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TREATMENT OF PETROLEUM DISTILLATES WITH AN ALKALI AND AN ALDEHYDE

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The present invention is directed to a method for treating sour petroleum distillates. More particularly, the invention is directed to the sweetening of sour petroleum distillates in the presence of an alkali metal hydroxide and a mild oxidizing agent.

Prior to the present invention, it has been known to treat sour petroleum distillates with aqueous alkaline solutions, such as solutions of alkali metal hydroxide, to remove hydrogen sulfide and other acidic bodies, following which the sour distillates were treated with sodium plumbite solution to convert deleterious sulfur compounds to compounds which are largely innocuous. This and other prior art processes relied on the addition of sulfur to cause the conversion of the sulfur compounds from mercaptans to disulfides. Other processes convert the undesirable compounds by means of lead sulfide, which is then separated from the gasoline. Frequently, the separation of lead sulfide from the gasoline was not complete, and, consequently, some was carried over into storage, which was disadvantageous. Furthermore, the addition of sulfur to gasoline frequently impaired the octane number level of the gasoline since it is well known that sulfur and is compounds affect gasoline detrimentally.

Efforts have been made in the prior art to remedy this situation, and the workers in the field have turned to adding certain compounds, such as phenols and amines, to alkaline solutions, such as sodium hydroxide, to cause conversion through an oxidation mechanism of the deleterious compounds in the sour naphtha. Frequently such expedients are unsatisfactory in not completely sweetening the product, and an after-treatment, by one of the well known sweetening procedures, becomes necessary.

It has also been known in the prior art to employ ketones in a non-oxidative sweetening process in which quantities of the ketone of the order of 2 to 20 volume per cent are added to solutions of sodium hydroxide which have been employed in extraction of mercaptans from sour stocks. In such a process the ketone is employed to prevent solidification of sodium hydroxide but such art is silent on employing the ketones in the presence of a mild oxidizing agent. It has also been known to employ aldehydes in a similar manner.

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From the foregoing discussion of the prior art, it will be seen that the petroleum refining industry has been faced with a problem of converting deleterious sulfur compounds present in petroleum distillates to those which do not detrimentally affect the quality of the product.

It is, therefore, the main object of the present invention to provide a treating process in which improved results are obtained in converting objectionable sulfur compounds to harmless bodies.

Another object of the present invention is to provide an improved sweetening process in which an active material is added to the petroleum distillate being sweetened to catalyze the conversion of deleterious sulfur compounds.

Another object of the present invention is to provide an improved sweetening process in which small amounts of catalytic reagents are employed.

In the foregoing discussion of the prior art it will be seen that the prior art workers added a compound such as phenol, amines and ketones to sweetening processes in which alkaline solutions were employed to treat sour naphthas. We have now found that, in distinction to the prior art workers, improved results may be obtained in an oxidative sweetening process in which an alkali metal hydroxide solution is employed by adding in the treating operation catalytic amounts of an organic compound having a carbonyl group such as a ketone or an aldehyde. Thus, in accordance with the present invention, the foregoing objects may be achieved by adding to a mixture of sour petroleum distillate and an alkali metal hydroxide a catalytic amount of an organic carbonyl compound while contacting the sour distillate with very small catalytic quantities of a solution of alkali metal hydroxide and maintaining in contact therewith a mild oxidizing agent.

Accordingly, the present invention may be described briefly as involving contacting a sour petroleum distillate having a boiling range of about 50° to about 750° F. with a solution of an alkali metal hydroxide to form a mixture thereof while maintaining in the mixture a catalytic amount of carbonyl compound such as a ketone or aldehyde and adding to the mixture undergoing contacting a mild oxidizing agent in amount sufficient to sweeten said distillate fol-

lowing which the alkali metal hydroxide is separated from the contacted distillate.

The carbonyl compound employed in the present invention may be illustrated by the ketones and aldehydes such as acetone, diethylketone, methylethylketone, methyl normal amylketone, dipropyl ketone, dibutyl ketone, dihexyl ketone, dioctyl ketone, and the higher members of the same homologous series. The aldehydes finding employment in the present invention may be illustrated by formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde, valeraldehyde, paraldehyde, and the higher members of the homologous series. Aromatic and cyclic carbonyl compounds are also useful in the practice of the present invention. Thus, methyl-p-tolylketone, p - methylcyclohexanone, benzophenone, acetophenone, benzyl, and the like, may be used.

