrease the selectivity and solubility relationships between the solvent and the hydrocarbon feed mixture. Typically, using a triethylene glycol organic compound containing about 7½% by weight of water, the process is operated at temperatures from about 100° F. to about 400° F., typically, about 225° F., and the solvent composition to hydrocarbon feed ratio is about 5:1 by volume.

The hydrocarbon feed mixture at the foregoing temperature and pressure conditions is fed through line **10** into extraction zone **11** at an intermediate point below the lean solvent inlet (which generally is in the upper portion of the column) and above the rich solvent outlet in the lowermost portion of the column. Lean solvent composition from which hydrocarbon solute has been removed in the hereinafter discussed distillation zone of the process, is passed into extractor **11** through line **14** at the desired temperature, e.g., 300° F., and pressure and at a rate to achieve the foregoing solvent-to-feed ratio.

Solvent extraction zone **11** may be of any type suitable for effecting countercurrent contact between two liquid phases at least partially but not wholly miscible in each other, and wherein the relatively more dense solvent may be brought into intimate contact with the relatively less dense hydrocarbon phase. Thus, extraction zone **11** may be a packed column or may contain a series of horizontal plates through which the liquid solvent flows in dispersed form and in countercurrent flow relationship to the ascending hydrocarbon stream.

Preferably, reflux is used in extraction zone **11** by passing thereinto from line **15** a hereinafter specified nonaromatic hydrocarbon-containing stream. Typically, such a reflux stream is introduced into extraction zone **11** at a point below the feed mixture charge line **10**.

As the hydrocarbon feedstock and reflux flow upwardly through extractor column **11** in countercurrent relationship to the descending solvent composition, the solvent selectively extracts the more soluble aromatic components of the feedstock and selectively rejects the paraffinic and other nonaromatic components which make up the raffinate. The raffinate phase comprising nonaromatic hydrocarbons admixed with a minor amount, such as less than 1% by volume, typically about 0.02%, of the organic compound, e.g., triethylene glycol, is separated from the extractor **11** through line **12** and is subjected to further processing as more fully discussed hereinbelow. Typically, the raffinate may have the following composition:

	Volume percent [1]
C_6 paraffins	48.0
C_6 naphthenes	4.8
C_6 aromatics	>0.1
C_7 paraffins	34.2
C_7 naphthenes	5.7
C_7 aromatics	0.7
C_8 paraffins	5.5
C_8 naphthenes	1.1
C_8 aromatics	----
	100.0

[1] On a solvent-free basis.

The rich solvent stream containing dissolved aromatic hydrocarbons flows downwardly through extraction zone **11** and countercurrently contacts the reflux introduced into the extraction zone through line **15**. The reflux in its countercurrent contact with the descending rich solvent displaces raffinate-rich paraffins which have a tendency to dissolve in the rich solvent to a small extent. The resulting rich solvent which now contains dissolved aromatic

hydrocarbons, and is substantially free of nonaromatic hydrocarbons, is removed from the bottom of extraction zone **11** through line **13** and transferred into the upper portion of rich solvent stripping zone **16** for the recovery of the hydrocarbon solute therefrom.

In the preferred manner of operating solvent stripper **16**, a first vapor fraction comprising water, but also containing light paraffin components such as the C_5, C_6 and C_7 paraffins, is removed overhead from stripper **16** through line **17**. These nonaromatic components are present because the solvent extraction step is not 100% selective for aromatic hydrocarbons. Accordingly, the nonaromatics accumulate in the system and are used as reflux on the extractor column as herein discussed. This overhead stream may also contain a minor amount of aromatic hydrocarbons which distill over at the same temperature as the paraffinic hydrocarbons. The resulting overhead vapor in line **17** is passed into receiver **33** wherein the hydrocarbon components are separated from the aqueous phase. These separated substantially nonaromatic hydrocarbons are removed from receiver **33** through line **15** and refluxed on extractor column **11** as specified hereinabove.

A second vapor fraction comprising the aromatic hydrocarbons, e.g., benzene and toluene, is removed from solvent stripper **16** through line **18**. It was noted that this vapor fraction contains not only the desired aromatic hydrocarbons, but also contains water which has been used in stripper column **16** as the stripping medium. Typically, the composition of this second vapor fraction is as follows: 85.0% by volume aromatic hydrocarbons and 15% by volume aqueous phase. The water, of course, under the conditions of temperature and pressure therein, is primarily in the vapor phase also. Further, since the operation of the solvent stripper is not 100% effective for the separation of the organic compound from the hydrocarbon phase, it was discovered that this second vapor fraction contains a minor amount of organic compound dispersed therein either as a mist or as entrained discrete particles. Surprisingly, the aqueous phase, typically, contains from 15% to 20% by weight of organic compound. The total stream in line **18** is thereafter passed to entrainment separator **19**, e.g., at a temperature of, say, 220° F., wherein the organic compound, e.g., triethylene glycol, is coalesced or otherwise separated and drops to the bottom of separator **19** as a liquid. The resulting liquid phase consisting of triethylene glycol is returned to solvent stripper **16** via line **21** at a locus, preferably, below the second vapor fraction withdrawal line **18**. The result of passing this stream into entrainment separator **19** is that substantially all of the organic compound is separated from the aromatic hydrocarbons and water. Entrainment separator **19** may be any conventional type of vessel having sufficient residuum time to allow separation of the entrained organic compound. The vessel may be empty or may contain suitable demister devices well known in the art.

