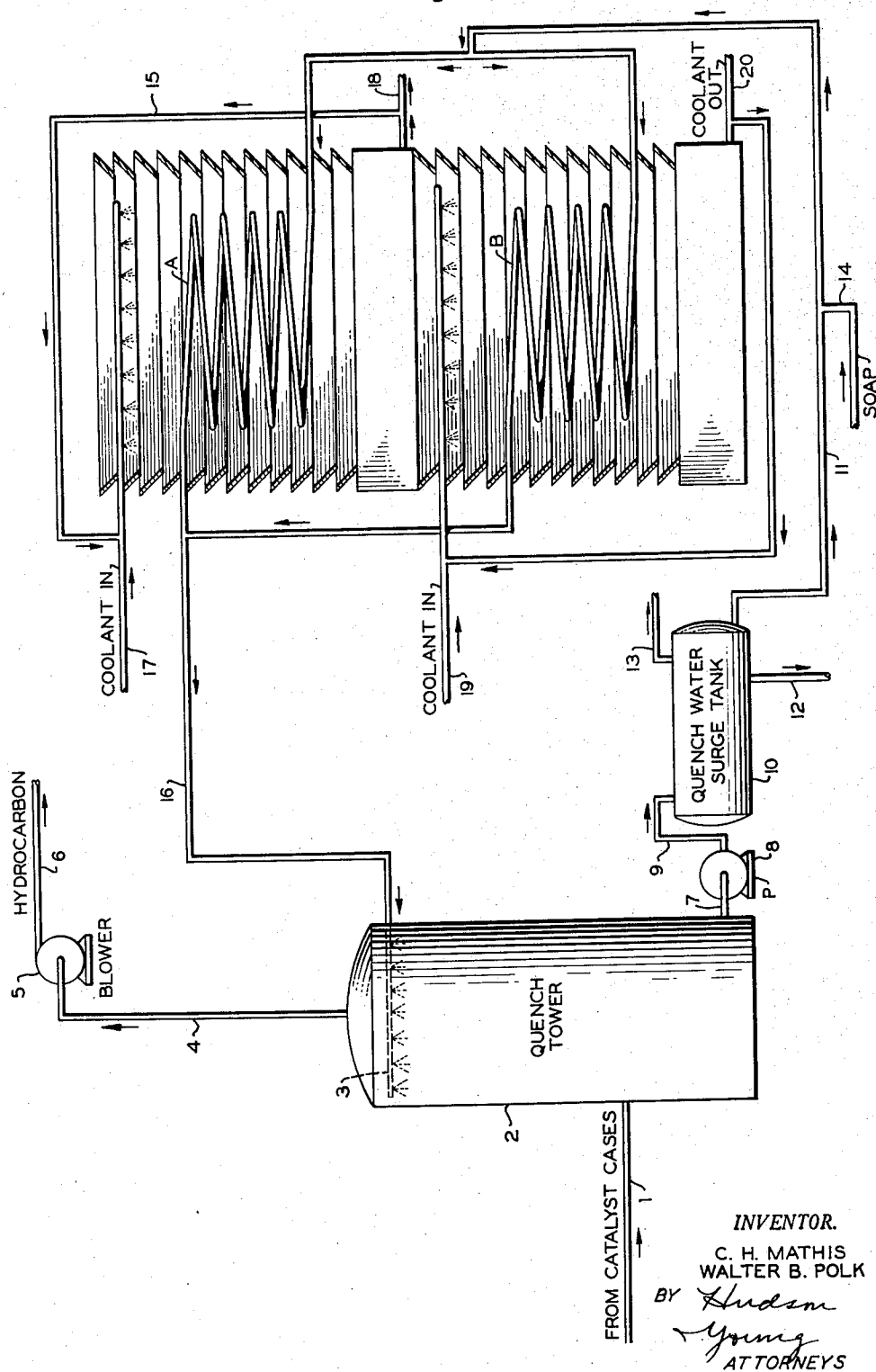


March 17, 1959

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IMPROVED QUENCHING METHOD

2,877,866

Filed Aug. 26, 1954



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IMPROVED QUENCHING METHOD

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Application August 26, 1954, Serial No. 452,412

