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2,921,020

TREATMENT OF SOUR HYDROCARBON DISTILLATE

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Application December 18, 1957, Serial No. 703,544

14 Claims. (Cl. 208—205)

This invention relates to the treatment of sour hydrocarbon distillate and more particularly to a novel method of effecting sweetening thereof.

Conventional practice at the present time includes the treatment of sour hydrocarbon distillate to remove mercaptans by contacting the hydrocarbon distillate with an alkaline solution. Mercaptides formed during this contacting are soluble in the alkaline solution, and the alkaline solution is separated from the treated distillate and subjected to regeneration. Although many attempts have been made in the past to regenerate the alkaline solution by oxidizing the mercaptides to disulfides, this process has not attained commercial success because efficient and sufficient regeneration has not been obtained. Various modifications have been attempted but still have been unsuccessful. For example, a proposed solution of this problem has been the use of a metal chelate such as disalicylal ethylene diamino cobalt. However, this and previously suggested compounds decompose during use, with the unsatisfactory result that the catalyst is of very short life and, probably more important, the cobalt or other metal is entrained or dissolved in the treated hydrocarbon distillate. The metal in the distillate acts as a pro-oxidant to catalyze undesirable oxidation reactions, with the resultant formation of gums, discoloration, and other deleterious effects.

Recently it has been found that certain phthalocyanine compounds are extremely effective catalysts for oxidizing mercaptans or mercaptides and that these phthalocyanine compounds are stable during use. With this new discovery, a novel process has been developed for effecting sweetening of hydrocarbon distillates, with regeneration of the alkaline solution now being efficiently accomplished by oxidation. During oxidation of the alkaline solution, disulfides are formed, the disulfides being dispersed through the alkaline solution. In accordance with the present invention the disulfides are coalesced and settled, the disulfides being separately withdrawn from the regenerated alkaline solution and the latter is reused in the process. This is an important step in the present process because a major portion of the sulfur compounds thus are removed and are not returned to the gasoline with the regenerated alkaline solution. Sulfur compounds appear to reduce the tetraethyl lead susceptibility of gasoline and, therefore, in accordance with the present invention a substantial proportion of the sulfur compounds are removed separately from the process.

In accordance with the present invention the hydrocarbon distillate is first extracted with an alkaline solution to remove a major portion of the mercaptans, the alkaline solution then is regenerated by oxidation in the presence of the phthalocyanine catalyst, disulfides are removed and a major portion of the regenerated alkaline solution is recycled to extract additional quantities of hydrocarbon distillate and, as an important feature of the present invention, a minor portion of the regenerated alkaline solution containing entrained or sorbed oxygen and/or oxygen

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compounds is contacted with the partly treated hydrocarbon distillate in order to oxidize mercaptans remaining in the gasoline. This produces a sweet or substantially sweet gasoline product. An important advantage to this novel method of final treating is that the oxygen and/or oxygen compounds contained in the alkaline solution are sufficient to oxidize remaining mercaptans but are not in excess which may have a deleterious effect on the hydrocarbon distillate.

From the above description it will be seen that a sweet or substantially sweet product is obtained by the novel process of the present invention. While removal of a major proportion of the mercaptans normally is readily obtained, removal of the remaining small amount of mercaptans is difficult and requires complicated and expensive treatments, such as copper treating, sodium plumbite treating, etc. These costly treating steps are avoided by the novel process of the present invention in which final sweetening is accomplished by a novel oxidizing treatment. As hereinbefore set forth, it is only because of the recent availability of the phthalocyanine catalyst that the improved process is attained.

The phthalocyanine catalyst is both very active and highly stable. Because of its high activity, the catalyst is used in exceedingly small concentrations. These may range from 5 to 500 and preferably 10 to 100 parts per million by weight of the alkaline solution, although lower or higher concentrations may be used in some cases. The use of higher concentrations are unnecessary in most cases but may be used if desired, and thus may range up to 25% or more by weight of the alkaline solution. Because of its high stability, the catalyst is used for exceedingly long periods of time. As will be shown in the following examples, caustic solution containing 50 parts per million of cobalt phthalocyanine disulfonate has been used to treat an equivalent of 36,000 barrels of gasoline, and the catalyst still was very active and can be used to treat additional gasoline.