The separated vapor stream comprising aromatic hydrocarbons and water is removed from separator **19** as vapor through line **20** and passed into receiver **22** under conditions sufficient to separate the water from the hydrocarbons. Typically, these conditions include a temperature of about 150° F. The desired aromatic hydrocarbon extract, e.g., benzene and toluene, is removed from the process via line **23** for further handling such as fractionation in order to recover benzene and toluene in high concentration. For example, recoveries on benzene exceed 99% by weight and exceed 98% by weight on toluene.

Returning now to the raffinate phase which is removed from extractor **11** through line **12**, this phase is passed into washing zone **25** wherein it is countercurrently contacted with water introduced into water wash tower **25** through line **24** at a temperature of, say, 100° F. and a pressure of, say 80 p.s.i.g. Generally, the ratio of raffinate feed to wash water is about 9:1 by volume.

However, in order to effect recovery of organic compound contained in the raffinate phase on an efficient basis, the water used to wash the raffinate must be free of organic compounds and must be confined to the smallest possible quantity sufficient to the purpose since excess water must be removed from the recovered solvent solution in order that it may be utilized again in the extraction zone. Thus, the source of such a purified aqueous stream is now available in receiver **22** which contains water substantially free of organic compound. Accordingly, a water phase is withdrawn from receiver **22** through line **24** and passed at least in part into water wash tower **25**. Additional purified and solvent-free water from an extraneous source may be added to the system via line **37** if needed or desired.

A washed raffinate, substantially free of the organic compound, e.g., triethylene glycol, is withdrawn from tower **25** through line **26** into storage or other processing stages covering the present extraction process. An aqueous wash effluent or water phase containing recovered organic compound, e.g., triethylene glycol, is removed from the bottom of washing tower **25** through line **27** and passed into receiver **28** via line **35**.

Since the water wash operation does not achieve a perfect separation between water and hydrocarbons, there is a small amount of nonaromatic hydrocarbons carried into the water phase as a contaminant therein. It was found that from 0.01 to 10% by volume of hydrocarbon, typically 1.0% was present in this water phase. Accordingly, the water phase is withdrawn from receiver **28** through line **29** into water stripping tower **30** at a temperature of, say, 235° F., whereby the hydrocarbon components in the water phase are separated from the water. An overhead fraction comprising nonaromatic hydrocarbons and water vapor is removed from water stripper **30** through line **32** and transferred into receiver **33** in admixture with the overhead fraction from solvent stripper **16** contained in line **17**. As previously discusssed, the hydrocarbons present in receiver **33** are separated from the water phase and recycled as reflux on extractor column **11** through line **15**. Since the water phase in vessel **33** contains hydrocarbon components from the solvent stripper **16** and from water wash tower **25**, it is passed from receiver **33** via line **34** into vessel **28** for recycle through water stripper **30** in order to remove any hydrocarbons therefrom.

The bottoms fraction from water stripper **30** is now substantially free from hydrocarbons and is withdrawn from stripper **30** via line **31** and passed into solvent stripper **16** for further recovery of the organic compound for reuse in the process.

The operation of solvent stripper **16** is performed under conditions well known to those skilled in the art whereby a lean solvent composition suitable for reuse is accumulated in the lower portion thereof. Accordingly, lean solvent is withdrawn from solvent stripper **16** and transferred via line **14** into extractor **11** for countercurrent contact with the hydrocarbon feed mixture coming into the process via line **10** as previously discussed. Fresh solvent, as needed, may be added to the system via line **36**.

It is noted from the above illustrative description that the critical interdependence of water stripper **30** and entrainment separator **19** operate to afford maximum solvent recovery in the process, in addition to providing a means for recovering aromatic hydrocarbons in extremely high purity. Without these critical steps, solvent losses would become high and considerable additional processing steps would have to be performed on the aromatic extract before extremely high aromatic purity could be achieved. For example, without entrainment separator **19** the water

phase in line 24 would contain organic compound to such an extent that this water phase would be unsuitable as wash water in tower 25; thereby imposing the almost exclusive use of purified water from an extraneous source to wash the raffinate phase if solvent loss is to be minimized while maximizing aromatic hydrocarbon recovery and purity. In similar manner, without the complementary operation of water stripper 30, the aqueous phase removed from water wash tower 25, containing a small amount of nonaromatic hydrocarbons, would be passed into solvent stripper 16 to thereby contaminate the aromatic extract being removed from the stripper via line 18. Therefore, in the prior art processing schemes high purity aromatics could only be recovered at the expense of solvent loss. Conversely, minimum solvent losses could be achieved by the prior art only at the expense of aromatic hydrocarbon purity. Accordingly, the present invention provides a means for achieving both high purity aromatics in excellent yield with minimum solvent loss.

