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METHOD FOR VAPORIZING DRIPOLENE

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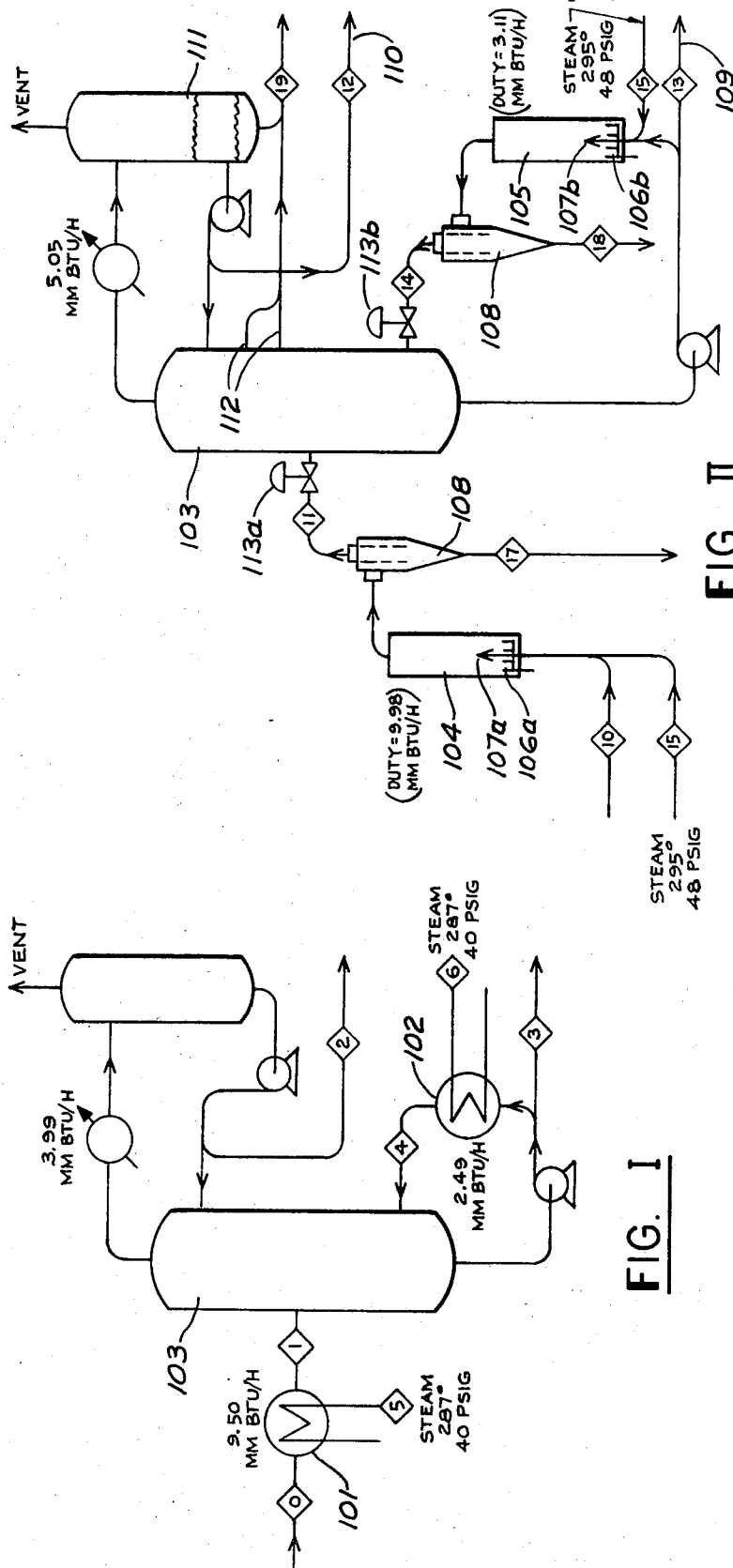