11 Claims. (Cl. 183—120)

This invention relates to an inhibited quench adapted to improved quench of hot reacted material. In one of its aspects, the invention relates to an improved hydrocarbon quenching operation comprising the contacting of a hydrocarbon stream with a solution of a quenching fluid and a surface-active agent to obtain improved quenching and to avoid deposition of materials from the hydrocarbon, or formed therein during the quenching operation, in apparatus employed to handle the quenching solution, for example, a cooler. In another aspect of the invention, it relates to a quenching operation in which such a solution is circulated through a cooler to cool the same and wherein periodically the flow of coolant to the cooler is discontinued to allow the uncooled or hot quenching solution of the invention to pass therethrough to clean the surfaces with which said solution comes into contact. Still another aspect of the invention is the provision of a closed quench solution circulation which is self-cleaning and which, therefore, need not be opened, thus keeping oxygen or air from entering into the system.

Other aspects, the objects and advantages of the invention are apparent from this disclosure, the drawing, and the appended claims to the invention.

It has been found that the addition of a surface-active or surface tension reducing agent to a quench, consisting essentially of water, and the use of said quench to quench a hydrocarbon stream such as vapors from a butane dehydrogenation unit results in cleaner heat exchangers, employed to cool the quench water before reuse thereof, as well as in better heat transfer in said cooler due to better wetting of the cleaner surfaces of said cooler. Specifically, in one instance of operation, the addition of approximately 25 pounds of sodium stearate per day to 40,000 gallons of quench water circulated at 1,200 to 1,500 gallons per minute, reduced the surface tension to about 50 dynes per centimeter and resulted in the advantages above set out in lieu of the sodium stearate, potassium stearate could have been, and can be, used.

According to the invention, there is provided an improved method of quenching hot reacted or converted materials which comprises contacting the same with a quench liquid which contains a suitable surface-active agent, thereby preventing substantially the deposition of polymers or other by-products in the system employed for handling and cooling said quench liquid.

Also according to the invention, periodically the flow of the quench liquid of the invention is continued while coolant to the quench liquid cooling zone is discontinued, thereby to aid the quench liquid of the invention to clean the surfaces of said zone without entry of oxygen or air into the system which is thus maintained closed.

The use of a quenching agent or liquid according to the present invention possesses the advantage that slugs or dispersed droplets of reacted materials are better and more rapidly contacted with the quench liquid and rapidly reduced in temperature, thus avoiding side-reactions or undesired reactions which otherwise might continue within

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said droplets until said droplets are otherwise thoroughly admixed or otherwise dissolved in the quench liquid. Of course, if the reacted material being quenched is a liquid, then the advantage here is all the more important, more especially if the material is non-miscible, ordinarily, with the quench liquid, e. g., an organic material and a water quench.

The surface-active agents which can be employed in any given instance can be determined by mere routine test by one skilled in the art and in possession of this disclosure. It is of advantage in a preferred form of the invention to employ wetting agents which, as employed, cause little or no foaming. Anti-foaming agents can also be employed in another preferred form of the invention. Triton X-45 (oil-soluble alkylaryl polyether alcohol) and Triton X-155 (water-soluble alkylaryl polyether alcohol) have been successfully employed as surface-active agents in the operations of the invention. Soaps can also be used as indicated. It is advisable to use either softened water or steam condensate in the quench system, since hard water will form a curd if fatty acid soaps are used. If it is found advisable to use water containing a degree of hardness, it is better to use synthetic detergents than to use the fatty acid soaps. The synthetic detergents do not form curds like the fatty acid soap forms. Any curds which form will have a tendency to deposit throughout the circulation system on the surface of the equipment. Synthetic detergents may be used when softened water or condensate is used as the quench.

The drawing shows an embodiment of the invention in which a hydrocarbon stream, in the instance described a dehydrogenated butane stream, is quenched in a tower disposed in a quench circulation system comprising a pump, a quench solution surge tank, cooling coils, etc., all shown diagrammatically.