The present invention is especially suitable for the sweetening of hydrocarbon distillates and particularly sour gasoline, including cracked gasoline, straight run gasoline or mixtures thereof, naphtha, jet fuel, kerosene, aromatic solvent, stove oil, range oil, fuel oil, etc. Other hydrocarbon distillates include lube oil, as well as normally gaseous fractions. In still another embodiment the novel features of the present invention may be utilized for purifying other organic fractions containing certain acidic impurities. These organic compounds include alcohols, ketones, aldehydes, etc.

Any suitable alkaline solution is utilized in the process and comprises particularly sodium hydroxide (caustic), potassium hydroxide, etc. The alkaline solution generally is utilized as an aqueous solution of from about 5 to about 50% weight concentration. When desired, solutizers, solubilizing agents, etc. are employed including, for example, alcohols and particularly methanol, ethanol, etc., phenols, cresols, butyric acid, etc., in order to increase the contact and/or reaction of the acidic compounds with the alkaline reagent. A particularly preferred agent for this purpose is methanol and its use will be described hereinafter in further detail. In some cases the hydrocarbon distillate contains phenol compounds in sufficient concentration to serve this purpose; otherwise they may be introduced from an extraneous source.

Any suitable phthalocyanine catalyst meeting the requirements of high activity and stability during use may be employed in the present invention. Particularly preferred metal phthalocyanines comprise cobalt phthalocyanine and vanadium phthalocyanine. The metal phthalocyanine in general is not readily soluble in aqueous solutions and, therefore, for improved operation is

preferably utilized as a derivative thereof. A particularly preferred derivative is the sulfonated derivative. Thus, a preferred phthalocyanine catalyst comprises cobalt phthalocyanine disulfonate. Another preferred catalyst comprises vanadium phthalocyanine disulfonate. These compounds may be obtained in the open market or may be prepared in any suitable manner as, for example, by reacting cobalt or vanadium phthalocyanine with 20% fuming sulfuric acid. While the sulfonic acid derivatives are preferred, it is understood that other suitable derivatives may be employed. Other derivatives include particularly the carboxylated derivative which may be prepared, for example, by the action of trichloroacetic acid on the metal phthalocyanine or by the action of phosgene and aluminum chloride. In the latter reaction the acid chloride is formed and may be converted to the desired carboxylated derivative by conventional hydrolysis.

The invention is further explained with reference to the accompanying flow diagrammatic drawing which illustrates several specific embodiments of the invention. It is understood that the broad scope of the present invention is not limited to the specific illustrations in the drawing.

In the interest of simplicity the drawing will be described with reference to the sweetening of a sour gasoline with caustic solution (sodium hydroxide) containing cobalt phthalocyanine disulfonate, although it is understood that other organic compounds, other alkaline solutions and other phthalocyanine compounds may be used as hereinbefore set forth. Referring to the drawing, sour gasoline is introduced into the process through line 1 and is directed, preferably through a suitable distributing device indicated at 2, into extractor 3. When the sour gasoline contains hydrogen sulfide, it may be given a prior wash with an alkaline solution and preferably caustic solution to remove hydrogen sulfide by conventional means, not illustrated. In the case here illustrated, zone 3 comprises a vertical extraction zone, which preferably contains suitable packing material and/or contacting means, including baffles, side to side pans, bubble trays, bubble decks, etc. A packing material preferably also is utilized and should be one that will not be detrimentally affected by the alkaline solution and hydrocarbons at the operating condition prevailing in this zone. A particularly suitable packing material comprises carbon Raschig rings. It is understood that two or more extraction zones may be employed and also that horizontal extraction zones may be employed.

In zone 3, the gasoline flows upwardly in intimate contact with caustic solution containing cobalt phthalocyanine disulfonate, introduced in the manner to be hereinafter set forth to zone 3 through line 4, preferably through a suitable spray arrangement illustrated at 5. When desired, fresh caustic may be introduced, or spent caustic withdrawn, by way of the extension of line 4. During contact of the gasoline with the caustic solution, acidic organic compounds, such as mercaptans and phenols contained in the gasoline, are converted into sodium mercaptides and phenolates and are dissolved in the alkaline solution. The rates of flow of the gasoline and alkaline solution are adjusted so that the treated gasoline being withdrawn from zone 3 through line 6 contains substantially less mercaptans than the sour gasoline introduced through line 1.