These compounds may be employed in amounts based on the naphtha varying from 0.1 to 1.0 per cent by volume with a preferred range from about 0.5 to 1.0 per cent by volume. It is to be emphasized that the specified amount of carbonyl compound may be added either to the naphtha, to the alkali metal hydroxide solution, or to the mixture thereof. However, it is to be preferred that the carbonyl compound be added to the naphtha in the case of the aldehyde since there is a tendency to formation of solid bodies when the aldehyde is added to the alkali metal hydroxide.

The alkali metal hydroxide employed in the present invention preferably should be a solution of an alkali metal hydroxide. Preferably the solution should be an aqueous solution having a Baumé gravity in the range of from about 30° to about 50° Baumé but solutions of lower strength may be used under some conditions. An aqueous solution of sodium hydroxide with a gravity of 40° Baumé has been found to give satisfactory results in the practice of the present invention. Other alkali metal hydroxides besides sodium hydroxide may be used. For example, lithium and potassium hydroxides may be used in lieu of sodium hydroxide but the latter is to be preferred.

The temperature at which the treating operation is conducted will usually be atmospheric temperature and may range from about 60° F. up to 200° F. and sometimes higher temperatures may be employed depending on the boiling range and the type of the feedstock being treated. A preferred temperature range may be from about 70° to about 95° F. Satisfactory results have been obtained at atmospheric temperatures encountered in the Texas Gulf Coast area.

The present invention will be further illustrated by the following examples:

EXAMPLE I

A hydrogen sulfide-free high sulfur petroleum distillate boiling in the kerosene boiling range having a copper number of 40 was divided into three portions: one portion was treated by contacting with 1% by volume of a 50° Baumé hydroxide solution in the presence of 300% of the theoretical amount of oxygen required to sweeten the kerosene. The second portion to which had been added 0.5% per volume of acetone base on the naphtha was contacted with 1% by volume of 50° Baumé sodium hydroxide solution. This treatment was also conducted in the presence of 300% of the theoretical amount of oxygen necessary to sweeten the naphtha. The third portion had added to it 0.5% by volume of methylethylketone based on the naphtha and then was contacted with 1% by volume of 50° Baumé sodium hydroxide solution in the presence of 300% by volume of the theoretical amount of oxygen required to sweeten. The copper numbers of the three treated samples were then determined immediately and after 1, 3, 5, and 20 hours settling time. The results of these tests are presented in Table I in which the first column shows the treatment with 50° Baumé caustic solution and oxygen. The second column shows the results in which acetone was added to the kerosene, and the third column shows the results when methylethylketone was added to the kerosene.

Table I

50° Bé. Caustic, percent	1.0	1.0	1.0
Oxygen, percent Theoretical	300	300	300
Acetone, percent		0.5	
Methyl-Ethyl Ketone, percent			0.5
Cu No. Before Treat	40	40	40
Cu No. After Treat:			
Immediately After	35	23	21
1 Hour	25	20	9
3 Hours		15	10
5 Hours	25		
20 Hours	20	5.0	5.0
Percent Cu No. Reduction: After 20 Hours	50	87.5	87.5
Saybolt Color	22	27	21

It will be noted from the results in the foregoing table that the addition of either acetone or methylethylketone to the naphtha resulted in reductions in copper number after 20 hours settling time of 87.5%, whereas the color when acetone was used as the catalytic agent was improved from the original color value of 22 to a value of 27; when methylethylketone was added to the naphtha the color was substantially unchanged at 21. These results indicate that the ketones are valuable catalytic agents in an oxidative sweetening process.

EXAMPLE II

In order to demonstrate further the beneficial aspects of the present invention a hydrogen sulfide-free kerosene, which was a raffinate of a kerosene fraction obtained by solvent extraction with sufur dioxide, was divided into three portions. One portion was contacted with a solution of 50° Baumé hydroxide in the presence of oxygen. The second portion had added to it 0.5% by volume based on the kerosene of methyl normal amyl ketone following which the kerosene containing the ketone was contacted with a solution of 50° Baumé sodium hydroxide in the presence of oxygen to sweeten the kerosene. The third portion was contacted with 50° Baumé sodium hydroxide, to which had been added 0.5% of methylethylketone, in the presence of oxygen, following which the sodium hydroxide solution containing the ketone was separated. The kerosene resulting from these operations was separated from the sodium hydroxide and was then tested for color and copper number immediately after treatment and after settling for 1, 3, 5, 24, and 48 hours. The results of these tests are given in Table II in which the first column presents the results where no ketone was employed, the second column presents the results where the ketone was added to the kerosene, and the third column presents the results where the ketone was added to the sodium hydroxide solution.

