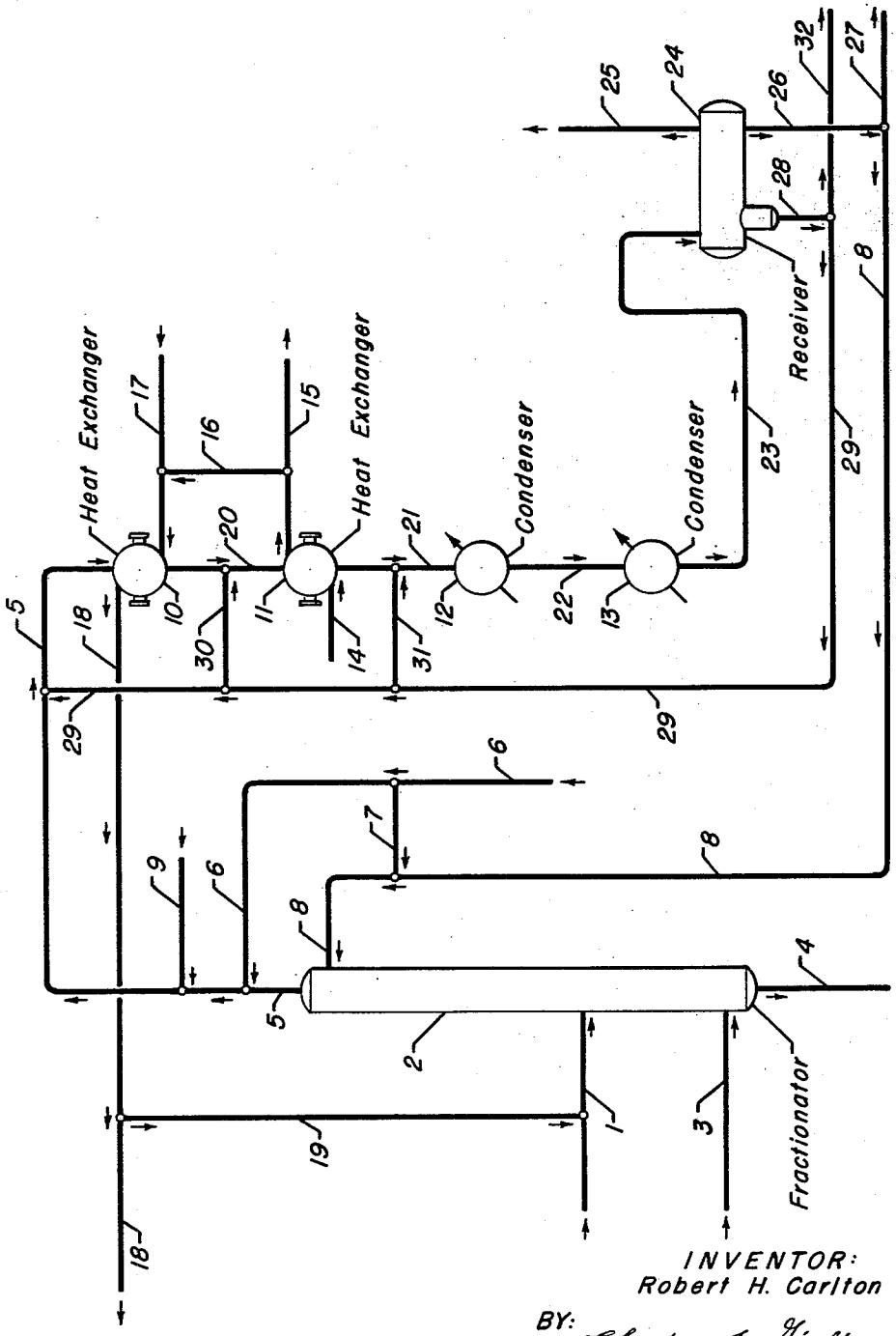
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RETARDING CORROSION OF HEAT EXCHANGERS

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# RETARDING CORROSION OF HEAT EXCHANGERS

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This invention relates to a novel method of retarding corrosion of heat exchangers used in the cooling of hot hydrocarbon fractions containing corrosive acidic components.