Treatment of the gasoline with caustic solution in zone 3 may be effected at any suitable temperature, which temperature is above the freezing point of the caustic solution. Generally ambient temperature is satisfactory, although in some cases lower or higher temperatures may be used, ranging from as low as about 25° up to about 220° F. Preferably temperatures of from about 80° to about 110° F. are employed. Any suitable pressure may be employed and generally is within the range of from about 25 to 200 pounds per square inch, although lower or higher pressures may be employed in some cases. Pref-

erably superatmospheric pressure is employed in the system in order to facilitate recovery of hydrocarbons from the excess air subsequent to the regeneration of the caustic solution when desired.

The spent caustic solution containing cobalt phthalocyanine disulfonate and sulfur compounds is withdrawn from the lower portion of zone 3 and is directed by way of line 7, preferably through a suitable spray arrangement illustrated at 8, into regenerator 9. Air, oxygen or other suitable oxygen-containing gas is introduced into zone 9 through line 10 and preferably through a suitable spray arrangement as illustrated at 11. In regenerator 9 sodium mercaptides are oxidized to regenerate sodium hydroxide and to oxidize the sulfur components to disulfides. Oxidation in zone 9 may be effected at any suitable temperature, which generally will be within the ranges hereinbefore set forth in connection with the description of zone 3. Excess air is withdrawn from the system through line 12 and may be reused in the process or disposed of as desired.

The regenerated caustic solution, cobalt phthalocyanine disulfonic and disulfides formed in zone 9 are withdrawn as a mixture through line 13 and are passed into coalescer 14, preferably through a suitable spray arrangement as illustrated at 15. As hereinbefore set forth, oxidation of the caustic solution in zone 9 results in a formation of disulfides. In order to avoid the deleterious effects of disulfides in the gasoline, it is important that the caustic solution be treated to remove the disulfides prior to recycling of the caustic solution for further use in the process. The disulfides contained in the caustic solution being withdrawn through line 13 are in finely dispersed condition and are not readily removable. This is accomplished in the present process by subjecting the mixture to treatment in zone 14 to coalesce the disulfides so that they may be separated from the caustic solution. Any suitable coalescing system may be employed and preferably comprises passing the caustic-disulfide mixture through a bed of sand, straw, glass wool, etc. A particularly effective coalescing agent is prepared by coating sand with a material available on the market as "Desicote" which is an organo silicone chloride. The mixture then is withdrawn from zone 14 through line 16 and is passed into settling zone 17.

In zone 17 an upper disulfide layer separates from an aqueous caustic solution layer containing cobalt phthalocyanine disulfonate. The disulfides are withdrawn through line 18 and may be used for any desired purpose. The regenerated caustic solution now substantially free from disulfides but containing cobalt phthalocyanine disulfonate is withdrawn from settler 17 through line 19 and a major portion thereof is recycled, in one embodiment of the invention, by way of lines 19 and 4 to extractor 3 for further use therein.

The regenerated caustic solution being recycled by way of line 19 in many cases will contain entrained or sorbed oxygen and/or oxygen compounds which, when the caustic solution is returned to extractor 3, will cause oxidation of mercaptans therein to disulfides. The disulfides will remain in the gasoline, and this increases the total sulfur content of the gasoline which, in many cases, is undesirable. In order to reduce the oxygen content of the recycled caustic solution, one and preferably both of the following methods are used. In one method, a portion (about 1 to about 25 volume percent) of the rich caustic solution withdrawn from extractor 3 through line 7 is passed through line 20 to commingle with the regenerated caustic solution in line 19. The oxygen contained in the regenerated caustic solution is consumed by oxidizing mercaptans and/or sodium mercaptides contained in the rich caustic solution. Here again, it will be noted that the caustic solution contains the cobalt phthalocyanine disulfonate catalyst and this catalyst serves to effect such oxidation. In the second method, the regenerated caustic solution being passed through line 19,

either with or without the rich caustic solution being passed through line 20, is directed through line 21, heated in exchanger 22 and then directed through line 23 and line 24 into line 19 for return to extractor 3. Heating of the caustic solution causes further oxidation of the more difficultly reacted mercaptans contained in the rich caustic solution, and this in turn consumes oxygen contained in the regenerated caustic solution. The caustic solution preferably is heated to a temperature within the range of from about 100° to about 300° F. and more particularly of from about 140° to about 200° F.