Table II

			(1)
50° Be. NaOH, Per Cent	1.0	1.0	1.0
Oxygen, Per Cent Theoretical	300	300	300
Promoter	None	Methyl-N-Amyl Ketone	Methyl-N-Amyl Ketone
Amount of Promoter, Per Cent		0.5	0.5
Copper No. before Treat	33	33	33
Color before	+22	+22	+22
Copper No. after Treat:			
Immediately After	26	33	30
1 Hour After	20	15	5
3 Hours After	20	9.5	5
5 Hours After	21		3
24 Hours After	22	5.0	2
48 Hours After	21		
Color after 24 Hours	−5	+16	19

[1] Different from the other treats in that the promoter is added to the caustic and not to the naptha.

Considering the data in Table II it will be immediately apparent that without the ketone present substantially little sweetening occurred even after 48 hours settling. It will be further apparent that the color had been decreased from 22 to −5. When the ketone was added to the kerosene the copper number was reduced after settling 24 hours from 33 to 5 with a color loss of only 6 points, whereas when the ketone was added to the sodium hydroxide solution the copper number was reduced to 2 after 24 hours settling time and the color was substantially unchanged at 19. Thus the results show conclusively that the ketone may be added either to the kerosene or to the sodium hydroxide solution with the latter giving slightly improved results.

EXAMPLE III

In this example hydrogen sulfide-free high sulfur kerosene, which was a raffinate resulting from sulfur dioxide extraction of a kerosene fraction, was divided into four parts. One part was contacted with 50° Baumé sodium hydroxide solution in the presence of 300% per volume of the theoretical amount of oxygen provided to sweeten. The second portion had added to it 0.5% per volume, based on the kerosene, of formaldehyde and it was contacted with 50° Baumé sodium hydroxide solution in the presence of 300% by volume of the theoretical amount of oxygen required to sweeten. The third portion was sweetened with a 50° Baumé sodium hydroxide solution to which had been added 0.5% by volume, based on the kerosene, of formaldehyde, while the fourth portion had added to it 0.5% by volume, based on the kerosene, of paraldehyde and then contacted with a solution of 50° Baumé sodium hydroxide in the presence of 300% by volume of the theoretical amount of oxygen required to sweeten. In each case the sodium hydroxide solution was employed in an amount of 1% by volume of the kerosene. The results of these runs are given in Table III in which the quantities of reagents employed and the results obtained on the treated and untreated kerosenes are presented. Column one of Table III presents data on the treat without the employment of the aldehyde, column two presents the results where formaldehyde was added to the kerosene, column three presents data obtained when formaldehyde was added to the caustic solution, and column four gives the results on the kerosene containing paraldehyde treated in accordance with the present invention.

Table III

50° Bé. Caustic, percent	1.0	1.0	1.0	1.0
Oxygen, percent Theoretical	300	300	300	300
Formaldehyde, percent		0.5	[1] 0.5	
Paraldehyde, percent				0.5
Cu No. before Treat	40	40	65	40
Cu No. after Treat:				
Immediately After	35	35	55	20
1 Hour After	25	19	31	10
3 Hours After			20	
5 Hours After	25			6
20 Hours After	20	8	5	2
Percent Cu No. Reduction After 20 Hours	50	80	92	95
Saybolt Color	22	27		

[1] Formaldehyde added to caustic, then the naphtha treated with the mixture.

The results in Table III show that formaldehyde or paraldehyde are both effective in sweetening a high sulfur kerosene by reducing the copper number from 40 down to a value as low as 2 without seriously lowering the Saybolt color thereof. The results also show that the aldehyde may be added either to the kerosene or to the sodium hydroxide solution.

EXAMPLE IV

Since it has been known in the prior art that formaldehyde and sodium hydroxide in admixture are extractive agents for the removal of mercaptans, a comparison was made between the practice of the present invention, where a solution of sodium hydroxide was employed to sweeten a sour kerosene and formaldehyde was added thereto, with air being used as an oxidation agent, and the use of formaldehyde-caustic solution as an extractive agent. In other words, in accordance with the present invention an oxidation agent such as air was employed, whereas in the run in accordance with the practice of the prior art oxygen was absent.