An example in which a heated hydrocarbon fraction contains acidic components and is cooled by heat exchange is in the fractionation of crude oil. This is done in a crude column, which may or may not be preceded by a preflash separation. In order to facilitate fractionation in the crude column, it is general practice to use steam therein and thereby to effect steam stripping. In the crude column, crude oil or reduced crude is subject to fractionation to separate different cuts of the crude oil. The different fractions, for example, may comprise an overhead consisting of gasoline boiling components, while kerosene and one or more middle distillate fractions may be removed as side cuts from the crude column. The overhead and the side cuts then are cooled in order to condense the heated fractions for subsequent treatment. Considerable difficulty has been experienced in refinery operations because of corrosion of the heaat exchangers and coolers used to condense the overhead effluent from the crude columns.

As one step in minimizing corrosion, ammonia is injected into the upper portion of the crude column and/or into the overhead vapor line therefrom. Most crude oils contain acidic components and, particularly, chlorine components. This results in the formation of ammonium chloride which is corrosive in the presence of an aqueous medium and, accordingly, causes corrosion of the heat exchangers and condensers through which the overhead fraction passes.

As another step in minimizing corrosion, a film forming corrosion inhibitor is injected, usually in the fractionator overhead vapor line and downstream from the injection of the ammonia. It will be noted that both the ammonia and the corrosion inhibitor are introduced into the hot vapors prior to cooling and condensing of the vapors. However, in spite of the injection of ammonia and of inhibitor, considerable difficulty has been experienced due to corrosion of the heat exchangers and condensers.

Corrosion difficulties also are experienced in heat exchangers and condensers employed to cool and condense overhead vapors from fractionators in refining processes such as thermal cracking, catalytic cracking, thermal reforming, catalytic reforming, etc. For example, in catalytic cracking the reactor effluent products are subjected to fractionation to separate overhead vapors comprising gasoline. The catalytic cracking is effected at a temperature of from about 800° to about 1000° F. and a pressure of from atmospheric to 200 p.s.i. in the presence of a suitable cracking catalyst. Silica-alumina is the most used cracking catalyst, although other cracking catalysts include silica magnesia, silica-alumina magnesia, silica-alumina zirconia, silica-alumina thoria, etc. Acidic impurities are contained in the charge to catalytic cracking and the overhead vapors from the fractionator contain these impurities and form ammonium salts including ammonium chloride, ammonium cyanide, etc. These ammonium salts cause corrosion of the heat exchangers and coolers used to condense the overhead vapors.

Corrosion of heat exchangers and condensers also is encountered in processes in which hot effluent products



from a reaction zone are cooled, condensed and collected in a receiver prior to subsequent fractionation or other treatment. For example, in a catalytic reforming process, gasoline or naphtha is passed at a temperature of from about 800° to about 1000° F. and a pressure of from about 100 to about 2000 p.s.i. or more, through a reaction zone containing a suitable reforming catalyst, and the hot reactor effluent products then are cooled and condensed by being passed through heat exchangers and condensers. Any suitable reforming catalyst may be employed. A particularly preferred catalyst comprising a composite of alumina, platinum and combined halogen, the platinum being in a concentration of from 0.02% to about 2% by weight and the halogen being in a concentration of from about 0.02% to about 5% by weight. The halogen preferably comprises chlorine and/or fluorine. Other platinum-containing catalysts include composites of alumina-platinum, silica-platinum, alumina-silica-plainum, etc.