While the heated and reacted caustic solution may be returned by way of lines 23, 19 and 4 to extractor 3, preferably the disulfides formed by the additional reaction are removed from the caustic solution prior to reuse of the latter in the extraction zone. In one embodiment this is accomplished by directing the heated and reacted caustic solution through line 25 into disulfide removal zone 26, preferably through a suitable spray arrangement illustrated at 27. One method of removing the disulfides is by extracting the disulfides from the caustic solution with a hydrocarbon distillate. While any suitable hydrocarbon distillate may be used, in a preferred embodiment it comprises a low boiling hydrocarbon fraction such as pentane, hexane or mixtures thereof, which are introduced to zone 26 through line 28, preferably through a suitable spray arrangement illustrated at 29. The hydrocarbon distillate is withdrawn from zone 26 through line 30 and, when a low boiling distillate is used, the distillate may be separated from the disulfides by distillation and the recovered distillate then may be reused in the process. The regenerated caustic solution now free of disulfides is withdrawn from zone 26 through line 31 and is passed by way of lines 19 and 4 to extractor 3 for further use therein. In another embodiment of the invention, removal of disulfides may be accomplished by allowing the mixture to settle, in which case zone 26 will resemble and function similarly to settler 17.

As hereinbefore set forth, the partly treated gasoline withdrawn from the upper portion of extractor 3 through line 6 is substantially reduced in mercaptan content but is not sweet. Sweetening of the gasoline is accomplished in a novel method in accordance with the present invention. In this method the gasoline is directed by way of line 6 into final treater 32, preferably through a suitable spray arrangement as illustrated at 33, and is contacted therein with a minor portion of the regenerated caustic solution, now free from disulfides but containing sorbed oxygen and/or oxygen compounds and cobalt phthalocyanine disulfonate catalyst, supplied by way of line 34 to zone 32. In many cases the regenerated caustic solution contains sufficient oxygen and/or oxygen compounds for effecting final sweetening. In other cases, there may be a deficiency of oxygen and, in such cases, all or a portion of the regenerated caustic solution is passed from line 34 through line 36 into oxidizer 37, preferably through a suitable spray arrangement illustrated at 38. Air or other suitable oxidizing medium is introduced into zone 37 by way of line 39 and spray device 40. In zone 37 the regenerated caustic solution is countercurrently contacted with an ascending stream of air to thereby increase the concentration of oxygen or oxygen-containing compounds in the caustic solution. Excess air is removed from zone 37 through line 41. The oxidized caustic solution is withdrawn from the lower portion of zone 37 through line 42 and is directed into line 34 and passed to final treater 32.

As hereinbefore set forth, final sweetening of the gasoline is accomplished by means of the oxygen and/or oxygen compounds contained in the caustic solution. Here again it is only because of the very active cobalt phthalocyanine disulfonate catalyst that this final sweetening is accomplished readily in this manner. Final sweetening is accomplished in zone 32 at substantially the same temperature and pressure conditions heretofore

described in connection with extractor 3. Sweet gasoline is withdrawn from the upper portion of zone 32 through line 43 and may be withdrawn from the process through line 44. The caustic solution is withdrawn from zone 32 through line 45 and preferably is returned by way of line 7 to regenerator 9 for further treatment and subsequent reuse in the process.

In general it is preferred to effect the final sweetening in a zone separate from extractor 3. However, in another embodiment of the invention, final sweetening may be effected in the upper portion of extractor 3 and in open communication therewith. In this embodiment, the regenerated caustic solution containing oxygen and oxygen-containing compounds is introduced into extractor 3 at an uppermost point thereof, while the regenerated caustic solution which had been heated and reacted to remove oxygen compounds is introduced at an intermediate point in extractor 3 although, in another embodiment, both of these recycled caustic solution streams may be commingled and introduced as a single stream at the upper portion of extractor 3.

When desired, the sweetened gasoline being withdrawn from zone 32 by way of line 33 may be subjected to water wash to remove any entrained caustic solution. This is accomplished by directing the sweetened gasoline through line 43 and line 46 into wash zone 47, preferably through a suitable spray device illustrated at 48. In zone 47 the gasoline is passed countercurrently to a descending stream of water, introduced through line 49 into wash zone 47, preferably through a suitable spray device illustrated at 50. Water containing caustic is removed from the lower portion of zone 47 through line 51 and may be reused, discarded or used for any suitable purpose, while the sweetened gasoline is withdrawn from the upper portion of zone 47 through line 52.