Referring now to the drawing, hydrocarbon effluent from a catalytic dehydrogenation of butane enters the system through conduit 1. The effluent is fed into an intermediate portion of quench tower 2 which is provided with spray means 3 through which there is introduced a cooled quench solution. In this instance, the quenching solution was water containing sodium or potassium stearate. Quenched hydrocarbon vapors are removed overhead by way of conduit 4 and hydrocarbon blower 5 and passed by way of conduit 6 to cooling towers not shown. Hot quenching solution, containing some dissolved hydrocarbons and small quantities of polymerized materials is removed from tower 2 by way of conduit 7, pump 8, and conduit 9 into quench water surge tank 10. In the quench water surge tank 10, phase separation of heavy particles such as tarry constituents is encouraged. However, it is not possible to remove all of tarry or other contaminating constituents which tend to clog the cooling coils to which the quenching solution is passed by way of conduit 11. Thus, while some tarry material or other contaminating substances can be removed by way of conduit 12 from surge tank 10, not all such materials can be removed from the quench solution. Any vapors formed in quench water surge tank 10 are taken overhead therefrom by way of conduit 13. Soap, or other suitable surface-active agent, is introduced by way of conduit 14 into conduit 11 and the solution is passed to at least one of the coils A and B in cooling tower 15. From coils A and B, the cooled quenching solution is passed by way of conduit 16 to spray means 3. Coolant for indirect cooling of the quenching solution in tower 15 is introduced by way of conduit 17 and removed from tower 15 by way of conduit 18. Also, coolant can be introduced by way of conduit 19 and removed from tower 15 by way of conduit 20. By means of the arrangement described, coils A and B can be used simultaneously or successively. Thus, as above described, one of the

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coils can be allowed to warm by discontinuing flow of coolant thereover, thus to at least periodically, aid the quenching solution in cleaning the same of any deposited materials. Such deposited materials ultimately can be caused to settle out in quench water surge tank 10 and removed from the system by way of conduit 12. Though not shown, it is possible to interpose in the circulation system of a filter means to remove filterable particles from the quenching solution.

According to the invention, the heat transfer in the cooling coils is improved, as discussed. Since it is desirable to operate the quench tower with the lowest temperature water which it is practical to obtain and since, the lower the temperature of the effluent hydrocarbon stream passing from the quench tower the lower will be the volume of the hydrocarbons and, therefore, of vaporized water removed from the quench tower therewith, the lower will be the horsepower required to compress this effluent. This is a significant and a very important advantage of the invention.

While the invention has been set forth diagrammatically some accessory equipment such as pumps has been shown. However, it is clear that other equipment may be necessary in any given instance for the execution of the invention in connection with any particular reacted stream of material to be quenched. One skilled in the art will be able to supply the necessary pieces of equipment and conditions required. Thus, it is evident from a study of the foregoing disclosure that valves for regulating flows, thermometers, or thermocouples for measuring temperatures, etc. have been omitted for sake of simplicity.

In operating a process such as that illustrated in the drawing, without the addition of soap to the system, the coils gradually became plugged. Some of the tubes in the coils became plugged faster than others. The degree of plugging in the tubes could be visually inspected by removing metal plugs from the tubes. After the coils were in operation about two years, it was necessary to clean them and remove the deposited polymers from the lines throughout the system. This costs about \$200 per coil and there are 46 coils. When the system had become fouled with polymerized oily material to the extent that it was necessary to clean the coils and remove the polymers from the system, about 75 pounds of soap were added per day for three days. The surface tension of the water in the system was reduced and maintained at about 50 dynes per centimeter. About 25 pounds of soap per day was required to maintain the water in the system with a surface tension of about 50 dynes per centimeter.

The polymerized oily material is withdrawn from the surge tank every eight hours.

After the addition of the soap, the amount of polymerized oily material removed from the surge tank at the end of each eight hours was at least ten times as great as it had been before the addition of soap. After the withdrawal of polymers at the end of each eight-hour period for three periods, the amount of polymers removed gradually decreased until it was only slightly greater at the end of each eight-hour period than had been removed before the addition of soap. After the soap had been added to the system for seven consecutive days, it was found that many of the tubes which had been partially plugged were clean and there were only a small number of tubes which remained plugged and from which the soapy water did not remove the polymerized oily material.

If the tubes had been clean when the soap was added to the system, it is believed that none of the tubes would have become plugged.

Thus, one skilled in the art will understand that there are or can be various ways in which the quench solution reaching quench tower 2 can have a certain desired temperature in spite of the fact that coolant has been

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discontinued to one of coils A and B. One manner in which said desired temperature can be maintained is by increasing the cooling capacity of the coil which remains under cooling while the other coil is allowed to warm. Further, the flow of quench material to be cooled can be increased to that coil which remains under cooling or correspondingly, if desired, flow to the coil being allowed to warm can be decreased, or even temporarily or periodically discontinued to accomplish a soaking action.

