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COMPLETE SPECIFICATION

Improvements in or relating to Treating Carbon Monoxide and Hydrogen Synthesis Products

We, TEXACO DEVELOPMENT CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 135 East 42nd Street, New York 17, New York, United States of America (assignees of HOWARD VINCENT HESS, GEORGE BENJAMIN ARNOLD and MARVIN LOUIS DRABKIN), do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a method for treating the product obtained by the catalytic conversion of carbon monoxide and hydrogen into synthetic fuel.

Catalytic conversion of carbon monoxide and hydrogen into synthetic fuel by contact with a fluidized iron catalyst at an elevated temperature of 500 to 750°F. and at a pressure of 100 to 500 pounds per square inch results in the formation of a product comprising a gas phase and a liquid phase, the latter consisting of approximately one part oil phase and two parts water. Oxygen-containing organic compounds, such as alcohols, acids, esters, ketones and aldehydes are distributed throughout the two phase liquid product; the molecular weight of the oxygen-containing compounds determines whether they are primarily found in the water phase or in the oil phase. The oxygen-containing organic compounds ordinarily found in the water phase comprise lower molecular weight compounds, such as C_1 to C_8 alcohols, esters containing up to about four carbon atoms and C_2 to C_6 organic acids with traces of the higher molecular weight compounds. The oxygen-containing organic compounds ordinarily found in the oil phase comprise higher molecular weight compounds, such as C_4 and higher alcohols, esters containing more than three carbon atoms and C_3 and higher organic acids with traces of the lower molecular weight compounds. It will be noted that there is considerable overlapping in the distribution of the oxygen-containing compound between the oil and water phases. This overlapping is due to the fact that compounds of intermediate molecular weights, such as C_5 alcohols, are found in substantial proportion in both oil and water phases.

The disposal of the water phase in large scale commercial operation poses a serious problem since the oxygen-containing organic compounds comprise as high as 20 per cent of the water phase and their presence therein would seriously pollute any stream or river into which the water phase is dumped. The oxygen-containing organic compounds present in both the oil and water phases are valuable chemicals in their own right and are in high demand as chemicals of commerce. The subject invention provides a method for expediting the recovery of oxygen-containing organic compounds from both the oil and water phases and for purifying the water phase to such an extent that it can be poured into rivers and streams without fear of polluting them.

This invention involves treating synthesis product in the vapor state at an elevated temperature of at least 500°F. with a basic compound of an alkali metal or of an alkaline earth metal or with mixtures of such basic compounds. Vapor phase basic treatment of synthesis product hydrolyzes esters present in the synthesis product to alcohols and acids and decarboxylates acids initially present in the synthesis product and those formed by ester hydrolysis to hydrocarbons or ketones. As a consequence of vapor phase basic treatment of synthesis product the oxygenates remaining therein comprise mainly alcohols and a small portion of ketones.

This invention discloses four modifications of vapor phase basic treatment of synthesis product. The first modification involves separation of the synthesis product into a gas phase and a liquid product which latter consisting of both oil and water phases is contacted in the vapor phase with a basic

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compound at a temperature between 500 and 1000° F. while the gas phase is recycled in whole or in part to the reaction zone. The base-treated liquid product is separated into a gas fraction which is advantageously recycled to the reaction zone, and aqueous phase from which oxygenates are removed by flashing and an oil phase from which oxygenates are separated by solvent extraction or silica gel adsorption. The second modification involves separation of the synthesis product into a gas phase, a water phase and an oil phase which latter is then fractionated into a gasoline fraction and a gas-oil fraction; the gasoline fraction is combined with the water phase and the composite thereby formed is contacted in the vapor phase with a basic compound at a temperature between 500 and 1000° F. Separation of oxygenates from base-treated composite is effected by the same procedure employed in the first modification.

