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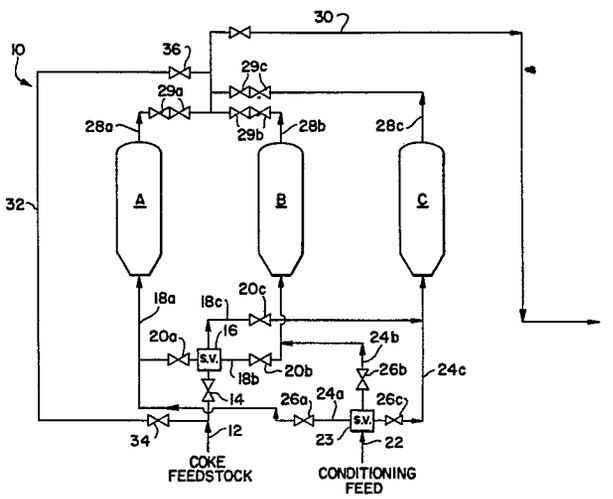
(54) Method for extended conditioning of delayed coke.

(57) A method for conditioning delayed coke includes allowing coke to form in a first chamber or coke drum, while simultaneously conditioning coke in a second coke drum by flowing hot conditioning fluid through it, and decoking a third coke drum. The coking, conditioning and decoking operations are sequentially switched among the coke drums.



EP 0 155 163 A2

Description

Method for Extended Conditioning of Delayed Coke

Background of the Invention

In the production of anisotropic coke, commonly known as needle coke, in the delayed coking process, it is common practice to condition the coke formed in the reaction chamber or coke drum by one of several methods. These are 1) raising the drum temperature while the coke is forming, especially during the latter stages of the coke formation; 2) after the coke is formed, by shutting off the fresh feed portion of the charge to the coke drum and recycling coker products or a portion thereof as a hot vapor through the already formed mass of coke; and 3) holding the already formed coke at a temperature above 750 degrees Fahrenheit. The above procedures, known as "temperature soaking" or "drying out" of the coke, are employed to condition or improve specific properties of the anisotropic coke. The improved properties include 1) lower volatile matter content, 2) increased hardness, and 3) increased crystallinity, resulting in a lower coefficient of thermal expansion.

In general practice, the amount of in situ coke conditioning is limited by the sizing of the drum to meet process unit capacity requirements. Since the drum must be fully decoked and prepared to receive feedstock within a fixed operating cycle, the time usually allowed for coke conditioning is typically less than 8 hours. Thus, the amount by which specific properties of the coke can be improved is limited.

Summary of the Invention

It is, therefore, an object of the present invention to permit extended conditioning of coke.

It is a further object of the invention to extend the conditioning without interrupting the coking process.

In order to achieve these and other objects, the method according to the present invention utilizes additional reaction chambers or coke drums to permit extending the allotted time for conditioning of the coke and, thus, permit greater improvement in the properties of the coke. For example, if the desired quantity of coke conventionally requires a two coke drum process unit employing an overall cycle of 48 hours for each drum, the use of a third drum permits extended conditioning of the coke. In the conventional process unit, each drum is employed sequentially and alternately for 24 hours of coke formation and 24 hours conditioning and decoking. In the present invention, the third drum sized identically to the other two permits each drum to operate sequentially and alternately in the following mode: 1) 24 hours coke formation, 2) 24 hours conditioning and 3) 24 hours decoking. Each of these time allotments can be varied to achieve desired requirements of process capacity, cycle time and product improvement. When each or any of the three portions of the overall cycle described above is decreased, the required size of the coke drum can also be decreased by an appropriate amount resulting from the number or fractional number of coking formation segments permitted by the overall cycle. In the example given above, if each segment were operated for 18 hours instead of 24 hours, the coke drums could be sized at 75 percent of the capacity required for the

24 hour cycles. Alternatively, if each drum were capable of holding the coke formed in 24 hours of operation, the overall unit production of coke could be increased by one-third if each of the 3 operations were reduced to 18 hours from 24 hours.