In purification processes, gasoline, naphtha and/or heavier oil is passed, at a temperature of from about 600° to about 800° F. and a pressure from about 50 to about 1000 p.s.i. or more, into a reaction zone containing a suitable purification catalyst, and the hot reactor effluent products then are passed through heat exchangers and condensers to cool and condense the effluent products. A preferred purification catalyst in a composite of alumina, molybdenum oxide and cobalt oxide. Other purification catalysts comprise composites of alumina-molybdenum oxide, alumina-nickel oxide, alumina-nickel oxide-cobalt oxide, similar composites containing silica or composites in which the silica replaces the alumina, as well as catalysts comprising the metal sulfides instead of, or in admixture with, the metal oxides hereinbefore set forth. Regardless of the particular catalyst used in the purification process, corrosion of the heat exchangers and condensers occurs.

During cooling of the hot hydrocarbon effluent, ammonium salts. and particularly ammonium chloride, solidify and, as hereinbefore set forth, cause corrosion of the heat exchangers and condensers. In order to dissolve the ammonium chloride crystals and wash them out of the heat exchangers, condensers and communicating piping, fresh water is commingled with the effluent products. However, while this has been of some benefit in reducing corrosion, it has not been completely satisfactory for various reasons. One important reason is that the introduction of fresh water into the system also introduces undesired impurities. Of these undesired impurities, oxygen is especially bad for two reasons. As one reason, there is a type of corrosion caused by oxygen and this corrosion then occurs because of the presence of oxygen. Another reason is that the oxygen tends to oxidize metal salts as, for example, magnesium chloride, calcium chloride, sodium chloride, organic chlorides, etc., and forms hydrogen chloride which causes corrosion of the heat exchangers, condensers and piping. Accordingly, deaeration of the water used in the process is desirable, but this adds considerably to the cost and, in many cases, is economically prohibitive. Other impurities contained in fresh water also may contribute to the corrosion problem and, accordingly, also are objectionable. For this reason, steam condensate or boiler water is used, but the available quantity thereof generally is much below the amount needed.

Another important objection to the use of fresh water is the disposal problem. The water becomes contaminated and, in many localities, cannot be discharged into the neighboring streams. Accordingly, it is necessary to treat this water prior to disposal and this further increases the cost. Still another reason is that in many localities water is scarce and fresh water may not be available for

such use or the cost thereof is economically prohibitive.

For the above reasons, the use of fresh water to dissolve and wash out the ammonium salts has been restricted to a minimum amount. However, this minimum amount of water has not been satisfactory to retard corrosion of heat exchangers and condensers to the desired extent in many cases. The present invention provides a novel method of retarding corrosion of the heat exchangers and condensers.

In accordance with the present invention, water once used to dissolve and wash out the ammonium salts is subsequently separated in a receiver and the water is reused for this purpose. The reuse of this water has presented a number of problems. For example, it has been found that the water must be introduced at a critical point in the process in order to effect satisfactory prevention of corrosion of the heat exchangers and condensers. Another problem associated with the reuse of the water is that the water becomes contaminated with the ammonium salts dissolved therein and the advisability of reusing such water was open to question. However, it has been found that the water may be satisfactorily reused, providing this reuse is accomplished in a particular manner as herein described in detail. The reuse of the water avoids the objections encountered with fresh water as hereinbefore set forth. These include (1) the scarcity of water, (2) the introduction of undesirable impurities, and (3) the disposal problem. In addition, the reuse water permits the use of large quantities of water so that it may be continuously injected and this, in turn, offers important advantages. The continuous injection of large amounts of water serves as an additional coolant and serves to maintain the heat exchangers at a lower temperature level. The use of the large volume of water establishes substantially constant conditions throughout the heat exchangers and condensers and thereby minimizes plant upsets which otherwise might occur when variations in the amount of water are employed. In addition, this serves to maintain a constant and uniform pH throughout the cooling and condensing system. Furthermore, the reuse water now has been buffered and the use of this uniform water avoids upsets which otherwise may be encountered by using water of varying composition. In addition to this, the reuse of the water is economical and practical and does not entail the excessive cost which may be entailed in using fresh water.