The third modification is concerned only with the production of a rejectable water and involves contacting the aqueous phase alone with a basic compound in the vapor phase at a temperature between 500 and 1000° F. This modification is employed where there is no demand for the oxygenate by-product of synthetic fuel production but where there is a necessity to produce a rejectable water. This third modification can be used in connection with the process wherein the oxygenates present in the gasoline and gas-oil fraction are deoxygenated during reforming the gasoline and gas-oil fraction to produce premium gasoline and gas oil.

The fourth modification involves contacting the entire synthesis product including the gas phase with a basic compound of the described type in the vapor phase at a temperature between 500 and 1000° F. This modification is ordinarily not employed because the gas phase comprises approximately 75 weight per cent of the total product when a recycle ratio of about 2 : 1 is employed which necessitates a base treater of very large capacity.

The liquid product, consisting of oil and water phases, obtained by the catalytic conversion of carbon monoxide and hydrogen into liquid hydrocarbons by contact with a fluidized iron catalyst at an elevated temperature of 500 to 750° F. and at a pressure of 100 to 500 pounds per square inch contains approximately 15 to 25 per cent oxygen-containing organic compounds. The distribution of the various types of oxygen-containing organic compounds in this 15 to 25 per cent fraction of product is best illustrated by considering the concentration of the oxygen-containing organic compounds in the oil and water phases obtained by separation of the liquid product at atmospheric conditions. The aqueous phase separated from the liquid product at atmospheric conditions contains approximately 20 per cent oxygen-containing organic compounds which are distributed among the various oxygen-containing organic compounds approximately as follows: 12 per cent alcohols, 3 per cent acids, 3 per cent esters, 1 per cent aldehydes, 1 per cent ketones. The oil phase separated from a typical liquid product at atmospheric conditions, contains approximately 13 per cent oxygen-containing organic compounds which are distributed among the various type of organic compounds as follows: 7 per cent alcohols, 2 per cent acids, 2 per cent esters, 1 per cent aldehydes, and 1 per cent ketones. It will be noted that alcohols form the major portion of the oxygen-containing organic compounds in both the water and oil phases; acids and esters are also present in the oil and water phases in a substantial portion, whereas aldehydes and ketones constitute a relatively small fraction of both the water and oil phases.

Treatment of synthesis product at elevated temperature in the vapor state with a basic compound of the type previously described, hydrolyzes esters to alcohols and acids and decarboxylates acids initially present and acids formed by ester hydrolysis. Water-soluble and oil-soluble alcohols and ketones are substantially unaffected by treatment of the liquid product with a basic compound under the aforedescribed conditions. Water-soluble and oil-soluble aldehydes are polymerized to high molecular weight materials which undergo cracking.

An outstanding feature of the subject invention is that hydrolysis of water-soluble and oil-soluble esters is effected in the vapor state. The vapor phase hydrolysis of esters at elevated temperatures over solid basic compounds of the type hereinbefore described, is a surprising and advantageous result of the process of the subject invention.

Another outstanding advantage of the subject invention resides in the fact that the water phase, after removal of aqueous azeotropes of the low molecular weight alcohols, ketones and hydrocarbons therefrom, is practically free from acids and other oxygen-containing organic compounds. Consequently, disposal of the water phase does not present a problem since it may be emptied into a river or a stream without fear of causing pollution.

A third advantage of the subject invention results from the fact that a high recovery of oxygen-containing organic compounds in the form of alcohols and ketones is realized.

Alkali metal hydroxides, alkali metal oxides, alkali metal salts, alkaline earth metal hydroxides, alkaline earth metal oxides and alkaline earth metal salts are included among the basic compounds which can be employed to effect vapor phase base-treatment of the liquid product obtained by the conversion of carbon monoxide and hydrogen into synthetic fuel. The alkali metals are the monovalent elements of the first group of the periodic system, lithium, sodium, potassium, rubidium and cæsium; the alkaline earth metals are divalent elements of the second group of the periodic system, beryllium, magnesium, calcium, strontium and barium. Both alkali metal compounds and alkaline earth metal compounds effect vapor phase hydrolysis of oil-soluble and water-soluble esters to alcohols and acids. Basic alkali metal compounds and basic mixtures of alkaline earth and alkali metal compounds decarboxylate oil-soluble and water-soluble acids mainly to hydrocarbons; on the other hand, basic alkaline earth metal compounds decarboxylate acids mainly to ketones.

