

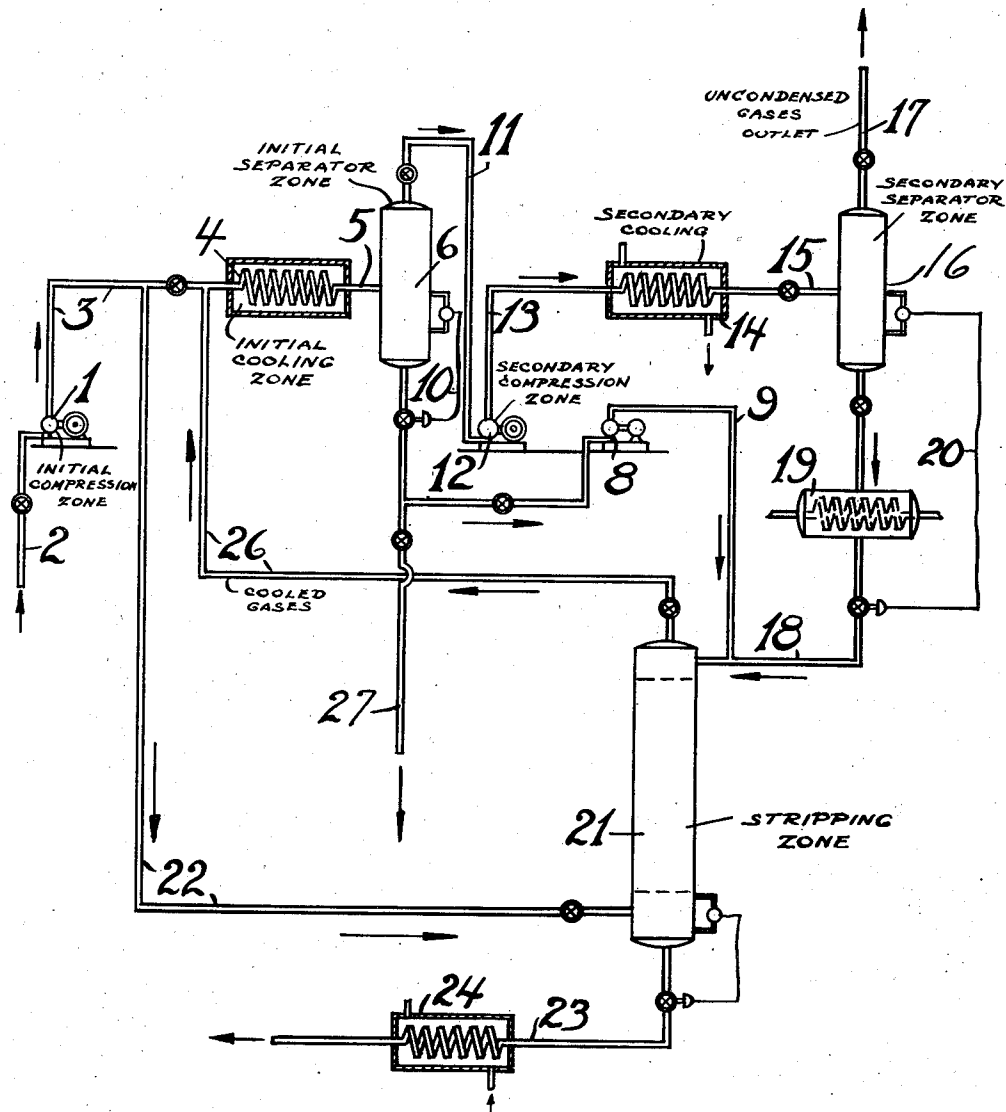
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REFINING PROCESS

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REFINING PROCESS

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The present invention is concerned with a process for the segregation and recovery of valuable hydrocarbon constituents from feed gas mixtures containing the same. The invention is more particularly directed to an improved process comprising compressing, cooling and stripping stages by which it is possible to efficiently and economically recover and segregate hydrocarbon constituents containing four or more carbon atoms in the molecule from normally gaseous hydrocarbon feed constituents containing the same.