Brief Description of the Drawings

Fig. 1 is a schematic representation of three coke drums and appropriate piping for use in connection with the process according to the present invention;

Fig. 2A is a representation of a prior art coking cycle;

Fig. 2B is an illustration of an exemplary coking cycle for the process according to the present invention; and

Fig. 2C is a schematic representation of an alternate coking cycle according to the present invention.

Detailed Description of the Preferred Embodiment

As can be seen from Fig. 1, the reference numeral 10 generally indicates apparatus for use in connection with the coking process according to the present invention. An inlet line 12 provides coke feedstock from a source, such as the residual bottoms of crude oil from a refining process. The residual bottoms are typically heated to a temperature of about 900°F - 1000°F in a conventional furnace, from which the hot oil is discharged. The inlet line 12 receives such a discharge and directs it through a main inlet valve 14 to a multi-position switch valve 16 which directs the flow of the coke feedstock to one of a plurality of connecting lines 18a, 18b or 18c. The connecting lines connect the valve 16 to conditioning

chambers or coke drums A, B and C, respectively. Valves 20a, 20b and 20c are positioned in the connecting lines to isolate the flow therethrough. A conditioning feed inlet line 22 is provided to direct hot conditioning fluid, such as coker products or a portion thereof as hot vapor to the coke drums A, B and C through a switch valve 23 and connecting lines 24a, 24b and 24c respectively. The conditioning fluid improves the coke by lowering its volatile matter content, increasing its hardness, and increasing its crystallinity, which lowers its coefficient of thermal expansion.

Isolation valves 26a, 26b and 26c are provided in the connecting lines 24a-c, respectively. It should be noted that the conditioning feed lines 24a-c are not required for all types of conditioning processes. For example, the coke can be conditioned merely by maintaining it at a high temperature, such as above 750°F. Outlet lines 28a, 28b and 28c extend from the coke drums A, B and C to permit the removal of light products from the coking process, thereby leaving only coke in the coke drums. The outlets 28a, 28b and 28c are connected to a common delivery line 30 through pairs of isolation valves 29a, 29b and 29c, the isolation valves being employed in pairs to account for valve leakage. A warm-up line 32 is connected directly from the coke feedstock inlet 12 to the delivery line 30, and flow therethrough is controlled by valves 34 and 36. During start up of the apparatus 10, before coke feedstock is fed to any of the coke drums, the hot vapors of the feedstock are allowed to flow into one of the coke drums A, B or C through its respective outlet line 28a, b or c to preheat the coke drum and, thereby, to avoid the thermal shock that can result if the hot feedstock is fed to a drum which is at ambient

temperatures.

In operation, the main inlet valve 14 is opened to allow the flow of coke feedstock through the inlet line 12 to the switch valve 16. The switch valve 16 directs the flow to one of the three coke drums, for example, coke drum A, through the associated valve, in this case valve 20a. At this time, the switch valve 16 prevents the flow of feedstock to any other drum. When the coke drum A is full of coke, the valve 20b controlling the flow of feedstock to coke drum B is opened, the switch valve 16 is operated to direct the incoming feedstock through the line 18b and the valve 20b, and the valve 20a controlling the flow to the coke drum A is closed. When coke drum B is full of coke, the valve 20c is opened, the switch valve 16 is operated to direct the flow of feedstock through the line 18c, and the valve 20b is closed. When the coking operation in coke drum B is completed, the same operation takes place with respect to coke drum C. The switch valve 16 may be operated manually, or automatically.

While the coking operation is taking place in drum A, coke which has already formed in drum C is being conditioned. The conditioning may include the flow of coker products comprising hot vapor derived from a coker fractionator through the coke drum containing the formed coke. As an alternative, steam can be used as a conditioning fluid. The conditioning fluid strips the highly volatile matter from the coke and maintains the coke at a high temperature. Without the flow of the conditioning material or the application of heat from some other source, the temperature of the coke would fall rapidly. Thus, the feed of conditioning fluid through the inlet line 22 to the switch valve 23 is directed by the switch valve through the

isolation valve 26c and the connecting line 24c to the coke drum. When the conditioning of the coke in coke drum C is complete, the switch valve 23 is moved to a position in which the flow of conditioning fluid is directed to coke drum A. Similarly, when the conditioning of the coke in coke drum A is completed, the switch valve 23 can be operated to direct the flow of conditioning fluid to coke drum B. The switch valve 23 may be operated manually or automatically.