Reasonable variation and modification are possible within the scope of the foregoing disclosure, drawing, and the appended claims to the invention, the essence of which is that an inhibited or self-cleaning quench for hot reacted materials has been set forth comprised in a modus operandi wherein the quench solution, containing a surface active agent, after it has been employed for quenching the hot material, such as a converted or dehydrogenated hydrocarbon vapor, is passed through a cooling coil before it is reused, and wherein the coolant to the cooling coil can be periodically discontinued to allow the temperature of said coil to rise to aid the improved quench solution in its cleaning of the said cooling coil, as described.

We claim:

1. An improved method of quenching hot reacted or converted material which contains quenching liquid-contaminating substances which are picked up by the liquid during quenching and then deposited on heat exchange surfaces used to cool said liquid prior to its reuse which comprises adding to said quenching liquid in a quantity effective to suspend said contaminants in said liquid and to maintain them suspended therein during cooling of said liquid a surface-active agent, then contacting said material with said quenching liquid containing said surface-active agent, then cooling said quenching liquid in contact with a cooling surface and then reusing the thus cooled quenching liquid.

2. An improved method of quenching hot reacted or converted material which contains quenching liquid-contaminating substances which are picked up by the liquid during quenching and then deposited on heat exchange surfaces used to cool said liquid prior to its reuse which comprises adding to said quenching liquid in a quantity effective to suspend said contaminants in said liquid and to maintain them suspended therein during cooling of said liquid a surface-active agent, then contacting said material with said liquid containing said surface-active agent, then passing quenching liquid separated from said quenched vapors through a cooling coil or heat exchanger to cool the same and then reusing said quenching liquid.

3. In an improved quenching operation wherein vapors to be quenched, containing materials which tend to deposit in cooling coils employed to cool the quench liquid employed to quench said vapors, are contacted with a quench liquid containing a surface-active agent, quenched vapors are separated from the quench liquid, the quench liquid containing said materials which tend to deposit is passed through a cooling coil and then reused, the improvement which comprises periodically discontinuing flow of coolant to said cooling coil, thus allowing the temperature thereof to rise to aid the cleaning of the surfaces thereof which come into contact with said quenching liquid.

4. An improved modus operandi for quenching a hot reacted hydrocarbon effluent which comprises feeding said hydrocarbon effluent to a quenching tower, in said quenching tower contacting said hydrocarbon effluent with a quench liquid containing a surface-active agent, separating quenched hydrocarbon vapors from said tower, removing used quenched liquid from said tower and passing the same through at least one cooling coil, and returning to said tower for use therein the thus-cooled quench liquid.

5. An improved modus operandi for quenching a hot reacted hydrocarbon effluent which comprises feeding

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said hydrocarbon effluent to a quenching tower, in said quenching tower contacting said hydrocarbon effluent with a quench liquid containing a surface-active agent, separating quenched hydrocarbon vapors from said tower, removing used quenched liquid from said tower, passing the used quenched liquid to a quench surge tank, therein separating readily settling materials contaminating said quench liquid, passing said quench liquid through at least one cooling coil, and returning to said tower for use therein the thus settled and cooled quench liquid.

6. A method of quenching a hot material with water which the hot material contaminates with matter which tends to clog a cooling coil later used which comprises adding to said water a surface-active agent, cooling said water after use as a quench liquid in a cooling coil and periodically increasing the temperature of said cooling coil to aid in its cleaning by said quenching liquid without having to open said cooling coil, thus excluding oxygen from the system.

7. A method of quenching a hot reacted stream of hydrocarbons containing dehydrogenated butane vapors and tarry matter which tends to deposit on equipment used to process water used to quench said vapors which comprises adding a surface-active agent to water forming an improved quench liquid, quenching said stream of hydrocarbons with the solution of said agent in said water, and then passing said solution to said equipment.

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8. A method for improved quenching of a hot material, at least a portion of which is in liquid phase, which comprises adding a surface-active agent to a quench liquid to materially reduce its surface tension and then using said quench liquid to quench said hot material.

9. An improved method for quenching a hot material with a quenching liquid which comprises adding to said liquid a wetting agent which, as employed, causes substantially no foaming and then quenching said hot material with the improved quenching liquid thus obtained.

10. A method according to claim 8 wherein the hot material quenched is a converted hydrocarbon vapor.

11. A method according to claim 9 wherein the vapor is dehydrogenated butane.

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