

[54] **QUENCH PROCESS**

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[58] Field of Search **260/683, 679; 208/48; 23/277**

[56] **References Cited**

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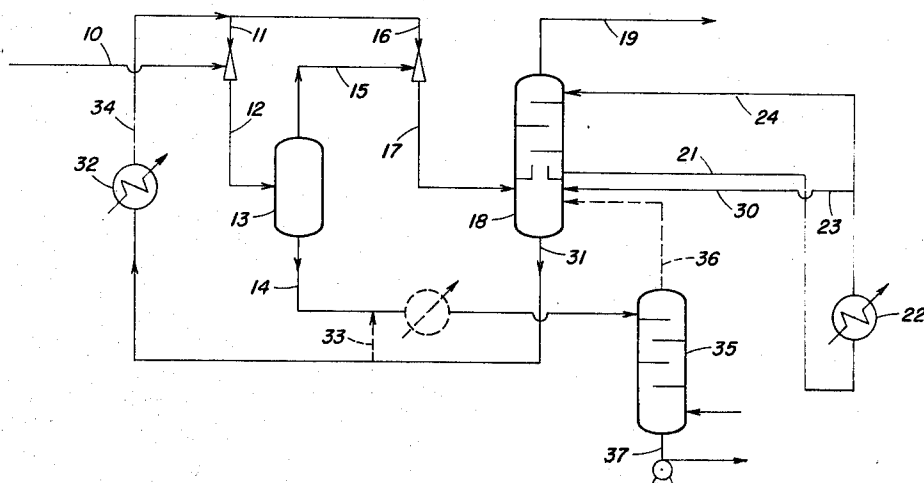
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[57] **ABSTRACT**

A quench process wherein an effluent from a high temperature process, such as, the pyrolysis of hydrocarbons, is contacted with a hydrocarbon quench oil having upper and lower cut points somewhere within the range between 500° and 1,000° F. (converted to one atmosphere) to rapidly cool the effluent to a temperature at which side reactions are minimized, the quench oil being partially vaporized as a result of such contacting. A mixture of the effluent and vaporized quench oil is then contacted with a quench oil having cut points within the above described range to effect cooling thereof to a temperature at which the vaporized quench oil is condensed, the temperature being a temperature no less than 400° F. in order to effect recovery thereof at a temperature sufficient to generate usable steam. The quench oil is then passed through a waste heat boiler to effect cooling thereof and generation of high pressure steam, with the cooled quench oil being recycled to the quench operation.