In accordance with the present process, feed gases containing recoverable hydrocarbons, secured in the refining of petroleum oils, as for example from distillation, reforming, cracking or related refining operations, are compressed and the hot gases separated into primary and secondary feed gas streams. The primary feed gas stream is cooled and passed into an initial separation zone in which the liquid condensate is separated as a primary condensate from the uncondensed vapors. The uncondensed vapors are withdrawn from the initial separation zone, further compressed, cooled, and passed into a secondary separation zone. The liquid condensate from the secondary separation zone, and preferably at least a portion of the primary condensate, are combined and passed to a stripping zone in which the condensates countercurrently contact the secondary stream of hot feed gases. A stripped liquid hydrocarbon product substantially free of undesirable hydrocarbon constituents is withdrawn from the bottom of the stripping zone, while uncondensed gases are withdrawn overhead from the stripping zone and combined with the primary stream of hot feed gases passed to the initial cooling zone.

It is well-known in the art to segregate valuable hydrocarbon constituents which may be utilized in motor fuels from gases containing the same by various processes. For example, it is known to contact feed gases containing recoverable hydrocarbons which may be included in motor fuels and the like with various solid adsorbents which have a preferential selectivity for the valuable hydrocarbon constituents. The adsorbed hydrocarbons are recovered from the adsorbent usually by heating the same. The common practice, however, for the recovery of these hydrocarbon constituents is to countercurrently contact feed gases under various temperature and pressure conditions with an absorption oil. The rich absorption oil containing the dissolved hydrocarbons is withdrawn from the bottom of the

absorption zone and handled in a manner to remove and recover the absorbed hydrocarbons, which usually comprises distilling the same in a distillation zone of one or more stages. The absorption oil, free of the absorbed hydrocarbons, is usually recycled to the absorption tower. However, a process of this character requires rather extensive equipment and is not particularly adapted for the processing of feed gases in which the quantities of the feed gases are relatively low, or when the feed gases are derived in rather isolated areas where steam generation facilities are not available for reboiling. In accordance with my process, valuable hydrocarbon constituents may be readily and efficiently segregated from feed gases containing the same, utilizing a novel arrangement of compressing, cooling and stripping zones.

The process of my invention may be readily understood by reference to the attached drawing illustrating modifications of the same. For purposes of illustration, it is assumed that the feed gases comprise hydrocarbon constituents, having from one to seven carbon atoms in the molecule, and are derived from crude well separators. These gases are introduced into an initial compression zone 1 by means of feed line 2. These gases are compressed in zone 1 and are withdrawn by means of line 3. The hot compressed feed gas stream withdrawn from zone 1 is segregated into a primary feed gas stream, which stream is passed to initial cooling zone 4, and into a secondary feed gas stream which stream is removed by means of line 22. The primary stream passed into initial cooling zone 4 is withdrawn by means of line 5, and introduced into initial separation zone 6. Condensed liquid is withdrawn from initial separation zone 6 by means of pump 8 and line 9. The desired liquid level is maintained in initial separation zone 6 by means of a float control valve arrangement 10. Uncondensed vapors are removed overhead from initial separation zone 6 by means of line 11, passed to secondary compression zone 12, withdrawn from said latter zone by means of line 13, cooled in secondary cooling zone 14 and passed into secondary separation zone 16 by means of line 15. Uncondensed gases are withdrawn overhead from secondary separation zone 16 by means of line 17 and further refined or handled in any manner desirable. The liquid level of secondary separation zone is maintained at the desired height by means of a float-control valve arrangement 20. The liquid condensate is withdrawn from secondary separation zone 16 by