In order to show the beneficial aspects of the present invention in a conclusive manner, a hydrogen sulfide-free high sulfur kerosene, which was a raffinate resulting from the sulfur dioxide extraction of a kerosene fraction, was divided into four portions. One portion was treated with 1% of 50° Baumé sodium hydroxide solution in the presence of 300% by volume of the theoretical amount of oxygen required to sweeten. The second portion had added to it 0.5% by volume, based on the kerosene, of formaldehyde and was contacted with 1% by volume of 50° Baumé caustic solution in the presence of 300% by volume of the theoretical amount of oxygen required to sweeten.

The prior art practice was illustrated by a run in which the kerosene had added to it 0.5% by volume, based on the kerosene, of formaldehyde and was then contacted with 1% by volume of

50° Baumé sodium hydroxide solution in the substantial absence of free oxygen. A comparative run was made where the kerosene was mixed with 1% by volume of sodium hydroxide solution to which has been added 0.5% by volume, based on the kerosene, of formaldehyde. This sweetening was also conducted in the substantial absence of free oxygen.

The results of these runs are presented in Table IV in which the two left hand columns present a comparison between contacting in the presence of oxygen but in the absence of formaldehyde and contacting in the presence of oxygen with formaldehyde in the kerosene, while the data in the two right hand columns illustrate the prior art where formaldehyde is added either to the naphtha or to the sodium hydroxide and the treating operation is conducted in the substantial absence of free oxygen.

Table IV

	Present Invention—Oxygen Sweetened		Prior Art—Extraction in the Absence of Oxygen	
50° Bé. Caustic, percent	1.0	1.0	1.0	1.0
Oxygen, percent Theoretical	300	300	---	---
Formaldehyde, percent	---	0.5	0.5	[1]0.5
Cu No. Before Treat	40	40	40	40
Cu No. After Treat:				
Immediately After	35	35	10	38
1 Hour After	25	19	---	---
3 Hours After	---	---	---	---
5 Hours After	25	---	---	---
20 Hours After	20	8	22	33
Percent Cu No. Reduction After 20 Hours	50	80	45	17.5
Saybolt Color	22	27	---	---

[1] Formaldehyde added to caustic and the mixture used to treat the naphtha.

It will be apparent from the data in Table IV that when the present invention is employed and formaldehyde is present in the mixture undergoing treatment a reduction in copper number from 40 to 8 is obtained with an appreciable improvement in color. Comparing the prior art practice with the present invention, it will be seen that after 20 hours settling time the copper number had not been appreciably reduced. In fact, the instance where the formaldehyde was added to the kerosene and contacted with sodium hydroxide in the absence of oxygen a lesser reduction in copper number was obtained than when oxygen and a caustic solution were employed in the absence of the aldehyde. Even less beneficial results were obtained in the absence of oxygen when formaldehyde was added to the sodium hydroxide solution. It may be concluded, therefore, that in the present invention in which an oxidation reaction is conducted in the presence of catalytic amounts of sodium hydroxide with formaldehyde in the reaction mixture substantially improved results are obtained over prior art processes where extraction is conducted in the absence of free oxygen.

EXAMPLE V

In this run a hydrogen sulfide-free high sulfur kerosene, which was a raffinate resulting from the sulfur dioxide extraction of the kerosene fraction, was divided into two portions. One portion was contacted with a solution of 50° Baumé sodium hydroxide while a second portion was contacted with a solution of 50° Baumé sodium hydroxide to which had been added 1% by volume of acetaldehyde. The copper numbers of the two portions of contacted kerosenes were determined immediately after the separation of the

treated kerosene from the sodium hydroxide solution and after settling for 1, 3, 24, and 48 hours.

The results of these tests are presented in Table V in which the left hand column gives the results without the acetaldehyde present in the sodium hydroxide and column two shows the effect of acetaldehyde when added to the sodium hydroxide solution. It is noticed that even though the acetaldehyde forms a solid mass when added to the sodium hydroxide a beneficial result was obtained in that the copper number was reduced from 33 to 1 after 24 hours settling.