While both basic alkali metal compounds and basic alkaline earth metal compounds effect decarboxylation of acids and hydrolysis of esters in the liquid product and a high degree of the clarification of the water phase of the liquid product, the alkali metal group or mixtures containing alkali metal group of compounds are preferred because they are more efficient. A quicker and more complete treatment of the liquid product can be effected with basic alkali metal compounds than with basic alkaline earth metal compounds. As a consequence, a larger quantity of liquid product can be treated in a unit of time with alkali metal compounds than with alkaline earth metal compounds. Sodium carbonate, sodium phosphate, potassium carbonate, potassium phosphate, potassium borate, sodium hydroxide and potassium hydroxide are examples of basic alkali metal compounds which can be employed in the process of this invention. Sodium carbonate and sodium phosphate are particularly preferred compounds for use in the method of this invention, not only are these compounds particularly active in effecting hydrolysis of esters and decarboxylation of acids, but they are also inexpensive chemicals. Calcium oxide, calcium carbonate, barium oxide, barium carbonate are examples of basic alkaline earth metal compounds used in this invention; calcium oxide and calcium carbonate are preferred basic alkaline earth metal compounds.

Contacting of the liquid product with a basic material is effected at a temperature between 500 and 1000° F.; it has been found that temperatures between 700 and 950° F. are preferred. It is advisable to employ temperatures in the upper part of this range, that is, temperatures of 800 to 1000° F. with alkaline earth metal compounds, whereas temperatures between 700 and 900° F. are advantageous with an alkali metal compound.

Pressures ranging from atmospheric to about 500 pounds per square inch may be employed for the basic treatment of the liquid product of H_2-CO conversion to synthetic fuel. Atmospheric pressure is ordinarily employed.

Synthesis product is contacted with a basic compound at a space velocity between about 1 and 10 volumes of liquid synthesis product per volume of solid basic material per hour. Space velocities between about 2 and 5 are preferred. As a general proposition, higher space velocities may be employed with alkali metal compounds than with alkaline earth metal compounds.

It is possible to effect the vapor phase contacting of the product of H_2-CO conversion in accordance with any of the usual techniques for catalytic vapor phase contacting. Accordingly, the product in the vapor phase can be passed through a fixed bed of solid basic material maintained at a temperature between 500 and 1000° F. or the product in the vapor phase can be contacted with a fluidized bed of basic material particles. The vaporized product can also be contacted with a moving bed of basic particles or with a stirred bed of basic particles.

In further description of the invention, the modification involving contact of the entire liquid product comprising water and oil phases with a basic compound in the vapor phase at a temperature between 500 and 1000° F. will be employed to illustrate the invention. Accordingly, treatment of synthesis product after base treatment will be illustrated by the procedure employed to treat the base-treated total liquid product.

After the entire liquid product is contacted with a basic compound, it is cooled and separated into a gaseous fraction, a water phase and an oil phase. This separation may be effected at atmospheric conditions, but it is advantageous to effect the separation at a temperature between 200 and 400° F. and at a pressure between 150 and 500 pounds per square inch. Separation of the base-treated product into a gaseous fraction, a water phase and an oil phase at the aforementioned elevated temperatures and pressures effects displacement of non-acidic normally water-soluble oxygenates from the water phase to the oil phase. Since the oxygenates are mainly alcohols in the base-treated product, separation at elevated temperature and pressure displaces normally water-soluble alcohols and ketones from the water phase to the oil phase thereby decreasing the amount of aqueous azeotropes of alcohols and ketones to be separated from the water phase by fractionation or flashing prior to its disposal.