1 Claim, 2 Drawing Figures



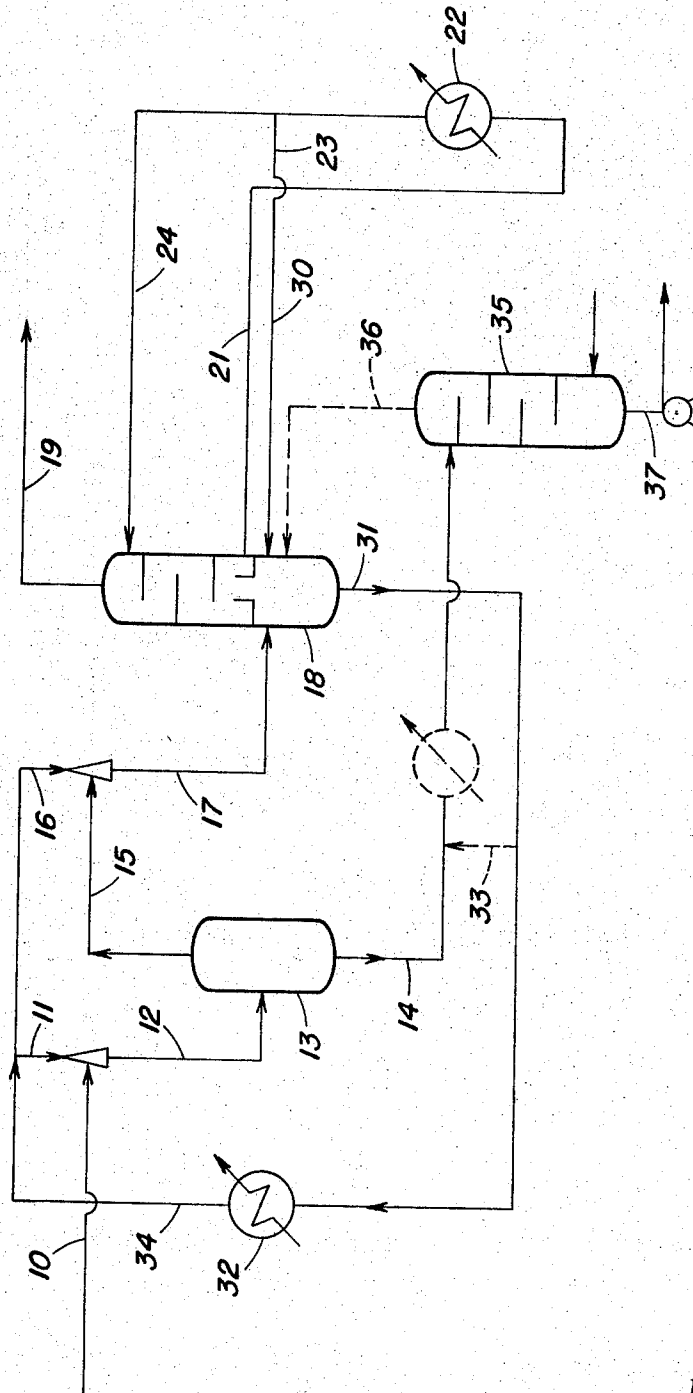


Fig. 1.

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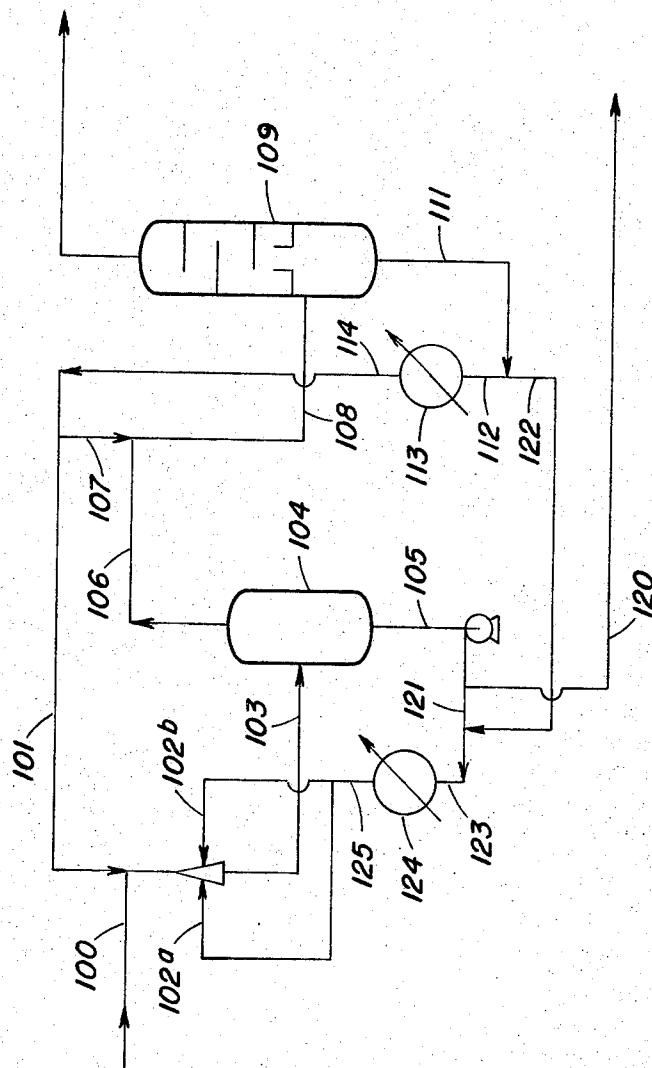


Fig. 2.

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QUENCH PROCESS

This invention relates to a quench system and more particularly to an oil quench system for rapidly reducing the temperature of an effluent from a high temperature process.