As hereinbefore set forth, still further improved results are obtained when a solutizer is used. The solutizer serves to increase solubility of the mercaptans in the caustic solution and thereby enhances conversion and extraction of mercaptans. A particularly preferred solutizer is methanol. However, for an economical commercial process, it is important to prevent loss of methanol from the process. The drawing illustrates one method of recovering the methanol which is dissolved in the sweetened gasoline and/or entrained in the excess air stream. In this embodiment the treated gasoline is directed from zone 32 by way of line 46 into wash zone 47, where it is countercurrently contacted with water in the manner heretofore described. Similarly, excess air from regenerator 9 is directed by way of lines 12 and 53 into wash zone 54, preferably through a suitable spray arrangement illustrated at 55. Water is introduced into zone 54 by way of line 56 and preferably through a suitable spray arrangement illustrated at 57. In a preferred embodiment, water containing methanol is withdrawn from zone 54 through line 58 and commingled with water withdrawn from zone 47 by way of line 51 and, while all or a portion may be removed from the process by way of line 59, at least a portion is directed through line 60 into methanol fractionator 61. Excess air is withdrawn from the upper portion of zone 54 through line 77.

In zone 61 the methanol-water stream is subjected to heating and distillation by any suitable means such as reboiler 62, or in any other suitable manner. In zone 61 methanol is separated from water and the latter is removed therefrom through line 63. A portion of the water is directed by way of line 64 into and through reboiler 62 and returned by way of line 65 into fractionator 61. The water withdrawn through line 63 may be removed, in part, from the system through line 66 but preferably is recycled through line 67 to wash zones 47 and/or 54. Additional water, when required, may be introduced into the system through line 66. Methanol is removed from the upper portion of zone 61 through line 68 and directed into and through condenser 69 and line 70 to

receiver 71, having conventional gas release line 72. Methanol is withdrawn from receiver 71 through line 73, a portion being recycled by way of line 74 to the upper portion of zone 61 to serve as a cooling and refluxing medium therein. The remaining portion of the methanol is directed by way of line 75 and, while all or a portion may be withdrawn from the process through line 76, preferably at least a portion of the methanol is directed through lines 75 and 19 and returned by way of line 4 to extractor 3. Line 76 may be utilized for the introduction of the original or additional methanol as desired. When desired, the methanol may be introduced into extractor 3 at a point beneath the introduction of the caustic solution. This has the advantage of using the caustic solution to extract methanol which may be entrained in the ascending gasoline.

In the interest of simplicity, pumps, compressors, valves and other appurtenances have been omitted from the drawing. It is understood that these will be provided as required and also that heat exchangers, heaters, etc. will be provided when elevated temperatures are employed in the various steps of the process and also coolers or condensers as may be required.

From the above descriptions it will be noted that an improved process for sweetening sour hydrocarbon distillate is provided. As hereinbefore set forth, a sweet gasoline is readily produced without the necessity of resorting to complicated and costly methods of the prior art, such as copper treating, etc. Also, the process permits regeneration of the alkaline solution by oxidation, which avoids the high temperatures required in the prior art method of high temperature hydrolysis which, in turn, has the disadvantage of adversely affecting plant equipment and requiring comparatively frequent replacement thereof. The improved process of the present invention is attainable only because of the recent availability of the phthalocyanine catalyst which is both an active oxidation catalyst and is stable under the conditions used in the process. Without such a catalyst, satisfactory regeneration of the caustic solution is not obtained. Furthermore, the gasoline product does not contain metal components resulting from decomposition of the catalyst during use. As will be shown in the examples appended to the present specifications, cobalt phthalocyanine disulfonate has been used for an extensive period of time and, to the limit of present analytical methods, shows no change in composition or activity. Furthermore, the gasoline products are free from cobalt which further confirms the high stability of the cobalt phthalocyanine disulfonate catalyst.

The following examples are introduced to illustrate further the novelty and utility of the present invention but not with the intention of unduly limiting the same.