The invention claimed:

1. Method for the solvent extraction of aromatic hydrocarbons from a hydrocarbon feed mixture containing aromatic hydrocarbons and nonaromatic hydrocarbons which comprises:

(a) contacting said feed mixture in an extraction zone with a solvent composition comprising water and an oxygen-containing organic compound, said composition being selective for aromatic hydrocarbons;

(b) separating a resulting raffinate phase comprising nonaromatic hydrocarbons admixed with a minor proportion of said organic compound from an extract phase comprising said solvent composition containing aromatic hydrocarbons dissolved therein;

(c) fractionating said extract phase in a distillation zone to form a

(i) first vapor fraction comprising water,

(ii) second vapor fraction comprising said aromatic hydrocarbons admixed with water containing a minor proportion of said organic compound, and

(iii) third liquid fraction comprising a major proportion of said organic compound;

(d) passing said second vapor fraction into first separation means under conditions sufficient to separate substantially all of said organic compound from the aromatic hydrocarbons and water;

(e) returning said separated organic compound directly to said distillation zone;

(f) passing said separated aromatic hydrocarbons and water from step (d) into second separation means under conditions sufficient to separate the aromatic hydrocarbons from the water;

(g) withdrawing aromatic hydrocarbons from said second separation means;

(h) washing said raffinate phase in a washing zone with water comprising at least a portion of said water separated from said second separation means under conditions sufficient to remove substantially all of said minor proportion of said organic compound therefrom;

(i) removing from the washing zone a raffinate phase substantially free from said organic compound and a wash-water stream containing said organic compound;

(j) reusing at least part of said wash-water stream in said extraction zone; and

(k) recycling at least a major proportion of said third fraction to said extraction zone.

2. Method according to claim 1 wherein said organic compound comprises triethylene glycol.

3. Method according to claim 1 wherein said solvent composition comprises 75% to 98% by weight polyalkylene glycol and 2% to 25% by weight water.

4. Method according to claim 3 wherein said wash-water stream and water from said first fraction are admixed, stripped to remove any hydrocarbons therefrom, and at least part of said stripped water admixture is reused in the extraction zone.

5. Method for recovering aromatic hydrocarbons from a hydrocarbon feed mixture containing aromatic hydrocarbons and nonaromatic hydrocarbons which comprises:

(a) contacting said feed mixture in an extraction zone with a solvent composition comprising water and an organic compound selected from the group consisting of polyalkylene glycol and sulfolane, said composition being selective for aromatic hydrocarbons under extraction conditions;

(b) withdrawing from the extraction zone a raffinate phase comprising nonaromatic hydrocarbons admixed with said organic compound, and an extract phase comprising said solvent composition containing aromatic hydrocarbons dissolved therein;

(c) separating said extract phase in a distillation zone into at least a first vapor fraction comprising water, a second vapor fraction comprising aromatic hydrocarbons admixed with water and said organic compound, and a third liquid fraction comprising said organic compound;

(d) passing said second vapor fraction into first separation means under conditions sufficient to form a vapor stream comprising aromatic hydrocarbons and water, and a liquid stream comprising said organic compound;

(e) returning said liquid stream directly to said distillation zone at a locus below the withdrawal locus for said second vapor fraction;

(f) passing said formed vapor stream into second separation means under conditions sufficient to form a first hydrocarbon stream comprising aromatic hydrocarbons and an aqueous stream comprising water substantially free of said organic compound;

(g) withdrawing said first hydrocarbon stream from said second separation means and recovering therefrom aromatic hydrocarbons in high concentration;

(h) washing said raffinate phase in a washing zone with said aqueous stream under conditions sufficient to form a second hydrocarbon stream comprising nonaromatic hydrocarbons substantially free of said organic compound, and water phase containing said organic compound and a minor proportion of nonaromatic hydrocarbons;

(i) passing said water phase from step (h) to stripping means and withdrawing from the stripping means an overhead fraction containing nonaromatic hydrocarbons and a bottoms fraction comprising water substantially free of nonaromatic hydrocarbons;

(j) recycling said third liquid fraction from step (c) to the extraction zone; and

(k) passing said bottoms fraction at least in part to said extraction zone.

6. Method according to claim 5 wherein said organic compound comprises triethylene glycol.

7. Method according to claim 5 wherein said solvent composition comprises 75% to 98% by weight polyalkylene glycol and 2% to 25% by weight water.

8. Method according to claim 7 wherein said organic compound is triethylene glycol and said water phase from step (h) is admixed with the water from said first fraction from step (c) and subsequently passed to said stripping means of step (i).

9. Method according to claim 5 wherein said aromatic hydrocarbon is selected from the group consisting of benzene, toluene, xylene, mixtures of benzene and toluene, and mixtures of toluene and xylene.

10. Method according to claim 9 wherein said aromatic hydrocarbon is benzene.

11. Method according to claim 3 wherein said organic compound is triethylene glycol and said aromatic hydrocarbon is benzene.

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DELBERT E. GANTZ, *Primary Examiner.*

C. E. SPRESSER, *Assistant Examiner.*

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