In one embodiment the present invention relates to a method of retarding corrosion of a heat exchanger being used to cool a hot hydrocarbon effluent containing vaporized nitrogeneous salt, which comprises cooling and condensing said hydrocarbon effluent in the presence of water introduced as hereinafter described, separating water from hydrocarbon, and commingling at least a portion of said water with said hot hydrocarbon effluent prior to cooling of said effluent to the solidification temperature of said salt.

From the hereinbefore embodiment, it will be noted that the reuse water must be introduced at a point prior to the solidification of said salt. As hereinbefore set forth, the water serves to dissolve the ammonium salt and to wash it out of the system. However, the water must be introduced before the ammonium chloride solidifies because it has been found that solid ammonium chloride will cause corrosion even in the absence of liquid water. It is believed that corrosion also occurs by solid ammonium chloride in the presence of water vapor, apparently the ammonium chloride attracts or sorbs the water vapor to form a corrodant. Applicant does not wish to be limited to this explanation but, regardless of the exact mechanism, the occurrence of such corrosion appears to be established. Therefore, the reuse water is injected before solidification of the ammonium chloride, and the ammonium chloride is dissolved and removed in the water without having an opportunity to attack the metal surfaces.



Solidification of the ammonium chloride also may be defined as reverse sublimation. In normal sublimation, a solid passes directly into a vapor state without going through a visible liquid state. In the solidification as used herein, the ammonia vapor and halide vapor form a solid without going through a visible liquid state. When present in the hot hydrocarbon vapors, the ammonia and halide are in the vapor state, either as individual components or as a single compound, which may be a loose combination or definite chemical composition. Upon cooling, the ammonium chloride solidifies. As hereinbefore set forth, it is essential that the reuse water be commingled with the hot hydrocarbon effluent prior to the solidification of the ammonium chloride so that the ammonium chloride is dissolved in the water and is prevented from attacking the heat exchangers and condensers.

As hereinbefore set forth, the desirability of reusing the water has been questioned because of the dissolved ammonium chloride therein. However, it has been found that this may be done satisfactorily. In the cooling of fractionator overhead effluent, a film forming inhibitor also is injected into the hot effluent products prior to the injection of water. As will be hereinafter described in detail, the preferred sequence is first the injection of ammonia, then the injection of a film forming inhibitor, and finally the injection of the reuse water.

The invention is explained further in connection with the accompanying diagrammatic flow drawing which illustrates several specific embodiments of the invention, but without the intention of unduly limiting the invention thereto.

Referring to the drawing, crude oil, reduced crude or other hydrocarbon charge is introduced through line 1 to fractionator 2. In the interest of simplicity, the drawing will be described with rerefrence to the fractionation of crude oil, with the understanding that the process also may be used in the cooling and condensing of other hydrocarbon fractions as hereinbefore set forth.

In fractionator 2, the crude oil is separated into an overhead fraction, generally comprising gasoline boiling components and containing vaporized acidic components. To facilitate separation in zone 2, steam is introduced thereto through line 3 and this serves to effect steam stripping and improved separation. In the case here illustrated, the heavier components of the crude oil are withdrawn from fractionator 2 through line 4 for any further treatment as desired. Generally, fractionator 2 also will contain side cut strippers in order to separate kerosene and one or more middle distillate fractions, but the side cut strippers are not pertinent to the present invention and, therefore, have been omitted from the drawing.

The vaporized fraction is removed from the upper portion of fractionator 2 through line 5 and is cooled and condensed to separate liquid hydrocarbon from water and gases. As illustrated in the drawing, ammonia is introduced through line 6 and all or a portion of the ammonia is injected into line 5 or all or a portion is introduced into the upper portion of fractionator 2 by way of lines 7 and 8. Line 8 is used to return liquid reflux to the upper portion of the fractionator to serve as a cooling and refluxing medium therein as will be hereinafter described. The ammonia is introduced in a concentrtaion to maintain the vaporized effluent at a pH within the range of from about 4.5 and preferably from about 6.5 to about 7.5 and, accordingly, will vary with the specific vaporized hydrocarbon fraction being cooled and condensed. In most cases the amount of ammonia will be from about 1 to about 100 parts per million based on the overhead vapor. However, in some instances, the charge being fractionated may contain ammonia or other nitrogenous components in a comparatively large concentration and the injection of extraneous ammonia is not required or the amount of extraneous may be reduced.