While coke is being allowed to form in coke drum A and conditioned in coke drum C, coke drum B can be decoked. Decoking involves the removal of the coke from the drum, such as by the use of high impact water jets to hydraulically bore and cut the coke.

In a conventional coking process, as can be seen from Fig. 2A, only two conditioning chambers or coke drums A and B are employed, and the coke forming process, including the feeding of the coke feedstock to the coke drum, occurs in one coke drum, while conditioning and decoking take place in the other drum. Thus, in a typical 48 hour cycle, coking takes place for approximately 24 hours and conditioning and decoking combined take place for 24 hours. As a result, the time available for conditioning is typically less than 8 hours.

As can be seen from Figs. 2B and 2C, the use of an additional coke drum, drum C, in connection with the process according to the present invention, permits a much greater conditioning time. For example, in the exemplary 72 hour cycle illustrated in Fig. 2B, coking or coke formation is allowed to occur for 24 hours, as it was in the prior art process. However, conditioning and decoking are each able to last for a 24 hour period. The same amount of conditioned coke is delivered from the process of Fig. 2B as was delivered

from the process of Fig. 2A, but a much greater conditioning time is available.

In the process of Fig. 2B, the allowing of the coke to form in coke drum A, including the feeding of the coke feedstock to the chamber, is simultaneous, for the same 24 hour period, with the decoking of coke drum B and the conditioning of the coke in coke drum C to improve one or more of its properties. Similarly, the conditioning of the coke in coke drum A is simultaneous for a 24 hour period with the coking in coke drum B and the decoking of coke drum C; and the decoking of coke drum A is simultaneous with the conditioning of coke drum B and the coking in coke drum C.

As can be seen from Fig. 2C, the overall operating cycle of the process according to the present invention can be reduced, for example, to 54 hours and, thus, provide a greater output of conditioned coke than was possible with the prior art system. In the example of Fig. 2C, the coking period is reduced from 24 hours to approximately 18 hours, as are the conditioning and decoking periods. However, the 36 hours provided for the conditioning and decoking periods together is still 50% greater than the 24 hour combined conditioning.

The invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the claims rather than by the foregoing description and all changes which come within the meaning and range of the equivalents of the claims are therefore intended to be embraced therein.

Claims

1. A process for conditioning coke comprising the steps of:

allowing coke to form in a first of a plurality of coke drums including feeding coke feedstock to the first drum;

conditioning the coke in the first drum to improve one or more of its properties;

decoking the first drum;

allowing coke to form in a second of said coke drums, including feeding coke feedstock to the second drum, during the conditioning of the coke in the first drum;

conditioning the coke in the second drum to improve one or more of its properties during the decoking of the first drum;

decoking the second drum;

allowing coke to form in a third of said coke drums, including feeding coke feedstock to the third drum, during the conditioning of the coke in the second drum;

conditioning the coke in the third drum to improve one or more of its properties during the decoking of the second drum; and

decoking the third drum.

2. The process of claim 1 wherein:

the steps of allowing the coke to form in the second and third drums are simultaneous, respectively, with the steps of conditioning the coke in the first and second drums; and

the steps of conditioning the coke in the second and third drums are simultaneous, respectively, with the steps of decoking the first and second drums.

3. The process of claim 1 wherein there are three coke drums, and the steps in the first drum of allowing coke to form, conditioning the coke, and decoking are simultaneous, respectively, with the steps in the third drum of conditioning the coke, decoking, and allowing the coke to form.

4. The process of claim 1 wherein the steps of conditioning the coke in each drum include applying heat to the coke.

5. The process of claim 4 wherein applying heat to the coke comprises flowing hot conditioning fluid through the coke.

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FIG. 1.