Example I

The gasoline used in this example was a cracked gasoline having a total sulfur content of 0.096% by weight and a mercaptan sulfur of 0.045% by weight. The gasoline was treated with a refinery caustic solution of about 10% by weight concentration. In a continuous laboratory treatment, 1,000 cc. per hour of gasoline was charged. 90 cc. per hour of the 10% by weight caustic solution containing 50 parts per million by weight of cobalt phthalocyanine disulfonate was utilized. The extraction was effected at room temperature. The treated gasoline removed from the extractor had a mercaptan sulfur content of 0.003% by weight. The caustic solution containing cobalt phthalocyanine disulfonate was regenerated at room temperature by contacting 700 cc. of air per hour. The regenerated caustic solution contained disulfides dispersed therein and was coalesced at room temperature by being passed through a bed of Desicote treated sand and then passed into a settler. A disulfide layer was removed from the upper portion of the settler and a regenerated caustic solution containing cobalt phthalocyanine

disulfonate was removed from the lower portion of the settler. A portion (80% by volume) of the regenerated caustic solution containing the phthalocyanine catalyst was commingled with a portion (10% by volume) of the rich caustic solution withdrawn from the lower portion of the extractor and the mixture was heated to a temperature of 195° F., washed with naphtha to remove disulfides and then recycled for further use in the extraction zone. The remaining portion (20% by volume) of the regenerated caustic solution containing cobalt phthalocyanine was found to contain sufficient oxygen and/or oxygen compounds to effect final sweetening and, accordingly, was contacted with the partly treated gasoline in a final treating zone at room temperature. The gasoline withdrawn from the final treater was doctor sweet.

Example II

In another run similar to that described in Example I, the regenerated caustic solution withdrawn from the settler, before use in the final treater to effect sweetening of the gasoline, is countercurrently contacted with air. The air is introduced at a rate of 4 cc. per hour, and the regenerated caustic solution at a rate of 3.6 cc. per hour. This operation is utilized when the regenerated caustic solution does not contain sufficient oxygen or oxygen-containing compounds to accomplish the final sweetening of the gasoline.

Example III

In still another run similar to Example I, approximately 24% by weight of phenols were added to the caustic solution in order to increase solubility of the mercaptans in the caustic solution. The caustic solution was regenerated by being countercurrently contacted with air in the presence of the cobalt phthalocyanine catalyst, and then was used to further treat the partly treated gasoline from the extractor. A doctor sweet product was obtained from the final treater.

Example IV

The cobalt phthalocyanine catalyst was used in the run described in Example I and in many other runs to treat approximately 30,000 cc. of gasoline. Additional caustic solution was added in the various runs as required. Computed on a commercial scale, an equivalent of one pound of cobalt phthalocyanine disulfonate catalyst is used to treat approximately 6,000 barrels of gasoline. As hereinbefore set forth, no change in activity or composition of the cobalt phthalocyanine disulfonate catalyst was detected and thus it still may be used to treat additional quantities of gasoline. In all these runs, a sweet gasoline was obtained from the final treater.

Example V

In this example sour kerosene is treated in a system in which vanadium phthalocyanine disulfonate is utilized as the catalyst. The sour kerosene contains 0.01% by weight of mercaptan sulfur and is subjected to counter-current extraction with 25% potassium hydroxide solution at ambient temperature. The treated kerosene is withdrawn from the upper portion of the extractor and now has a mercaptan content of 0.001% by weight. The potassium hydroxide solution is regenerated by blowing with air at ambient temperature in a regeneration zone in the presence of the dissolved vanadium phthalocyanine disulfonate catalyst. The regenerated potassium hydroxide solution is coalesced and settled. A portion (85% by volume) of the regenerated caustic solution is heated to a temperature of 60° C. and passed into a settler, wherefrom a disulfide layer is withdrawn and the regenerated caustic solution, now free from sulfides, is recycled through the extraction zone. The remaining portion (15% by volume) of the regenerated caustic solution is oxidized by being passed countercurrently to an ascending stream of air and then is contacted at ambient temperature with the partly treated kerosene withdrawn from

the upper portion of the extraction zone. A substantially sweet kerosene is recovered as the product of the final treater and is subjected to countercurrent washing with water to remove entrained caustic solution.