Table V

50° Bé. NaOH, percent	1.0	1.0
Theor. Oxygen, percent Theoretical	300	300
Promoter	None	[1]Acetaldehyde
Amount of Promoter, percent	---	0.5
Copper No. before Treat	33	33
Color before	+22	+22
Copper No. after Treat:		
Immediately After	26	19
1 Hour After	20	8
3 Hours After	20	4.5
5 Hours After	21	3.0
24 Hours After	22	1.0
48 Hours After	21	---
Color after 24 Hours	−5	---

[1] Formed solid mass when added to caustic.

EXAMPLE VI

The effectiveness of aromatic carbonyl compounds and cyclic carbonyl compounds was illustrated by treating a hydrogen sulfide-free, high sulfur kerosene which was a raffinate resulting from the sulfur dioxide extraction of a kerosene fraction. This raffinate was divided into three portions. One portion was treated with 1 volume per cent of sodium hydroxide with a gravity of 50° Baumé in the presence of 300% of the theoretical oxygen required to sweeten the material; another portion had added to it 0.5 volume per cent methyl-p-tolylketone and was then contacted with 1 volume per cent caustic with a gravity of 50° Baumé in the presence of 300% of the theoretical oxygen required to sweeten the material; the third portion had added to it 0.5 volume per cent p-methyl-cyclohexanone and was then contacted with 1% by volume of sodium hydroxide with a gravity of 50° Baumé in the presence of 300% of the theoretical oxygen required to sweeten the material. The copper numbers of the three portions of contacted raffinate were determined immediately after the separation of the treated raffinate from the sodium hydroxide solution and also after settling for 3 and 20 hours.

The results of these tests are presented in Table VI. It is to be observed that both the aromatic and cyclic carbonyls are effective promoters although the cyclic compound is more effective than the aromatic compound. The percentage reduction in copper number is over twice as great when the reaction is catalyzed by the aromatic carbonyl as for the uncatalyzed reaction and over three times as great for the reaction catalyzed by the cyclic carbonyl as for the uncatalyzed reaction.

Table VI

50° Bé. NaOH, percent	1.0	1.0	1.0
Oxygen, percent Theoretical	300	300	300
Promoter, Vol. percent	None	---	---
Methyl-p-tolylketone	---	0.5	---
p-Methylcyclohexanone	---	---	0.5
Copper No. after Treat:			
Immediately After	38	38	38
3 Hours After	35	22	20
20 Hours After	31	20	9
Percent copper No. Reduction in 20 Hours	22	50	77

In the foregoing examples, the improvements obtained by the practice of the present invention has been illustrated by the copper number test. This is a well known analytical procedure in the petroleum industry. A description of the method of test may be found in "U. O. P. Laboratory Test Methods for Petroleum and Its Products," third edition, page H–61, Universal Oil Products Co., Chicago, 1947. This test is a measure of the mercaptan sulfur content of the oil being tested.

Although not illustrated by the several examples, one of the particular advantages of the present invention resides in the catalytic effect of the alkali metal hydroxide solution. The alkali metal hydroxide appears to function as a true catalyst since the small amount used may be recycled to treat large quantities of the sour petroleum distillate. A small amount of the alkali metal hydroxide solution may be entrained in the treated naphtha, and, therefore, it may be necessary to replace the entrained amount with fresh solution. In short, it is contemplated in the practice of the present invention that the alkali metal hydroxide solution will be reused over and over again since it is not necessary to regenerate the alkali metal hydroxide solution.

The invention has been described and illustrated by employement of a mild oxidizing agent such as oxygen. It is contemplated that mixtures of oxygen with other gases, such as air, may be employed. It is also contemplated that other mild oxidizing agents such as peroxides, permanganates, and the like may be used. For example, a hydrogen peroxide solution may be employed as the mild oxidizing agent.

In practicing the present invention, it is to be understood that the petroleum distillate may be subjected to a preliminary treatment for removal of hydrogen sulfide if the distillate contains hydrogen sulfide. Such preliminary treatment may include washing with a dilute alkali metal hydroxide solution or blowing with a free-oxygen containing gas such as air. If hydrogen sulfide or other acidic compounds are present and not removed, the alkali metal hydroxide solution employed as the catalyst may very quickly become seriously depleted in activity.

In the practice of the invention, it will be desirable to use an amount of oxygen in excess of the theoretical required to sweeten the sour petroleum distillate. Ordinarily, an amount of about 300% of the theoretical amount to sweeten may be employed. However, sweetening in accordance with the present invention may be obtained with considerably lesser quantities of oxygen. In other instances as much as 500% of the theoretical amount required to sweeten may be employed. In fact, sweetening may be obtained in some cases by contact with the oxygen present in the treating vessel. It will be desirable to employ an amount of oxidizing agent at least equivalent to the theoretical amount required to sweeten.