As hereinbefore set forth, in a system as illustrated in the drawing, a film forming inhibitor is injected through line **9** into line **5** downstream of the injection of the ammonia. Any suitable film forming inhibitor may be employed. Preferred film forming inhibitors comprise carboxylic acid salts of high molecular weight amines or polyamines. Illustrative examples of such inhibitors include monocarboxylic acid or polycarboxylic acid salts of dodecyl amine, tridecyl amine, tetradecyl amine, pentadecyl amine, hexadecyl amine, heptadecyl amine, octadecyl amine, nonadecyl amine, eicosyl amine, etc. and, particularly, of commercially available mixtures of amines such as tallow amine (predominating in alkyl groups of 16 to 18 carbon amines each). Polyamines include N - alkyl - 1,2 - diaminoethane, N - alkyl - 1,3 - diaminopropane, N-alkyl-1,4-diaminobutane, etc., in which the alkyl group contains from 10 to 30 carbon atoms or more. Here again a mixture is available commercially as "Duomeen T" which is N-tallow-1,3-diaminopropane, the alkyl group predominating in 16 to 18 carbon atom chains. Other mixed N-alkyl-1,3-diaminopropanes comprise those in which the alkyl group is derived from lauric acid, coconut oil, soya oil, etc. Monocarboxylic acids used in forming the salt may contain from 1 to 50 carbon atoms and include acetic, propionic, butyric, valeric, caproic, caprylic, pelargonic, capric, lauric, myristic, palmitic, stearic, cerotic, oleic, linoleic, gadoleic, cetoleic, etc. Polycarboxylic acids include oxalic, malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic, sebacic, etc., and various mixed polybasic acids including "VR–1 Acid" which is a mixture of polybasic acids having an average molecular weight of about 1000, "Dimer Acid" which is similar to "VR–1 Acid," etc. It is understood that a mixture of acids and amines may be used in preparing the film forming inhibitor.

Another film forming inhibitor comprises a high molecular mono- or polyamine. These amines may be selected from those hereinbefore specifically set forth. Preferred amines compirse tallow amine, "Duomeen T" and amines derived from fatty acids. Other film forming inhibitors comprise high molecular weight polyalkylene polyamines and, particularly, $N^1,N^3$-dialkyl-diethylene - triamine, $N^1,N^3$ - dialkyl - dipropylenetriamine, etc., $N^1,N^4$, - dialkyl - triethylenetetramine, $N^1,N^4$ - dialkyl - tripropylenetetramine, etc., $N^1,N^5$-dialkyl - tetraethylenepentamine, $N^1,N^5$ - dialkyl - tetrapropylenepentamine, etc., in which the alkyl groups contain from 1 to 20 and preferably from 6 to 12 carbon atoms each, hydroxyethylated alkylene alkyl amines or alkylene polyamines, imidazolins, amides, etc. It is understood that any suitable hydrocarbon soluble film forming corrosion inhibitor may be used in accordance with the present invention. In general, the inhibitor will be used in a concentration of from about 5 to about 50 parts per million or more, and preferably from about 10 to about 30 parts per million, based upon the hot hydrocarbon effluent stream.