means of line 18, heated in heating zone 19 if desired, and combined with the liquid condensate withdrawn from initial separation zone 6. The combined condensates are introduced into stripping zone 21 in which they countercurrently contact the segregated secondary feed stream of hot compressed gases which is removed from initial compression zone 1 and segregated from said primary stream. These gases are introduced into the bottom section of stripping zone 21 by means of line 22. A liquid fraction substantially completely free of undesirable hydrocarbon constituents is removed from the bottom of stripping zone 21 by means of line 23, cooled in cooler 24 and withdrawn from the system by means of line 25. This product is substantially free of undesirable relatively low boiling constituents, is appreciably more stable than the condensates removed from the initial and secondary separation zones and thus may be incorporated in motor fuels or preferably employed as an intermediate feed stock for alkylation, isomerization or other allied processes. Uncondensed gases are withdrawn from stripping zone 21 by means of line 26 and mixed with the primary feed gas stream prior to cooling the same in initial cooling zone 4. Under certain conditions it may be desirable to withdraw at least a part of the condensate from the initial separation zone from the system by means of line 27.

The process of the present invention may be widely varied. The process may be adapted for the segregation of any particular hydrocarbon fraction desirable constituents from any feed gas containing the same. The process, however, is particularly adapted for the segregation of hydrocarbon constituents containing four or more carbon atoms from feed gases comprising hydrocarbon constituents containing one to seven carbon atoms in the molecule. The invention is especially adapted for the processing of gases of this character which are derived from crude oil well separators. It is, however, to be understood that the invention may be employed for treating feed gases derived from any refining, distilling, cracking, reforming or related operations. In general, it is preferred that the feed gases be compressed in the initial separation zone to a pressure in the range of about 200-400 lbs. per square inch, preferably to a pressure of about 260-320 lbs. per square inch. It is desirable that the temperature of the gases be raised to a temperature in the range from about 200° to 300° F., preferably to a temperature in the range from about 225° to 275° F.

The relative proportions of the primary and secondary feed gas streams may vary considerably depending upon the character of the feed gases and also upon general operating conditions. In general it is desirable that the secondary feed gas stream comprise at least 50% of the total feed gases. Particularly desirable results are secured when the secondary feed gas stream comprises at least 75% of the total feed gas.

The extent to which the primary feed gas stream is cooled in the initial cooling zone will vary considerably and will depend to a large extent upon the character of the feed gases. However, it is preferred that the primary gas stream be cooled in the initial cooling zone to a temperature below about 120° F., preferably to a temperature below about 100° F. In general, it is desired to condense approximately 5% to 25% by volume of the primary feed gas stream constituents.

The gases removed from the initial separation zone are compressed to a relatively high pressure in the general range from about 900 to about 1800 pounds per square inch. Particularly desirable results are secured when these gases are compressed to a pressure in the range above about 1500 pounds per square inch. The compressed gases are similarly cooled in the secondary cooling zone to a temperature below about 125° F., preferably to a temperature in the range from about 70° F. to 100° F. When operating without the stripping zone, a condensate is produced which contains a large percentage of hydrocarbons containing three or less carbon atoms in the molecule.

Although operating conditions in the stripping zone may be adjusted within relatively wide limits, it is preferred to maintain a pressure in the stripping zone in the range from about 190 pounds to 390 pounds per square inch and to maintain the temperature within said zone in the range from about 150° F. to 250° F.

In order to illustrate the invention further, the following example is given which should not be construed as limiting the invention in any manner whatsoever:

Feed gases comprising hydrocarbon constituents containing from one to seven carbon atoms in the molecule were compressed in an initial compression zone to about 265 pounds per square inch. The temperature of the compressed gases was about 203° F. These gases were segregated into a primary feed gas stream comprising about 25% of the total feed gases. This stream was cooled in an initial cooling zone to about 90° F. whereby the pressure of the same was reduced to about 230 pounds per square inch. The uncondensed vapors were separated from the condensate in an initial separation zone and were compressed to a pressure of about 940 pounds per square inch, whereby the temperature of the same was increased to about 200° F. These gases were cooled in the secondary cooling zone to a temperature of about 90° F., whereby the pressure of the gases was reduced to about 910 pounds per square inch. The liquid condensates from the initial separation zone and from the secondary separation zone were combined and introduced into the top of a stripping zone at a pressure of about 260 pounds per square inch. These condensates countercurrently contacted the remainder of the feed gases which had been segregated into a secondary feed gas stream in said stripping zone under conditions in which the temperature at the bottom of the stripping zone was maintained in the range from about 160° F. to 180° F.