After alcohols and ketones have been

separated from the water phase in the form of aqueous azeotropes, the water phase contains less than 0.2 per cent oxygen-containing organic compounds and may be introduced into a river or stream for disposal without fear of polluting them. The gaseous fraction which comprises mainly gaseous hydrocarbons, such as ethane, ethylene, propane, etc., and which is of relatively small volume, only comprising up to 4.0 weight per cent of base-treated liquid product, is advantageously recycled to the reaction zone wherein hydrogen and carbon monoxide are converted into synthetic fuel. The oil phase separated from the base-treated liquid product is advantageously separated by fractional distillation into a gasoline fraction and a gas oil fraction. Division into gasoline and gas oil fractions is ordinarily made at a temperature between 350 and 400° F. Alcohols and ketones are readily separated from the gasoline fraction by solvent extraction with a solvent, such as, ethylene glycol, diethylene glycol, propylene glycol, aqueous acetone or methanol, furfural, etc. Solvent extraction does not work too well for separation of oxygen-containing organic compounds from the gas oil fraction because of the similar solubility characteristics of the hydrocarbons and high molecular weight alcohols and ketones. Consequently, silica gel adsorption is ordinarily employed to separate high boiling alcohols and ketones from the gas oil fraction. Alcohols can also be removed from the gas oil fraction by the boric acid esterification technique.

The effect of contacting the liquid product in the vapor state with a basic material of the described type is illustrated by the substantial increase in alcohol content and substantial decrease in acid and ester content of both the oil and water phases after treatment with sodium carbonate at a temperature of approximately 900° F. The oil phase, after separation from the liquid product at atmospheric conditions, had an alcohol content of 8 volume per cent, an acid content of 3 volume per cent and an ester content of 3 volume per cent, whereas the water phase separated from the liquid product at atmospheric conditions, had an alcohol content of 12 volume per cent, and acid content of 3 volume per cent and an ester content of 3 volume per cent. After the total liquid product comprising oil and water phases was contacted with a fixed bed of sodium carbonate at a temperature of about 900° F., a space velocity of 2 volumes of liquid product per volume of solid basic compound per hour and after separation of the base-treated liquid product into oil and water phases at atmospheric conditions, the oil phase had an alcohol content of 10 volume per cent, an acid content of less than 0.1 volume per cent, and an ester content of 0.1 volume per cent, after the aforementioned treatment, the water phase had an alcohol content of 13 volume per cent, an acid content of less than 0.1 volume per cent, and an ester content of less than 0.1 volume per cent. The decrease in the acid and ester contents of both oil and water phases and the increase in the alcohol content of both phases are significant. As has been indicated previously alcohols and ketones are readily removed from the water phase in the form of aqueous azeotropes by flashing.

In the accompanying figure there is presented a flow diagram wherein the modification of the invention involving contact of the entire liquid product including water and oil phases with a basic compound in the vapor state is described in detail.

Hydrogen and carbon monoxide are introduced through a pipe 1 into a synthesis reactor 2 wherein conversion of carbon monoxide and hydrogen into liquid hydrocarbons is effected by contact with an iron catalyst maintained in a fluid state at a temperature between 500 and 750° F. and a pressure between 100 and 500 pounds per square inch.

An effluent comprising unconverted hydrogen and carbon monoxide, carbon dioxide, and products of reaction comprising water, gaseous and liquid hydrocarbons and oxygen-containing organic compounds issues from the synthesis reactor 2 through a pipe 3 and is introduced into a heat exchanger 4 wherein the product is cooled to a temperature between 150 and 400° F. and preferably to a temperature between 200 and 300° F. without any reduction in pressure. Thereafter, the effluent is introduced through a pipe 5 to a separator 7 maintained at a temperature between 150 and 400° F. and preferably at 200 to 300° F. and a pressure between 150 and 500 pounds per square inch. Advantageously, the separator is maintained at approximately the same pressure as is employed for the conversion of carbon monoxide and hydrogen in the synthesis reactor 2. In the separator 7, the effluent is separated into a gas phase and into a liquid product comprising oil and water phases.

