

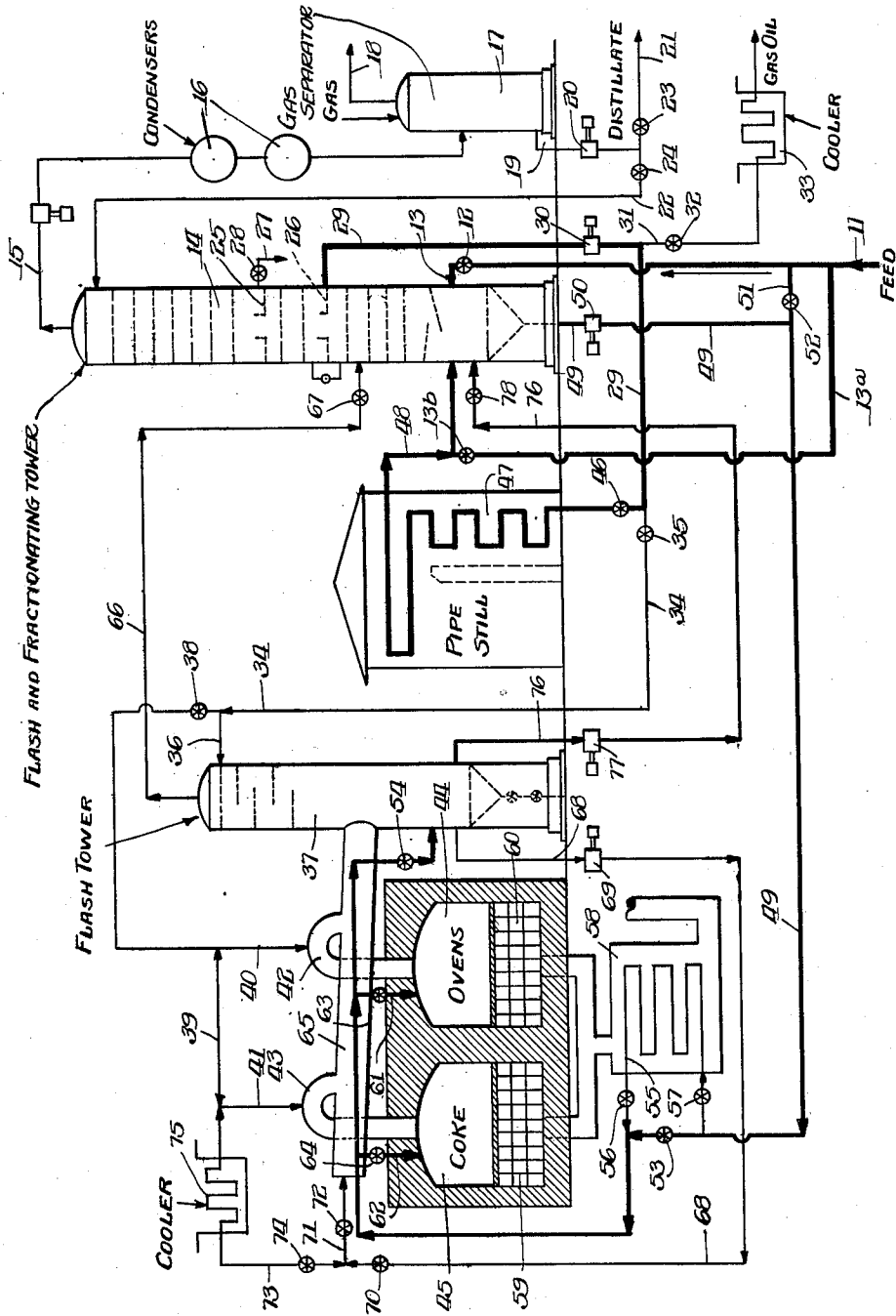
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METHOD OF COKING HYDROCARBONS

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METHOD OF COKING HYDROCARBONS

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This invention relates to a new and improved method of coking hydrocarbons. During past years the method of coking heavy residues in externally heated steel coking stills has been extensively used. On account of the very heavy maintenance and labor cost this method has been gradually replaced by coking either in the reaction chamber of cracking units or in coking chambers internally heated by hot oils or vapors to the point where coking takes place. In both these methods the coke produced is usually greatly reduced in value due both to its being broken up in removal and also its high percentage of volatile matter.