In numerous high temperature operations, such as the pyrolysis of hydrocarbons, the reaction effluent must be rapidly cooled in order to prevent undesired side reactions, such as, coking, polymerization, etc. In general, such rapid cooling is effected by either indirect or direct heat transfer. In an indirect heat transfer process employing quench coolers, difficulties are encountered as a result of fouling, coke deposits and the like, caused by the unstable nature of the reaction products. In a direct heat transfer process, the effluent is directly contacted with a quench liquid, either a hydrocarbon oil or water, to effect the rapid cooling and the quench liquid separated from the effluent. The quench liquid is then cooled and recycled to the quench step. Although the direct quench processes are effective for rapid cooling of the effluent, the heat recoveries in such processes are poor, mainly due to the relatively low temperatures which must be employed to separate the quench liquid from the reaction products.

Accordingly, an object of this invention is to provide a new and improved process for effecting quenching of an effluent from a high temperature process.

Another object of this invention is to provide a new and improved process for effecting direct quenching of an effluent with a hydrocarbon quench oil.

A further object is to provide a quench oil system having improved heat recovery.

Yet another object of this invention is to provide a process for quenching an effluent from a high temperature process wherein the heat removed from the effluent may be employed to generate usable steam.

These and other objects of the invention should become apparent from the following detailed description thereof when read with reference to the accompanying drawing wherein:

FIG. 1 is a simplified schematic flow diagram of an embodiment of the invention; and

FIG. 2 is a simplified schematic flow diagram of another embodiment of the invention.

The objects of this invention are broadly accomplished by quenching an effluent from a high temperature process with a hydrocarbon quench oil having upper and lower cut points falling somewhere within the range between about 500° F. and about 1,000° F. (converted to 1 atmosphere). The quench oil is added to the effluent in two stages, the first stage being operated at a temperature and pressure such that the effluent is cooled to a temperature at which both side reactions are minimized and the quench oil is at least partially vaporized. The effluent, now containing vaporized quench oil, is then contacted with additional quench oil, in a second stage, the second stage being operated at a temperature and pressure such that substantially all of the vaporized quench liquid is condensed. The quench liquid is separated from the effluent at a temperature and pressure sufficient to generate steam at a pressure high enough for economic use and then passed through a waste heat boiler to thereby generate such steam and cool the quench liquid for recycle to the quenching operation.

The quench oil, as hereinabove noted, has cut points falling within the range between about 500° F. and about 1,000° F. and it is to be understood that this term includes quench liquids having a boiling range between about 500° F. and about 1,000° F., as well as liquids having boiling ranges within this range. Thus, for example, a preferred quench liquid has a boiling range between about 700° and about 800° F.

The first stage quenching, as hereinabove noted, is operated as a "vaporizing quench" step. Thus, the reaction effluent is cooled by the vaporizing quench oil to a temperature at which undesired side reactions are minimal and, therefore, it should be apparent that the upper cut point of the quench oil is related to the temperature to which the reaction effluent is to be cooled in the first stage. Similarly, the quantity and tempera-

ture of the quench oil mixed with the effluent in the first stage are at values sufficient to effect rapid cooling to the desired temperature. In general, the high temperature effluent is at a temperature from about 1,200° F. to about 1,700° F. and the temperature thereof is reduced to from about 500° F. to about 800° F. by the first stage quenching.

The second stage, involving the recovery of vaporized quench oil, is effected with a quench oil in a quantity and at a temperature sufficient to reduce the temperature of the combined effluent-vaporized quench oil stream to a temperature at which the quench oil is condensed to effect recovery thereof. The quenching temperature in the second stage should not be at a temperature at which usable steam can not be generated by indirect heat transfer with the recovered quench oil and, therefore, the second stage quenching is effected at temperatures no lower than 400° F. and generally at temperatures from 450° - 500° F.

The invention will now be further described with reference embodiments thereof illustrated in the accompanying drawings and it is to be understood that the scope of the invention is not to be limited thereby. It is also to be understood that equipments such as pumps, valves, and the like have been omitted from the drawing to facilitate the description thereof and the use of such equipments at appropriate places is deemed to be within the scope of those skilled in the art.