We claim as our invention:

1. A continuous regenerative sweetening process which comprises contacting sour hydrocarbon distillate with an alkaline solution containing a phthalocyanine catalyst in an extraction zone, separately withdrawing therefrom a partly treated hydrocarbon distillate and a used alkaline solution containing sulfur compounds and said phthalocyanine catalyst, contacting the last mentioned alkaline solution with an oxygen-containing gas to substantially completely regenerate the alkaline solution and to oxidize the sulfur components to disulfides in a regeneration zone, said reactions being catalyzed by the phthalocyanine catalyst, withdrawing therefrom regenerated alkaline solution containing disulfides, phthalocyanine catalyst and entrained oxygen, separating said regenerated solution into a disulfide phase and an alkaline solution phase, reducing the oxygen content of a first portion of the separated alkaline solution and returning the same to said extraction zone for further use therein to extract mercaptans from sour hydrocarbon distillate, contacting a second portion of the separated alkaline solution containing phthalocyanine catalyst and entrained oxygen with said partly treated hydrocarbon distillate to effect oxidation of mercaptans remaining in said distillate and to produce a sweet hydrocarbon distillate, and separately recovering said sweet hydrocarbon distillate.

2. The process of claim 1 further characterized in that said phthalocyanine catalyst is cobalt phthalocyanine disulfonate.

3. The process of claim 1 further characterized in that said phthalocyanine catalyst is vanadium phthalocyanine disulfonate.

4. The process of claim 1 further characterized in that said contacting of the sour hydrocarbon distillate with alkaline solution and said regeneration are effected at substantially ambient temperature, and said first portion of the separated alkaline solution is heated to a temperature of from about 100° to about 300° F. prior to being returned to said extraction zone.

5. The process of claim 4 further characterized in that disulfides are removed from the heated alkaline solution prior to returning to said extraction zone.

6. The process of claim 4 further characterized in that a portion of the used alkaline solution withdrawn from said extraction zone and prior to regeneration thereof is commingled with said second portion of the separated alkaline solution containing phthalocyanine catalyst and the mixture is heated to a temperature of from about 100° to about 300° F., following which disulfides are removed and the alkaline solution is returned to said extraction zone for further use therein.

7. The process of claim 1 further characterized in that said second portion of separated alkaline solution is subjected to oxidation prior to contacting with said partly treated distillate.

8. A continuous regenerative sweetening process which comprises countercurrently contacting sour gasoline with caustic solution containing a phthalocyanine catalyst in an extraction zone, separately withdrawing therefrom a partly treated gasoline and a used caustic solution containing sulfur compounds and said phthalocyanine catalyst, substantially completely regenerating the used caustic solution by oxidizing with air in the presence of the phthalocyanine catalyst and at the same time oxidizing sulfur compounds to disulfides in a regeneration zone, withdrawing therefrom regenerated caustic solution containing disulfides, phthalocyanine catalyst and entrained oxygen, separating said regenerated solution into a disulfide phase and a caustic solution phase, reducing the oxygen content of a major portion of the separated caustic solution and returning the same to said extraction zone for further use therein to extract mercaptans from sour gasoline, contacting a minor portion of said separated caustic solution containing said phthalocyanine catalyst and entrained oxygen with said partly treated gasoline to effect oxidation of mercaptans remaining in said gasoline and to produce a sweet gasoline, and separately recovering said sweet gasoline.

9. The process of claim 8 further characterized in that said phthalocyanine catalyst is cobalt phthalocyanine disulfonate.

10. The process of claim 8 further characterized in that said phthalocyanine catalyst is vanadium phthalocyanine disulfonate.

11. The process of claim 8 further characterized in that said reducing the oxygen content of the major portion of the separated caustic solution is effected by contacting the same with a portion of the rich caustic solution prior to regeneration, whereby the oxygen contained in said major portion of caustic solution is consumed by oxidizing mercaptans contained in said rich caustic solution.

12. The process of claim 8 further characterized in that said reducing the oxygen content of the major portion of the separated caustic solution is effected by heating the same to a temperature of from about 100° to about 300° F., whereby more difficultly reacted mercaptans are oxidized by the oxygen contained in said major portion of said separated caustic solution.

13. The process of claim 8 further characterized in that said reducing the oxygen content of said major portion of the separated caustic solution is effected by contacting the same with a portion of the rich caustic solution prior to regeneration and heating the mixture to a temperature of from about 100° to about 300° F., whereby the oxygen contained in said major portion of caustic solution is consumed by oxidizing mercaptans contained in said rich caustic solution and also by oxidation of the more difficultly reacted mercaptans contained in the caustic solutions.

14. The process of claim 8 further characterized in that said caustic solution also contains methanol and that the sweet gasoline product and excess air are each separately countercurrently contacted with water to recover methanol carried in said gasoline and air, the water-methanol recovered therefrom being fractionated to separate methanol from the water, and each is separately recycled within the process for further use therein.

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