In United States Patent No. 1,805,711, a successful method of coking such hydrocarbons is described. This method has been found to produce a much more satisfactory grade of coke than prior methods and also does away with the difficulties of removal which heretofore have existed. We have found that with certain charging stocks a tendency to coke up the heater was in evidence and also that the overhead oils produced were not of as low viscosity and cold test as might be desired.

It is an object of the present invention to provide a new and improved method of coking hydrocarbons.

It is a further object to provide a method in which the charging stock for the coking step is treated to remove volatiles and lighter fractions before being introduced into the coking unit.

It is an additional object to provide a method in which the charging stock is heated as well as stripped of its lighter constituents so that the through put of the coking unit is increased.

It is also an object to provide a coking method adapted for the production of valuable by-products.

Other and further objects will appear as the description proceeds.

This invention relates more specifically to an improvement on that step in the coking process which comprises heating the charging stock before its introduction into the coking ovens. This is accomplished by taking the usual heavy residues from previous operations usually at a temperature of between 700° F. and 800° F., under usual discharge pressure and flashing into a tower, preferably under vacuum conditions. The release of pressure results in flashing off gas oil and lighter distillates which may be contained therein. These ascend through the trays of the column in the tower. A drawoff deck located at a suitable point vertically of the tower, enables

a stream of gas oil to be removed from the tower. This stream is pumped through a heater where its temperature is raised usually in excess of 850° F. In turn it is again discharged into the tower at a point separated from the drawoff deck by bubble trays, over which reflux is passed. The hot vapors discharged into the tower further increase the temperature of the bottoms, thus flashing off additional light fractions and increasing the gravity of the bottoms to, in some cases, as low as 1 to 3 A. P. I. gravity. This material is then fed into the ovens at a temperature preferably above 750° F. where it readily cokes. The overhead products from the oven may be discharged into the same tower below the bubble decks if this is desired. With proper fractionation the products of the operation are coke, gas, gas-oil, and distillate, all of good quality and readily saleable. The distillate may be fractionated to have a desired end point or returned to the main cracking unit for rerunning.

In actual operation this method has resulted in keeping the heater as well as the tower free from carbon deposits for long periods, both of which are highly desirable. A further advantage is the greater production of overhead products in the tower rather than in the oven. This decreases the load on the oven, thus increasing the through put, and also results in a better quality of product. The passage through the heater also reduces the viscosity and pour point of the gas oil which is removed for sale, thus greatly increasing its value.

We have shown in the single figure of the accompanying drawing, somewhat diagrammatically, an elevation of one layout of apparatus adapted for carrying out our improved methods of treatment.

In the drawing the line 11 serves to introduce the charging stock, this line being controlled by a valve 12 and terminating at 13 below the trays in the fractionating or flash tower 14. Line 13a, controlled by valve 13b, may also be used if desired to heat the feed by introducing it with the heated material from the pipe still. The line 15 leads from the upper end of the tower 14 through condensers 16 to a gas separator 17. The gas line 18 leads from the top of the separator. The distillate line 19 leads from the bottom of the separator through pump 20 to the junction of lines 21 and 22 controlled by valves 23 and 24 respectively. The line 21 leads to any desired distillate using or holding apparatus. The line 22 leads to the upper portion of the tower 14 and serves to

return the distillate for use in refluxing in the tower.

The tower 14 is provided with drawoff decks indicated at 25 and 26. The line 27 leads from the deck 25, this line being controlled by valve 28 and leading to any desired holder for distillate drawn off at this point. The line 29 leads from the deck 26 through pump 30 to a junction with line 31 controlled by valve 32. The line 31 passes through cooler 33 and leads to any desired holding apparatus for the gas oil drawn off at this point. The line 29 leads on to a junction with line 34, line 34 being controlled by valve 35. This line 34 has a branch 36 leading into the top of the flash tower 37. The line 34 further continues through valve 38 to a junction with line 39. Line 39 is provided with branches 40 and 41 leading into the top of the overhead offtake passages 42 and 43 which lead from the coke ovens 44 and 45.