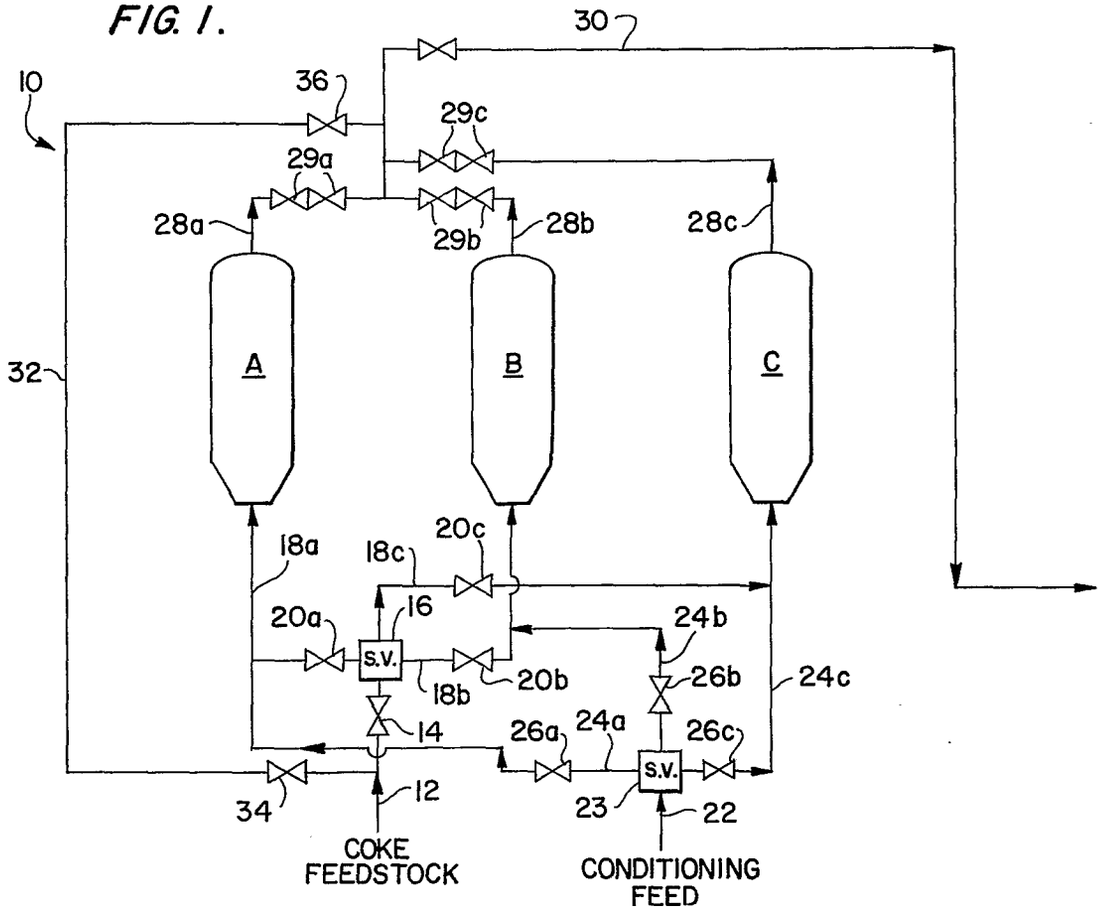

FIG. 2A.
(PRIOR ART)

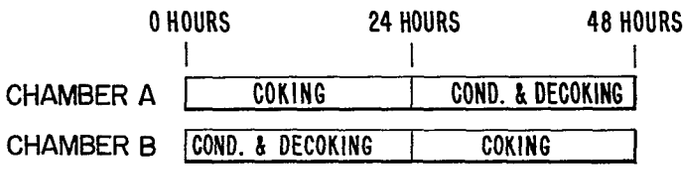

FIG. 2B.

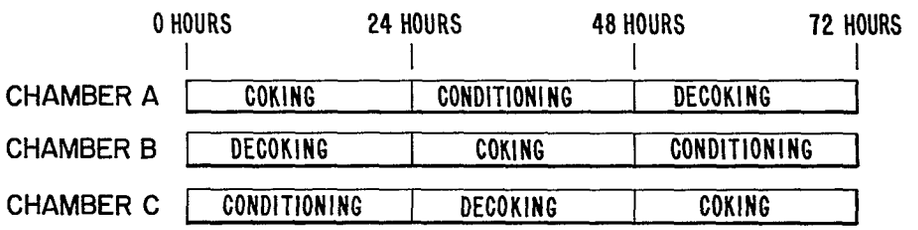

FIG. 2C.