Referring to the drawing, the vaporized overhead fraction from fractionator **2** is passed through line **5** into and through a plurality of heat exchangers and condensers. The exact number of heat exchangers and condensers will depend upon the particular system employed, but usually will comprise at least one heat exchanger and at least one condenser. The heat exchanger generally is used to preheat, at least in part, the charge to fractionator **2**, although, of course, other fractions may be supplied to the heat exchanger. In the case here illustrated, the cooling and condensing system includes heat exchangers **10** and **11** and condensers **12** and **13**. In the condensers, the hydrocarbon fraction is cooled by indirect heat exchange with cooler water. In the particular embodiment illustrated in the drawing, the charge to fractionator **2** is first partially preheated by being passed through line **14** into and through heat exchanger **11** and then directed by way of line **15** and, while all or a portion may be removed through an extension of this line, at least a portion of the charge is passed by way of lines **16** and **17** into and through heat exchanger **10**. The preheated charge is withdrawn from heat exchanger **10** through line **18** and, while all or a portion may be removed from the process through the extension of this line, at least a portion thereof is directed by way of line **19** into line **1** for subsequent introduction into fractionator **2**. Generally, additional heating of the charge is provided and this may be accomplished in any suitable manner, not illustrated, including additional heat exchangers, a fired heater, etc. The drawing also illustrates an embodiment in which one fraction is heated by heat exchange in exchanger **11** and a different fraction is heated in exchanger **10** by being introduced through line **17** and withdrawn from the process by way of the extension of line **18**. It is understood that one or three or more heat exchangers may be employed, as desired.



The hydrocarbon vapors pass by way of line **5** into and through heat exchanger **10**, through line **20**, into and through heat exchanger **11**, through line **21** into and through condenser **12**, through line **22** into and through condenser **13** and then by way of line **23** into receiver **24**. The drawing illustrates two condensers, each being cooled with water. Here again one or three or more condensers may be employed, as desired.

In receiver **24**, normally gaseous material is vented by way of line **25**. Liquid hydrocarbons are withdrawn from receiver **24** through line **26** and all or a portion thereof are removed from the process by way of line **27**. Preferably, at least a portion of the condensed hydrocarbon liquid is recycled by way of line **8** to the upper portion of fractionator **2** to serve as a cooling and refluxing medium therein.

Water is separated in receiver **24** and is removed therefrom by way of line **28**. In accordance with the present invention, at least a portion of the water is recycled by way of line **29** to commingle with the hot hydrocarbon fraction passing through line **5**. Depending upon the temperature and the composition of the hot hydrocarbon vapors, the reuse water may be introduced into line **5**, into line **20** by way of line **30** or into line **21** by way of line **31**. In some cases, a portion of the water may be introduced at one or more points indicated above. In any event, at least a portion of the water is continuously commingled with the heated hydrocarbon vapors prior to solidification of the ammonium chloride and, in a preferred embodiment, all of the water is introduced at this point. The heated hydrocarbon vapor is progressively cooled as it passes through heat exchangers **10** and **11** and condensers **12** and **13**, and the exact point of introducing the water will depend upon the temperature and composition of the hydrocarbon vapors along its travel. In some cases, the specific arrangement of the plant equipment may not permit the introduction of the water at the preferred point and, in such cases, the water should be injected at the closest available hotter point. In general, the reuse water will be injected before the vapors are cooled to a temperature within the range of 190° to 350° F.

As hereinbefore set forth, steam is introduced into fractionator **2** and, in a preferred embodiment of the invention, an amount of water corresponding to the amount of steam introduced through line **4** is withdrawn from the process by way of lines **28** and **32**. In this way, a buildup of water in the system will be avoided, the system will be balanced, and a continuous withdrawal of ammonium chloride from the system will be accomplished. As hereinbefore set forth, this will provide reuse water of constant volume and constant composition which offers the advantages previously described of permitting the use of large volumes of water, providing water of constant composition and thereby avoiding the introduction of undesired impurities, and establishing a balanced operation throughout the system.

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*

This example describes the use of the present invention in the operation of a crude column, utilizing two exchangers and two condensers as illustrated in the drawing. Steam is introduced into the lower portion of the crude column at a rate of 2250 pounds per hour. The overhead vaporous fraction is withdrawn at a rate of 7500 barrels per day and at a temperature of 275° F. and pressure of 9 p.s.i.g. Ammonia is introduced into the vapor line at a rate of 50 pounds per day and a corrosion inhibitor is introduced at a concentration of 20 parts per million based on the overhead vapor. The inhibitor is introduced downstream from the ammonia injection, but before the mixture is passed into the first heat exchanger. The inhibitor is a dibasic acid of a high molecular weight alkyl amine. In the first heat exchanger, the vaporized overhead is cooled to about 240° F. and further cooled in the second heat exchanger to a temperature of about 200° F. Crude oil being charged to the process is passed successively through the second heat exchanger and the first heat exchanger, after which it is further heated and then supplied to the crude column. The overhead effluent, after passing through the second heat exchanger, is then finally cooled in the condensers to a temperature of 90° F. and is separated at this temperature and a pressure of 5 p.s.i.g. in the receiver.