Separation of the synthesis product into a gas phase and a two phase liquid product is advantageously effected at an elevated temperature of between 150 and 400° F. and at a pressure equivalent to that existing in the synthesis reactor in order to relieve the load on the heat exchange facilities. Since the liquid product is raised to a temperature of 500 to 1000° F. immediately after the separation of the gas phase therefrom, separation of the product at an elevated temperature of about 150 to 400° F. rather than at atmospheric conditions reduces the amount of heat exchange required to vaporize the liquid product.

The gas phase is removed from the separator 7 through a pipe 9 through which it is recycled to the synthesis reactor 2 so that a recycle ratio of recycle gas to fresh feed between about 1 to 1 and 5 to 1 may be maintained. A draw-off pipe 10 affords means of withdrawing that portion of the gas phase which is not recycled.

The two-phase liquid product is withdrawn from the separator 7 through a pipe 12 and is introduced into a heat exchanger 13, wherein it is heated to a temperature of approximately 500 to 1000° F. and preferably to a temperature between 700 and 950° F. Thereafter, the liquid product which is still under a pressure of approximately 200 to 300 pounds per square inch, is introduced through a pipe 14 into a base treater 20 containing a basic material of the type heretofore described and maintained at a temperature between 500 and 1000° F. and at atmospheric pressure.

The modification involving contact of the total synthesis product with a basic compound in the vapor phase is illustrated in the drawing. If this alternative is employed, the effluent leaves the reactor 2 by a pipe 3 and is then introduced directly into the heat exchanger 13 through a conduit 6. In this alternative, the total effluent which leaves the reactor 2 at a temperature between 500 and 700° F. is raised to the selected base treating temperature which falls between 500 and 1000° F. in the heat exchanger 13 and is then introduced into the base treater 20.

Returning to the preferred modification, the liquid product in the vapor state contacts in the base treater 20 a basic compound of an alkali metal or of an alkaline earth metal or a mixture of such compounds. For purposes of description, it will be assumed that the base treater 20 contains an alkali metal salt, such as sodium carbonate. The basic treatment of the liquid product in the vapor state with sodium carbonate hydrolyzes the esters to alcohols and acids and decarboxylates the acids initially present together with those formed by ester hydrolysis to form hydrocarbons.

The water-soluble and oil-soluble aldehydes are polymerized by vapor phase contacting with sodium carbonate to high molecular weight compounds which are partially cracked to smaller molecular weight hydrocarbons. The oil-soluble and water-soluble alcohols and ketones are substantially unaffected with the exception that the alcohol content is substantially increased by ester hydrolysis.

The base-treated liquid product with its acid, ester and aldehyde content substantially reduced, but with an increased content of alcohols and hydrocarbons, is introduced through a pipe 23 into heat exchanger 26 wherein it is cooled to a temperature between 150 and 400°F. and preferably to approximately 250° F. The base treated product which is mostly in the liquid phase is then introduced through a pipe 27 into a separator 30 wherein it is separated into a gaseous fraction, an oil-rich phase and a water-rich phase at elevated temperature and pressure.

Separation of the base-treated liquid product into an oil phase and water phase at an elevated pressure between 150 and 500 pounds per square inch and at an elevated temperature of 150 to 400° F. effects displacement of alcohols and ketones normally soluble in the water phase into the oil phase. The gaseous fraction comprising a relatively small amount of gaseous hydrocarbons, such as ethane, butenes and butanes, is withdrawn from the separator 30 through pipe 31 through which it is recycled to the reaction zone. The pipe 31 leads into the pipe 9 through which the gas phase originally separated from the synthesis product is recycled to the synthesis reactor 2. If the alternate procedure comprising base treatment of the total synthesis product is employed, the gaseous fraction separated from the base-treated product in the separator 30, will be of large volume.