FIG. II

TEMPERATURES AND FLOW RATES OF STREAMS

	①	②	③	④	⑤	⑥	⑩	⑫	⑬	⑭	⑮	⑯	⑰	⑱	①	①①
° F	50	149	244	249	287	287	50	146	240	285	255	295	255	146	225	220
H ₂ O L	100 000	18 570	81 430	31 000			100 000	50	270	1 350	75	2 344	12 135	1 371	91 950	665
H ₂ O V				363				18 565	81 413	101 800	1 192	5	15	2	99 985	
HC V					10 300	2 700										
TOT V				16 700	215						12 800	3 370			8 050	
TOT L & V	100 000	18 570	81 430	47 700	10 300	2 700	100 000	18 615	81 683	103 150	12 800	3 370	12 150	2 349	80 50	100 650

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METHOD FOR VAPORIZING DRIPOLENE

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9 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure teaches a method for heating unstable hydrocarbons, and more particularly dripolene, a liquid byproduct of hydrocarbon cracking processes. The hydrocarbon is contacted directly with steam (preferably injected in a dispersed form and at high velocity via a sparger), and is maintained at a pressure sufficient for condensing the steam for preventing vaporization of the hydrocarbon. Condensate is then separated from the hydrocarbon.

BACKGROUND OF INVENTION

This invention relates to heating unstable hydrocarbons. By way of example it will be applied to heating dripolene, a liquid byproduct of hydrocarbon cracking processes, but it should be understood that this dripolene application is intended to be illustrative and that the invention can be applied to heating other similar unstable hydrocarbons or cracked hydrocarbons or readily polymerizable substances such as polymer precursors (vinyl chloride, styrene, cyclopentadiene, etc.). In hydrocarbon pyrolysis processes, heating dripolene with conventional indirect heat-transfer equipment presents severe operating difficulties. Dripolene, like other substances here contemplated, contains large concentrations of conjugated diolefins as well as other highly reactive compounds which polymerize readily onto heating surfaces, even at moderate temperatures. Similar, though less severe, difficulties arise in heating cracked liquid fractions.

SUMMARY OF INVENTION

This invention solves the foregoing problem of heating highly unstable substances in a particularly novel and facile way. It is here proposed to heat such substances (exemplified by dripolene) without the use of heat-transfer surfaces. The liquid is contacted with steam. This operation is conducted at a pressure sufficient to insure little (if any) vaporization of the dripolene and substantially complete condensation of the steam. When it is desired to heat and partially vaporize the dripolene stream, that stream is first heated by directly contacting it with finely dispersed steam (without substantial vaporization) to a temperature above the desired terminal temperature. The dripolene is then flashed to the desired terminal temperature and degree of vaporization.

One object of this invention is to heat highly unstable hydrocarbons with minimal fouling of heat-transfer equipment.

A further object is to simplify plant maintenance.

A further object is to conserve product by eliminating undesired polymerization.

DRAWING AND EXAMPLE

The foregoing and other objects will appear more fully from the accompanying drawing which represents operation of a fractionating tower designed to depentanize a dripolene feed. Feed rate is 1000,000 lb./h. raw dripolene having a diene value of 50 and a gum content of 80 mg./100 ml.

FIG. I illustrates conventional operation, using a tubular surface feed heater 101 and a reboiler 102. Operat-

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ing heater 101 with 40 p.s.i.g. steam, it is necessary to install a spare heater and to clean these heaters 101 after every 5 to 7 days of operation in order to sustain acceptable on-stream efficiencies. Added to the capital cost involved in the installation of the spare heater is the weekly maintenance. Also tower 103 operation entails frequent adjustments as the heat-transfer surfaces of heaters 101 and 102 gradually foul.

FIG. II depicts the same tower 103 as that of FIG. I operating with direct-contact steam heating of the feed in apparatus 104 and of the reboiler stream in apparatus 105.

The duties of the various heaters and condensers are shown in the figures. Temperatures and flow rates of the streams are tabulated below the figures. This tabulation along with FIG. II serves as an example of the present invention.