In accordance with the present invention, water separated in the receiver is continuously commingled with the overhead vapors prior to solidification of the ammonium chloride. In the system of this example, the water is introduced before the overhead vapor is cooled below 240° F. and, accordingly, normally would be introduced at a point between the two heat exchangers. However, in this particular arrangement, enough piping was not available between the heat exchangers to permit the introduction of water at this point. Therefore, the reuse water was injected into the vapor line ahead of the first heat exchanger. The reuse water is supplied at a rate of 18 gallons per minute, and the excess water removed from the receiver is withdrawn from the process at a rate of 2250 pounds per hour, which corresponds to the rate of introduction of steam to the crude column. As hereinbefore set forth, this establishes a constant balance through the system and results in improved operation.

Prior to reuse of the water in the manner as above described, frequent corrosion in the second heat exchanger and in the first condenser was experienced. This necessitated shunting down the plant to remove the exchangers from service and to replace corroded parts. In contrast, employing the resue water in the manner described above has resulted in satisfactory operation of the heat exchangers. The absence of corrosion in the heat exchangers was followed by analyzing the water withdrawn from the receiver. It was found that the concentration of metals in the water was only of minute quantity and remained unchanged from the period during which these analyses were made. If corrosion were occurring, the concentration of iron and other metals would be considerably higher.

*Example II*

This example describes the use of the present invention in the operation of a crude column following a preflashing system. The preflash crude is supplied to the crude column and separated therein at a pressure of 14 p.s.i.g. Steam is introduced to the crude column at a rate of 1000 pounds per hour. A naphtha overhead is removed at a rate of 9400 barrels per day and a temperature of 310° F. Ammonia is introduced into the upper portion of the crude column at a rate of 70 pounds per day and a corrosion inhibitor is introduced at a concentration of 30 parts per million based upon the overhead vapor. The overhead vapor is withdrawn at a temperature of 310° F. and then is cooled in a heat exchanger in which the overhead vapor is passed in indirect heat exchange with crude oil being changed to the process. In the heat exchanger, the overhead vapor is cooled to a temperature of 250° F. and then is further passed through two condensers and finally collected in the receiver at a temperature of 90° F. Prior to the use of the resue water, minor corrosion was observed in the heat exchanger. Accordingly, it has been decided to inject the reuse water ahead of the heat exchanger. The reuse water was continuously injected at a rate of 25 gallons per minute and the excess water was removed at a rate of 1000 pounds per hour. Here again, the withdrawal of water from the process corresponds to the amount of water introduced as steam to the crude column.

Prior to the continuous introduction of the reuse water in the manner described above, the service life of the carbon steel tubes in the heat exchanger was as short as three months. New carbon steel tubes were installed in the heat exchanger and the system was frequently checked for heat transfer coefficient. During the first 27 days of the run, reuse water was not injected and the heat transfer coefficient showed a sharp decline. Upon the continuous injection of reuse water, the decreased coefficient trend was halted and an increase in heat transfer coefficient was noted. After 75 days on stream, the exchanger was inspected and no evidence of scale or corrosion on the tubes was noted.

The effect of the reuse water also was observed by analyzing the receiver water for chlorine and iron. Without the injection of reuse water, the chlorine ($Cl^-$) concentration was 320 parts per million and the iron ($Fe^+$) concentration was 2.5 parts per million. However, after 96 hours of operation with the continuous injection of reuse water, the chlorine concentration in the water was 455 parts per million and the iron concentration in the water was less than 1 part per million. Accordingly, it is noted that more chlorine is removed from the system and practically no corrosion occurred as evidenced by the considerable decrease in the iron content of the water.