The oil phase is withdrawn from a separator 30 through a pipe 33 and is introduced into a fractionating column 34 wherein the oil phase is separated into a gasoline fraction and a gas oil fraction. Separation of alcohols and ketones from the oil phase is expedited by separation of the oil phase into a gasoline fraction and a gas oil fraction. The gasoline fraction is taken off overhead from the fractionating column 34 through a pipe 35 and ordinarily comprises a 350 to 400 E.P. fraction. Alcohols and ketones are readily removed from the gasoline fraction by solvent extraction with a gasoline-immiscible solvent, such as ethylene glycol, diethylene glycol, propylene glycol, acetone and furfural.

The gas oil fraction is withdrawn from the fractionating column 34 through a pipe 36. Alcohols and ketones and the traces of acids and esters remaining therein are advantageously separated from the gas oil fraction by adsorption on an adsorbent, such as silica gel.

The gasoline fraction obtained in the aforedescribed manner has an alcohol content of 9 volume per cent, an acid content of 0.1 volume per cent, an ester content of 0.1 volume per cent and a ketone content of 1 volume per cent. The gas oil fraction obtained in the manner described above, has an alcohol content of 7 volume per cent, an acid content of 0.1 volume per cent, an ester content of 0.1 volume per cent and a ketone content of 1 volume per cent. The high alcohol content and the low ester and acid contents of the gasoline and gas oil fractions are significant.

The water phase is withdrawn from the separator 30 through a pipe 40 and is introduced therethrough to a flash tower 41. Aqueous azeotropes of alcohols, ketones and hydrocarbons are removed from the flash tower 41 through a pipe 42. Thereafter, the azeotropes may be further separated into individual constituents. The reject water obtained from the flash tower 41 through a draw-off pipe 43 has an alcohol content less than 1.0 volume per cent, an acid content less than 0.1 volume per cent and an ester content less than 0.1 volume per cent. The water phase thus substantially free from organic compounds, may be rejected through the pipe 43 and poured into a nearby body of water without danger of polluting same.

It will be understood that the foregoing detailed description is merely illustrative of the process of the invention and is not intended as any limitation thereon. The synthesis product can be cooled and separated into a gas phase and a liquid product at atmospheric conditions rather than at elevated temperature and pressure in the detailed description prior to contacting the liquid product in the vapor phase with a basic compound. Moreover, it is also possible to separate the base-treated product into a gaseous fraction, a water phase and an oil phase at atmospheric conditions rather than at elevated temperature and super-atmospheric pressure as in the detailed description.

As has been indicated previously, a basic alkaline earth metal compound, such as calcium oxide or mixtures of basic alkali metal compounds and alkaline earth metal compounds, can be employed for the vapor phase treatment of the liquid synthesis product. The use of a basic alkaline earth metal compound increases the ketone content of the liquid product by decarboxylation of acids to ketones.

Moreover the two other described modifications of the invention can be employed with slight modification in the procedure described heretofore in detail. Thus the aqueous phase alone or a composite consisting of gasoline fraction and aqueous phase can be contacted in the vapor phase with a basic compound.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is :—

1. A process for treating synthesis product containing water, hydrocarbons and oxygen-containing compounds comprising alcohols, esters, acids, aldehydes and ketones and which is obtained by the catalytic conversion of carbon monoxide and hydrogen into synthetic fuel which comprises contacting said entire synthesis product or a portion thereof in the vapor phase at a temperature of 500 to 1000° F. with a basic material selected from the group consisting of alkali metal compounds, alkaline earth compounds and mixtures thereof, whereby esters are hydrolyzed to acids and alcohols and acids are decarboxylated to hydrocarbons or ketones.

2. A process according to claim 1, wherein said base-treated product is cooled and separated into a gaseous fraction, a water phase and an oil phase, and alcohols and ketones are removed from said water phase and said water phase is subsequently rejected.

3. A process according to claim 2, wherein said base-treated product is cooled to a temperature of about 150 to 400° F., and said base-treated product is separated at an elevated temperature of about 150 to 400° F. and at an elevated pressure into said gaseous fraction, said water phase and said oil phase, said gaseous fraction being recycled to the conversion of carbon monoxide and hydrogen, and the oxygen-containing organic compounds being separated from said oil phase.