Beyond the junction with line 34, the line 29 is controlled by valve 46 and leads to the pipe still 47. The line 48 leads from the pipe still into the lower end of the fractionating or flash tower 14. The bottom of the fractionating or flash tower 14 is provided with a drawoff 49 which passes through pump 50 to a junction with line 51 which is controlled by valve 52. The line 51 connects the feed line 11 with the line 49. The line 49 leads through valve 53 and valve 54 to a discharge into the lower portion of the flash tower 37. The line 49 is provided with a by-pass line 55 which connects to the line 49 on opposite sides of valve 53. The line 55 is provided at its opposite ends with valves 56 and 57. The line 55 is located in an enlargement 58 in the offtake flues from the heating passages 59 and 60 located below the floors of the coke ovens 44 and 45.

The line 49 is further provided with branch lines 61 and 62 controlled by valves 63 and 64 respectively, these branch lines leading into the top of the coke ovens 44 and 45. The offtake passages 42 and 43 from the coke ovens join in the main 65 which discharges into an intermediate portion of the flash tower 37. The line 66 is provided for carrying off the overhead from the flash tower 37, this line extending from the top of that tower to a point below the drawoff deck 26 in the fractionating or flash tower 14. The line 66 is controlled by valve 67. The lower portion of the flash tower 37 is provided with an offtake 68 passing through pump 69 and leading through valve 70 to the line 71 controlled by valve 72. The line 71 leads into the end of the main 65 and may serve to introduce liquid for flushing the line. The line 73 controlled by valve 74 passes through cooler 75 and leads to the line 39. The lower end of the flash tower 37 is also provided with the offtake line 76 which passes through pump 77 and leads through valve 78 into the lower portion of the fractionating or flash tower 14.

In one method of carrying out our improved treatment of liquid hydrocarbons, the liquid hydrocarbons will be led through feed line 11, past valve 12 and into the lower end of the fractionating or flash tower 14. If desired some or all of the hydrocarbons may pass through line 13a, past valve 13b to a junction with line 48 to further heat the feed. The valve 52 will be closed. This feed liquid or charging stock may be at a temperature of approximately 780° F. and under approximately 50 pounds pressure. It will be discharged into the lower end of the tower 14 and the lighter portions will flash off and pass upwardly through the tower. The overhead passing out of the top of the tower goes through condensers 18

and the fixed gas is separated in separator 17. Such portion of the distillate as is desired will be pumped back and into the top of the tower 14 through line 22 for refluxing the gases and vapors in the tower. The character of the overhead may be controlled by controlling the quantity and character of the refluxing material.

The overhead products which are caught on the drawoff deck 26 are carried through line 29 by means of pump 30 and forced through the pipe still 47 from which they are returned to the bottom of the tower 14. These lighter products may be heated in the pipe still to a temperature of from 850 to 1100 degrees F. without danger of serious deposit of carbon in the still. These heated products will carry into the flash tower 14 sufficient heat so as to maintain the heat loss by the vaporization of the charging stock in the bottom of that tower, and will be further flashed in the tower upon discharge therein. The distillate in the flash tower 37, which will come in hot from the coking ovens, may also be added to the material in the bottom of tower 14, being added through line 76. Further, the overhead from the flash tower 37 may be introduced at an intermediate point into the tower 14 through line 66.

The heavy bottoms from the bottom of tower 14 are forced through line 49 by pump 50 and discharged through lines 61 and 62 into the top of the coke ovens 44 and 45. If desired, these bottoms may be further heated by closing valve 53 and opening valves 56 and 57 in which case the bottoms will pass through the line 55 and be heated by the hot products of combustion leaving the flues of the ovens. A portion of the gas oil drawn off through line 29, instead of being heated in the pipe still and returned to the tower 14, will be passed through the line 34 and line 36 and used as a refluxing agent in the flash tower 37. A portion of this gas oil may be also used to wash down the offtakes 42 and 43 of the coke ovens. The distillate from the bottom of the tower 37 may partly be used for washing down the offtakes 42 and 43, being led to that point through lines 68 and 41 and 42. This material may be also passed through line 71 to wash down the main 65. Gas oil from the tower 14 may be also used to wash down the main 65 if desired, or these two materials may be mixed for that purpose.

It will be understood that the volume of feed in the tower 14 will be such as to give time in the tower for the proper vaporization of the lighter constituents of the feed material. The apparatus shown is by way of illustration only and it will be understood that the method may be carried out in other and different forms of apparatus. As an example of such modifications the functions of the towers 37 and 14 may be carried on in a single unit, in which case the overhead from the coke ovens would be introduced into the lower portion of the combined unit.