*Example III*

This example illustrates the use of the process of the present invention in the cooling of the hot reactor effluent in a desulfurization process. In the desulfurization process, a gasoline boiling fraction is heated to 750° F. and is passed at a pressure of 600 p.s.i.g. through a bed of catalyst comprising alumina-molybdenum sulfide-cobalt sulfide. The reactor effluent is withdrawn at a temperature of 650° to 675° F. Ammonia is injected in the reactor effluent and a corrosion inhibitor is injected downstream in this line. The corrosion inhibitor used in this example is $N^1,N^3$-dioctyl-diethylenetriamine. The reactor effluent is cooled in a first heat exchanger to a temperature of about 500–525° F. and then cooled in a second heat exchanger to a temperature of 300–350° F., following which the reactor effluent is further cooled in two successive condensers and then collected in a receiver. Fresh water is introduced between the second heat exchanger and the first condenser in an amount of about 2% by volume of the reactor effluent. Water separated from the receiver is reused by being recycled and injected between the second heat exchanger and the first condenser. The amount of reuse water injected at this point is about 8% by volume of the reactor effluent, while the excess water is removed from the process in an amount of about 2% by volume of the reactor effluent. It will be noted that the volume of water withdrawn from the process corresponds to the volume of fresh water supplied to the cooling and condensing system.

I claim as my invention:

1. A method of retarding corrosion of a heat exchanger being used to cool hot hydrocarbon vapors from a crude column containing nitrogenous salt, which comprises: conditioning the overhead vapors by injecting ammonia and then a corrosion inhibitor therein cooling and condensing said conditioned hydrocarbon vapors in the presence of water introduced as hereinafter described, separating water from hydrocarbon, and commingling at least a portion of said water with said hot hydrocarbon vapors prior to cooling same to the solidification temperature of said salt.

2. A method of retarding corrosion of at least one of a plurality of heat exchangers and condensers being used to cool hot hydrocarbon vapors from a crude column containing ammonium chloride, which comprises: conditioning the overhead vapors by injecting ammonia and then a corrosion inhibitor therein cooling and condensing said conditioned hydrocarbon vapors in the presence of water introduced as hereinafter described, collecting the condensed hydrocarbon effluent, separating water from hydrocarbon, and continuously injecting at least a portion of said water into said hot hydrocarbon vapors prior to the solidification of the ammonium chloride.

3. The process of claim 2 wherein said water is injected between two heat exchangers.

4. The process of claim 2 wherein said water is injected between a heat exchanger and a condenser.

5. A method of retarding corrosion of a heat exchanger and a condenser being used to cool overhead vapors from a crude column containing ammonium chloride, which comprises: conditioning the overhead vapors by injecting ammonia and then a corrosion inhibitor therein, said ammonia being present in a concentration sufficient to maintain the pH of the vapors within the range of from about 4.5 to 7.5, cooling and condensing said conditioned overhead vapors in the presence of water continuously introduced as hereinafter described, subsequently separating water from condensed hydrocarbon, and continuously injecting a portion of said water into said overhead vapors prior to the solidification of the ammonium chloride.



6. The process of claim 5 wherein said water is injected prior to entering said heat exchanger.

7. The process of claim 5 wherein said water is injected between said heat exchanger and said condenser.

8. The process of claim 5 wherein steam is injected into said crude column and a quantity of water corresponding to the quantity of steam injected into the crude column is continuously withdrawn from the process.

9. The method of claim 5 wherein a plurality of heat exchangers and condensers are used in the cooling and condensing of the hot effluent products, and the water is injected between two heat exchangers.

10. The method of claim 5 wherein a plurality of heat exchangers and condensers are used in the cooling and condensing of the hot effluent products, and the water is injected between the last heat exchanger and the first condenser.

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