	Feed gas to primary compression zone	Gas from secondary separation zone	Liquid product from stripper zone
	Mol %	Mol %	Mol %
C ₁	58.0	59.0	2.0
C ₂	18.0	18.0	
C ₃	18.0	18.6	9.0
IsoC ₄	2.4	1.5	23.0
NC ₄	3.4	2.2	32.0
C ₅	1.6	0.6	23.0
C ₆ +.....	0.6	0.1	11.0
	100.0	100.0	100.0
Volume..... per cent..	100	95.6	4.4

NOTE.—“C” with the sub-numeral represents the number of carbon atoms in the respective molecules.

From the above, it is apparent that unexpected

desirable results are secured by operating in accordance with the present invention.

What I claim as new and wish to protect by Letters Patent is:

1. Process for the removal and recovery of hydro-carbon constituents comprising at least four carbon atoms in the molecule from feed gases comprising hydrocarbon constituents containing less than four carbon atoms in the molecule, which comprises passing the feed gases through an initial compression zone, segregating the compressed gases without cooling into a primary feed gas stream and into a secondary feed gas stream, cooling said primary feed gas stream in an initial cooling zone, passing the mixture from said initial cooling zone into an initial separation zone wherein a separation is made between uncondensed vapors and the liquid condensate, passing said uncondensed vapors into a secondary compression zone, followed by cooling the same in a secondary cooling zone, passing the mixture from said secondary cooling zone into a secondary separation zone wherein a separation is made between uncondensed vapors and a liquid condensate, combining the condensates from said initial separation zone and said secondary separation zone and countercurrently contacting these condensates with said secondary feed gas stream in a stripping zone under conditions to withdraw as a liquid bottoms from said stripping zone a liquid product substantially free of undesirable hydrocarbon constituents.

2. Process as defined by claim 1, in which said compressed feed gases withdrawn from said initial compression zone are segregated into a primary feed gas stream comprising about 25% of the total volume of feed gases and into a secondary feed gas stream comprising about 75% of the total feed gases.

3. Process for the recovery and segregation of

hydrocarbon constituents containing three or more carbon atoms in the molecule from feed gases containing the same, comprising hydrocarbon constituents containing from one to seven carbon atoms in the molecule, which comprises compressing the feed gases in an initial compression zone to a pressure in the range from about 200 to about 400 pounds per square inch, segregating said compressed gases into a primary feed gas stream and into a secondary feed gas stream, cooling said primary feed gas stream to a temperature below about 125° F., separating a liquid condensate from uncondensed vapors in an initial separation zone, compressing said uncondensed vapors from said initial separation zone in a secondary compression zone to a pressure in the range above 900 pounds per square inch, cooling said compressed gases removed from said secondary compression zone in a secondary cooling zone, and separating a liquid condensate from uncondensed vapors in a secondary separation zone, combining the condensates removed from the initial separation zone and the secondary separation zone, and countercurrently contacting the condensates with said secondary feed gas stream in a stripping zone at a pressure of above about 190 pounds per square inch and at a temperature above about 150° F., whereby a bottoms stream is removed from said stripping zone which is substantially free of hydrocarbon constituents containing less than two carbon atoms in the molecule.

4. Process as defined by claim 3, in which said compressed feed gases withdrawn from said initial compression zone are segregated into a primary feed gas stream comprising about 25% of the total volume of feed gases and into a secondary feed gas stream comprising about 75% of the total feed gases.

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