The invention has been described and exemplified by employment of 0.5 to 1.0% by volume of the catalytic alkali metal hydroxide solution. It is contemplated that as little as 0.1 and as much as 5% by volume, or more, of the alkali metal hydroxide solution, based on the sour naphtha, may be employed. Very good results, however, are obtained with 1% by volume and this amount will be preferred.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and to secure by Letters Patent is:

1. A method for treating a petroleum distillate which comprises contacting a sour petroleum distillate containing mercaptans and boiling below 750° F. with a catalytic amount in the range between 0.1% and 5% by volume based on the distillate of a solution of an alkali metal hydroxide in the presence of less than 1.0% by volume based on the distillate of an aldehyde while adding a mild oxidizing agent in a sufficient amount to obtain a sweetened distillate.

2. A method for sweetening a sour petroleum distillate containing mercaptans and boiling below 750° F. which comprises forming a mixture of an aqueous solution of an alkali metal hydroxide in a catalytic amount in the range between 0.1% and 5% by volume based on the sour distillate and said sour petroleum distillate, maintaining in said mixture an amount of an aldehyde in the range from 0.1 to 1.0% by volume based on said distillate, and then contacting the mixture while adding a sufficient amount of a mild oxidizing agent to obtain a sweetened distillate.

3. A method for sweetening a sour petroleum distillate containing mercaptans and boiling below 750° F. which comprises forming a mixture of an aqueous solution of sodium hydroxide in a catalytic amount in the range between 0.1% and 5% by volume based on the sour distillate and said sour petroleum distillate, adding to said mixture an amount of an aldehyde in the range from 0.1 to 1.0% by volume based on said distillate and then contacting the mixture while adding a sufficient amount of air to obtain a sweetened distillate.

4. A method for sweetening a sour petroleum distillate containing mercaptans and boiling below 750° F. which comprises forming a mixture of an aqueous solution of sodium hydroxide in a catalytic amount in the range between 0.1% and 5% by volume based on the sour distillate and said sour petroleum distillate, adding to said mixture an amount of an aldehyde in the range from 0.1 to 1.0% by volume based on said distillate, and then contacting the mixture while adding a sufficient amount of air for a time sufficient to cause sweetening of said distillate, separating said sodium hydroxide solution from said distillate, and recovering said agitated distillate.

5. A method for sweetening a sour petroleum distillate containing mercaptans and boiling below 750° F. which comprises forming a mixture of an aqueous solution of sodium hydroxide in a catalytic amount in the range between 0.1% and 5% by volume based on the sour distillate and said sour petroleum distillate, adding to said mixture an amount of an aldehyde in the range from 0.1% to 1% by volume based on said distillate selected from the class consisting of formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde, valeraldehyde, and paraldehyde, and then contacting the mixture while adding a sufficient amount of air for a time sufficient to cause sweetening of said distillate, separating said sodium hydroxide solution from said contacted distillate and recovering said contacted distillate.

6. A method for sweetening a sour petroleum distillate containing mercaptans and boiling below 750° F. which comprises adding to said distillate an amount of an aldehyde in the range from 0.1% to 1% by volume based on said distillate, and then contacting the distillate to which the aldehyde has been added with an aqueous

solution of sodium hydroxide in a catalytic amount in the range between 0.1% and 5% by volume based on the sour distillate while adding a sufficient amount of air for a time sufficient to cause sweetening of said distillate, separating said sodium hydroxide solution from said contacted distillate and recovering said contacted distillate.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,954,959	Stratford et al.	Apr. 17, 1934
2,015,038	Pevere	Sept. 17, 1935
2,043,254	Malisoff	June 9, 1936
2,059,075	Yabroff et al.	Oct. 27, 1936
2,123,492	Yabroff et al.	July 12, 1938
2,146,353	Rosebaugh	Feb. 7, 1939
2,316,759	Bond	Apr. 20, 1943
2,345,449	Birkhimer	Mar. 28, 1944
2,464,576	Hibbard et al.	Mar. 15, 1949
2,488,000	Bernard	Nov. 15, 1949

OTHER REFERENCES

Russell, Science, pages 372–3, Oct. 17, 1947.