Referring now to the drawing, an effluent from a high temperature process, for example, a hydrocarbon effluent from a pyrolysis zone employed to produce ethylene from naphtha or a gas oil in line 10 is admixed with a quench oil in line 11, the quench oil being at a temperature sufficient to effect rapid cooling of the effluent. The quench oil in line 11 is of the type hereinabove described; i.e., a vaporizable, narrow boiling fraction (cut points within the range between 500° F. to about 1,000° F.). As a result of the contact between the quench oil and the effluent in line 12, the quench oil is partially vaporized and the higher boiling unstable constituents contained in the effluents are condensed.

The mixture of hydrocarbon effluent and quench oil in line 12 is introduced into a separator 13 and the liquid, containing the residual products of the effluent stream and any unvaporized quench oil, is withdrawn therefrom through line 14. A gaseous stream, now containing vaporized quench oil, is withdrawn from the separator 13 through line 15, combined with additional quench oil in line 16 and the combined stream in line 17 introduced into a fractionator 18. The quench oil in line 16 is introduced at a rate such that the combined stream in line 17 is at a temperature at which substantially all of the quench oil in the gaseous effluent in line 15 is condensed, this temperature, as hereinabove noted, generally being no less than about 400° F.

The fractionator 18 is operated at temperature and pressure conditions to recover a quench oil bottoms and a gasoline and lighter components overhead, the overhead being withdrawn through line 19. The fractionator 18 is provided with reflux by withdrawing liquid therefrom through line 21 which is cooled in cooler 22 and returned to the fractionator 19 through lines 23 and 24 to effect further cooling and condensation of remaining vaporized quench oil.

The quench oil at an elevated temperature is withdrawn from the fractionator 18 through line 31 and passed through a waste heat boiler 32 wherein steam is generated; e.g., in the order of 100 to 400 psig steam. A portion of the quench oil in line 31 may be passed through line 33 and combined with the residual products in line 14, to effect cleansing of the oil. The cooled quench oil is withdrawn from waste heat boiler 32 through line 34 and passed through lines 11 and 16 as hereinabove described.

The liquid, containing residual products, in line 14 is introduced into a stripper 35, operating at a temperature and pressure to produce an overhead fraction within the boiling range of the quench oil. The overhead fraction is withdrawn from the stripper 35 through line 36 and combined with the quench oil; e.g., in the fractionation to supply make-up

quench oil for the system. A bottoms is withdrawn from stripper 35 through lines 37 and may be employed as a fuel oil.

The hereinabove described process may be modified in numerous ways within the spirit and scope of the invention. Thus, for example, quench oils having different cut points, both falling within the hereinabove noted range (500°–1,000° F.), may be employed in the two stages, instead of an identical quench oil being used in both stages, as specifically described with reference to the embodiment illustrated in the drawing. As another modification, make-up quench oil may be supplied from an extraneous source, or from the net produced effluent, instead of by stripping the fuel oil fraction. As a further modification, heat recovery from the quench oil may be effected in a manner other than by generating high pressure steam, although steam generation is preferred.

Still another embodiment of the overall invention is illustrated in FIG. 2 which differs from the embodiment of FIG. 1 in the use of a two-stage primary quench. Referring now to FIG. 2, an effluent from a high temperature process, for example an effluent from a pyrolysis furnace, in line 100 is admixed with quench oil in line 101 and further admixed with quench oil in lines 102a and 102b to effect rapid cooling of the effluent. The quench oil in line 101 is a vaporizable quench oil, as hereinafter described, and the quench oil in lines 102a and 102b is a partially vaporizable quench oil, as hereinafter described.

The mixture of effluent and quench oil in line 103 is introduced into a separator 104 and a liquid, containing residual products of the effluent stream and any unvaporized quench oil, is withdrawn therefrom through line 105. A gaseous stream, containing vaporized quench oil, is withdrawn from the separator 104 through line 106, combined with quench oil in line 107, as hereinafter described, and the combined stream in line 108 introduced into a fractionator 109. The quench oil in line 107 is introduced at a rate such that the combined stream in 108 is at a temperature at which substantially all of the quench oil in the gaseous effluent in line 108 is condensed, generally a temperature no less than about 400° F.