PREFERRED EMBODIMENT

Various equipment can be selected for the practice of this invention. Intimate admixture of dripolene with steam can be achieved in a small packed column or with venturi or mechanically operating mixers; but in general, a cheap, convenient method is to inject steam through fine spargers 106A and 106B into the dripolene streams 107A and 107B in heaters 104 and 105 respectively as shown in FIG. II. Separation of the dripolene from water condensate is essential to proper operation and can be effected by use of conventional phase separators. An advantageous method for effecting this separation is by use of hydroclones 108 in conjunction with coalescers.

When heating dripolene (or some other highly unstable substance), some mutual solubility between the dripolene and water condensate is experienced. This mutual solubility results in introduction of a little water into dripolene streams 107A and 107B. In operating the heating method here described in connection with tower 103, introduction of water causes an increase in overhead condenser and reboiler duties. However, since mutual solubilities are quite low (below 400° F.), the above-noted effects are minor. For conventional operation per FIG. I, tower 103 operates at a top pressure of 40 p.s.i.a.: This increases to 43.9 p.s.i.a. with the direct-contact, steam-heated operation of FIG. II due to the above-noted slight solubility of water in dripolene streams 107A and 107B. Part of the dissolved water leaves in bottoms 109 and overhead 110 streams; but most of the dissolved water is removed from the overhead phase separator drum 111 and from a few top trays 112.

Note that feedstream 107A, which is available at 40 p.s.i.g., does not require additional pumping, but towers bottoms 107B must be pumped to at least 48 p.s.i.g. before admission to the contacting device 105. The heated liquid streams, after separation from the steam condensate in hydroclones 108, are depressurized through pressure control valves 113A and 113B to a pressure slightly in excess of tower pressure. The depressurized streams are thereby partially vaporized upon injection into tower 103. Reboiler stream 107B temperature is increased until sensible heat due to permissible or desired temperature rise is sufficient to satisfy tower 103 heat-balance requirements. In general the balance between liquid circulation through direct-contact, steam-heated reboiler 105, and the temperature rise of the liquid is determined by instability of the stream (limiting the permissible temperature rise), pressure of the available steam supply, and considerations of economy.

With direct-contact, steam-heated operation of FIG. II, tower 103 as well as heaters 104 and 105 can be operated for periods of months without significant loss of operating efficiency. Even then, the principal fouling is found in pressure regulating valves 113A and 113B which

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can be provided with spares at low cost. Although dissolution of water is found to increase heat requirement a little (less than 10% in this case) the net gain in lower equipment and maintenance costs provide savings much greater than the utilities penalty. Furthermore tower operation is freed of frequent interruptions and adjustments.

It will be apparent to those familiar with tower design and/or heat transfer that wide deviations may be made from the main theme of invention set forth in the following claims.

What is claimed is:

1. A method for heating a highly unstable hydrocarbon and consisting essentially of the steps of:

contacting the hydrocarbon directly with steam, maintaining a pressure sufficient for substantially preventing vaporization of the hydrocarbon and substantially completely condensing the steam,

separating the condensate from the hydrocarbon.

2. The method of claim 1 wherein the steam is finely dispersed for contacting the hydrocarbon.

3. The method of claim 2 with dripolene as the hydrocarbon.

4. The method of claim 3 and after separating the condensate from the hydrocarbon reducing the pressure on the hydrocarbon and flashing prior to subsequent processing.

5. A method for heating and partially vaporizing a highly unstable hydrocarbon to reach desired terminal temperature and vaporization conditions, the method consisting essentially of the steps of:

contacting the hydrocarbon directly with finely dispersed steam to reach a temperature above the desired terminal temperature,

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maintaining a pressure sufficient for preventing vaporization of the hydrocarbon and for essentially complete condensation of the steam,

separating the steam condensate from the hydrocarbon, flashing the hydrocarbon to the desired terminal temperature and degree of vaporization.

6. The method of claim 5 with dripolene as the hydrocarbon.

7. The method of claim 6 in which the steam and dripolene are intimately mixed.

8. The method of claim 6 with the desired terminal temperature below 400° F.

9. The method of claim 7 and injecting the steam into the dripolene via a sparger.

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