4. A process according to claim 2 or 3, in which alcohols and ketones are separated from the water phase by flashing.

5. A process according to any one of the preceding claims, in which said product is contacted with the basic material at a temperature of 700 to 950° F.

6. A process according to any one of the preceding claims in which the catalytic conversion of carbon monoxide and hydrogen into synthetic fuel is effected by contact with an iron catalyst at a temperature of 500 to 750° F. and at a pressure of 100 to 500 pounds per square inch.

7. A process according to any one of the preceding claims, in which the product is contacted with a basic alkali metal salt.

8. A process according to claim 7, in which the product is contacted with sodium carbonate.

9. A process according to any one of claims 1 to 6, in which the product is contacted with a basic alkaline earth salt.

10. A process according to any one of the preceding claims wherein said synthesis product is separated into a gas phase and a liquid product, and said liquid product contacted in the vapor state at said elevated temperature of 500 to 1000° F. with the basic compound.

11. A process according to claim 10, wherein said gas phase is recycled to the catalytic conversion of carbon monoxide and hydrogen without contact by said basic compound.

12. A process according to claims 2 and 11, in which said gaseous fraction separated from

the base-treated product and the gaseous phase separated prior to the treatment with said basic compound are both recycled to the conversion of carbon monoxide and hydrogen.

13. A process according to claim 10, 11 or 12, wherein said synthesis product is separated at an elevated temperature of 150 to 400° F. and at an elevated pressure into said gas phase and said liquid product.

14. A process for treating a product containing water, hydrocarbons and oxygen-containing organic compounds comprising alcohols, esters, acids, aldehydes and ketones, and which is obtained by the catalytic conversion of carbon monoxide and hydrogen into synthetic fuel, which comprises separating said product into a gas phase, a water phase and an oil phase, fractionating said oil phase into a gasoline fraction and a gas oil fraction, combining said water phase with said gasoline fraction to form a composite phase consisting of said gasoline fraction and said water phase, contacting said composite in the vapor state at a temperature of 500 to 1000° F. with a solid basic material selected from the group consisting of alkali metal compounds, alkaline earth compounds and mixtures thereof, separating said composite into a gaseous fraction, a water phase and a gasoline fraction, separately removing alcohols and ketones from said water phase and said gasoline fraction.

15. A process according to claim 14, in which the composite is contacted with said basic material at a temperature of 700 to 950° F.

16. A process according to either of claims 14 or 15, in which the separation of the synthesis product into a gas phase, a water phase and an oil phase is effected at a temperature of about 150 to 400° F. and at elevated pressure.

17. A process according to any one of claims 14 to 16, in which the base-treated composite is separated into a gaseous fraction, a water fraction and a gasoline fraction at an elevated temperature of 150 to 400° F. and at elevated pressure.

18. A process according to any one of claims 14 to 16, in which the separation of the base-treated composite into a gaseous fraction, a water phase and a gasoline is effected under atmospheric conditions.

19. A process for treating a product containing water, hydrocarbons and oxygen-containing organic compounds comprising alcohols, esters, acids, aldehydes and ketones and which is obtained by the catalytic conversion of carbon monoxide and hydrogen into synthetic fuel which comprises separating said product into a gas phase, an oil phase and a water phase, contacting said water phase in the vapor state at a temperature of 500 to 1000° F. with a basic compound selected from the group consisting of basic alkali metal compounds, basic alkaline earth metal compounds and mixtures thereof, thereafter condensing said water phase and removing hydrocarbons, alcohols and ketones from said water phase.

20. A process according to claim 19, wherein said product is separated into gas phase, oil phase and water phase at an elevated temperature of 200 to 300° F. and at an elevated pressure of 150 to 500 pounds per square inch.

21. The process of treating carbon monoxide and hydrogen synthesis products substantially as hereinbefore described.

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1 SHEET

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