In one case of actual operation 12° A. P. I. charging stock was introduced into a unit through line 11 at a temperature of 750° F. into the base of fractionating tower 14. A considerable amount of gas oil contained in the hot tar was distilled by the reduction in pressure to approximately 2" of mercury vacuum. The temperature maintained at the base of the tower was on the order of 730° F. The gas oil distilled was fractionated in the tower and withdrawn from drawoff deck 26 through line 29 at a temperature of 600° F. In pipe still 47 this was

5 mildly cracked by heating to a temperature of 930° F., being then reintroduced into tower 14 through line 48, thereby supplying heat for the distillation and fractionation of the gas oil derived from the tar charging stock. The stripped tar remained liquid at the base of tower 14, and was then transferred by pump 50 and line 49 directly into the coke ovens in which, by the addition of heat through the refractory floor, it was reduced to a hard, dry coke. Gas and vapors formed in the ovens, after leaving the coke layer, were reduced in temperature to approximately 600° F. in order to prevent further cracking. This cooling was effected by introducing cool oil.

15 The vapors and any entrained carbon particles were then washed by hot reflux in the equivalent of flash tower 31, this washing zone having been incorporated in the base of tower 14 for simplicity of construction. When operating as described above and charging a tar derived from a cracking operation the following yields were obtained: 400 end point distillate—3.3%; 22° A. P. I. gas oil of low cold test—55.9%; coke 14.6%; gas 26.2%.

25 It will be further understood that the method itself is capable of modification and change to meet varying conditions and requirements and we contemplate such variations as come within the spirit and scope of the appended claims.

30 We claim:

1. A method of coking hydrocarbons in fluent form which comprises passing said hydrocarbon charge to a flashing zone maintained at sub-atmospheric pressures, passing vapors formed directly to a fractionating zone in which said vapors are fractionally condensed by refluxing to form a condensate containing materials of high viscosity and high pour point, drawing off fractionated condensate from the fractionating zone, heating said condensate to a temperature in excess of 850° F. whereby the viscosity and pour point are reduced, returning said condensate to the flashing zone which flashing zone precedes the fractionating zone from which said high viscosity and high pour point condensate is withdrawn, withdrawing additional condensate of low pour point and low viscosity as a product of the operation at a point above the drawoff of the high viscosity, high pour point condensate, utilizing the heat of the condensate returned to the flashing zone to drive off simultaneously addi-

tional lighter fractions from said charge, thus reducing the charge to a pitchy material of approximately 1° to 3° A. P. I. gravity, discharging the pitchy material while hot into an externally heated coking chamber under approximately atmospheric pressure, distilling off volatiles in said chamber, separating said overhead volatile products into liquid and relatively clean vaporous fractions in an intermediate zone, fractionating said vaporous fractions in said first mentioned fractionating zone, passing liquid portions from the intermediate zone to the flash zone, and coking the pitchy material to a hard, dense coke.

2. A method of coking hydrocarbons in fluent form which comprises passing said hydrocarbon charge to a flashing zone maintained at sub-atmospheric pressures, passing vapors formed directly to a fractionating zone in which said vapors are fractionally condensed by refluxing to form a condensate containing materials of high viscosity and high pour point, drawing off fractionated condensate from the fractionating zone, heating said condensate to a temperature in excess of 850° F. whereby the viscosity and pour point are reduced, returning said condensate to the flashing zone which flashing zone precedes the fractionating zone from which said high viscosity and high pour point condensate is withdrawn, withdrawing additional condensate of low pour point and low viscosity as a product of the operation at a point above the drawoff of the high viscosity, high pour point condensate, utilizing the heat of the condensate returned to the flashing zone to drive off simultaneously additional lighter fractions from said charge, thus reducing the charge to a pitchy material of approximately 1° to 3° A. P. I. gravity, further heating the pitchy material and discharging the pitchy material while hot into an externally heated coking chamber under approximately atmospheric pressure, distilling off volatiles in said chamber separating said overhead volatile products into liquid and relatively clean vaporous fractions in an intermediate zone, fractionating said vaporous fractions in said first mentioned fractionating zone, passing liquid portions from the intermediate zone to the flash zone, and coking the pitchy material to a hard, dense coke.

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