The fractionator 109 is operated as the fractionator described with reference to the embodiment of FIG. 1 to produce a quench oil bottoms, having cut points within the range from about 500° F. to about 1,000° F.

A portion of the quench oil bottoms withdrawn from fractionator 109 through line 111 is passed through line 112 and waste heat boiler 113 to both effect cooling thereof and generate usable steam. The cooled quench oil from waste heat boiler 113 in line 114 is passed through lines 101 and 107 to provide the vaporizable quench oil for the primary quenching and the quench oil for the secondary quenching, respectively.

A portion of the liquid fraction withdrawn from separator 104 through line 105 is passed through line 120 to further processing, for example a fuel oil stripper as described with reference to the embodiment of FIG. 1, and the remaining portion thereof in line 121 is combined with a portion of the quench oil bottoms from fractionator 109 in line 122. The portion of the liquid withdrawn for further processing through line 120 is net product recovered from the effluent and the respective portions of the heavy material in line 121 condensed during the primary quenching and the quench oil in line 122 are selected to provide a mixture in line 123 having the desired flow properties.

The mixture in line 123 is passed through waste heat boiler 124 to both cool the mixture and generate steam and the cooled mixture in line 125 is passed through lines 102a and 102b as the partially vaporizing quench oil for the primary quenching. In general, the primary quenching is operated in a manner whereby the vaporizing quench oil in line 101 provides from about 10 percent to about 40 percent, preferably from about 15 percent to about 35 percent, of the total quenching requirements.

The above modifications and numerous other modifications should be apparent to those skilled in the art from the teachings contained herein.

The following example is illustrative of the invention but the scope of the invention is not to be limited thereby.

EXAMPLE

An ethylene containing effluent from a pyrolysis furnace at a temperature of 1,450° F. is quenched with a hydrocarbon quench oil having upper and lower cut points of about 525° and 680° F., respectively, under the conditions tabulated below.

Line	Temp. °F.	Flow Rate (lbs./hr.)
10	1450°F.	13,700
11	360	34,800
12	570	48,500
14	570	675
15	570	47,825
16	360	22,000
17	480	69,825
19	290	13,025
21	480	56,800

Under the above conditions, about 5,700 lbs./hr. of 120 psig. steam is generated in waste heat boiler 32.

The process of this invention is suitable for quenching an effluent from a wide variety of high temperature processes, including: the pyrolysis of hydrocarbons to produce, ethylene, propylene, acetylene and the like; gasification of hydrocarbons; partial oxidation of hydrocarbons; and the like. The process has numerous advantages over those heretofore employed in the art, with the primary advantages being the excellent heat recovery and the elimination of the deposition of tar and the like as a result of the use of a narrow boiling fraction.

Numerous modifications and variations of the invention are possible in light of the above teachings and, therefore, it is to be understood that the invention may be practiced otherwise than as particularly described.

What is claimed is:

1. A process for quenching an effluent from a high temperature process by direct contact with a hydrocarbon quench oil, comprising:

- contacting the hydrocarbon effluent with a liquid quench oil from hereinafter step (f) to effect a first stage cooling thereof, said quench oil having upper and lower cut points falling within the range from about 500° F. to about 1,000° F., converted to 1 atmosphere, the combined stream after said contacting being at a temperature at which a first portion of the liquid quench oil is vaporized quench oil and a second portion is liquid quench oil;
- recovering said second portion of liquid quench oil;
- contacting the effluent and said first portion of vapor quench oil from step (b) with a liquid quench oil having upper and lower cut points falling within the range from about 500° F. to about 1,000° F. converted to one atmosphere, obtained from hereinafter step (e) to further cool said effluent, the temperature of the combined stream after the contacting being at a temperature at which substantially all of the quench oil is in the liquid phase, said temperature being a temperature no less than about 400° F.;
- recovering the liquid quench oil from step (c);
- passing a portion of the quench oil from step (d) as liquid quench oil to step (c); and
- cooling and passing both liquid quench oil from step (b) and another portion of the liquid quench oil from step (d) as liquid quench oil to step (a).

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