firebox (not shown). The coke catcher 50 is located upstream of the secondary transfer line exchanger 16, where a change of direction of the effluent from the primary transfer line exchanger 14 causes the coke to continue straight into the coke catcher 50 while the effluent gas turns toward the secondary transfer line exchanger 16 via flow line 52. The coke catcher is essentially a length of pipe forming a "dead leg" in the heater outlet located after the primary transfer line exchanger 14 and before the secondary transfer line exchanger 16.

[0009] The coke catcher is located in the plant such that the coke can periodically be emptied and carted away for disposal. Unfortunately, the design as illustrated in Figure 2 provides no means for isolating the coke catcher from the heater effluent, thus requiring the heater 1 to be taken out of service and cooled to clean out the coke catcher 50. Shutting down cold stresses heater parts and causes a loss in production. Additionally, sizing the coke catcher for an extended run length may require a very large volume, and leaving coke and potentially some tar in the coke catcher for such an extended period may result in an agglomerate that is difficult to remove.

SUMMARY OF THE CLAIMED EMBODIMENTS

[0010] The present disclosure provides for processes including a coke catcher that may be emptied during normal operation or steam standby, thereby overcoming the deficiencies in the prior design as discussed above, the coke catchers and process flows disclosed herein protecting the secondary transfer line exchanger from foulant while not limiting the time between heater cold shutdowns. The designs consider the impact of decoking options, such as when decoking to a firebox as opposed to a decoking drum. Further, flow and cost considerations are addressed in various embodiments; for example, decoke valves are fairly expensive, and process flows disclosed herein may provide for relocation of the decoke valve to facilitate coke catcher operations while not adding an expensive valve to the overall operating flow scheme.

[0011] ~~In one aspect, e~~Embodiments disclosed herein relate to a process for reducing fouling, the process including: transferring a process stream from a continuous or semi-continuous process, the process stream comprising a gaseous fraction and a foulant fraction, through a flow conduit to a process device, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering

the process device and (ii) flow of the foulant fraction to continue into a foulant collection device or portion thereof; accumulating an amount of the foulant fraction in the foulant collection device or portion thereof; and isolating and emptying accumulated foulant fraction from the foulant collection device. In one aspect, there is provided a process for reducing fouling, the process comprising: transferring a process stream from a continuous or semi-continuous process, the process stream comprising a gaseous fraction and a foulant fraction, through a flow conduit to a process device, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering the process device and (ii) flow of the foulant fraction to continue into a foulant collection device or portion thereof; accumulating an amount of the foulant fraction in the foulant collection device or portion thereof; isolating and emptying accumulated foulant fraction from the foulant collection device; and wherein the process device comprises at least one of a pump, a heat exchanger, a valve, and a compressor.

[0012] ~~In another aspect,~~Other embodiments disclosed herein relate to a system for reducing fouling, the system including: a flow conduit for transferring a process stream from a continuous or semi-continuous process, the process stream comprising a gaseous fraction and a foulant fraction, through the flow conduit to a process device, a branch in the flow conduit, wherein the branch causes (i) flow of the gaseous fraction to change direction before entering the process device and (ii) flow of the foulant fraction to continue into a foulant collection device or portion thereof; the foulant collection device, wherein the foulant collection device has a volume for accumulating an amount of the foulant fraction in the foulant collection device; and means for isolating and emptying accumulated foulant fraction from the foulant collection device.

[0013] In another aspect, embodiments disclosed herein relate to a process for reducing heat exchanger fouling, the process including: cooling a process stream from a continuous or semi-continuous process in a first heat exchanger to form a cooled effluent comprising a gaseous fraction and a foulant fraction; transferring the cooled effluent through a flow conduit to a second heat exchanger, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering the second heat exchanger and (ii) flow of the foulant fraction to continue into a

foulant collection device; accumulating an amount of the foulant fraction in the foulant collection device or a first portion thereof; and isolating and emptying accumulated foulant fraction from the foulant collection device.

[0014] ~~In another aspect,~~Other embodiments disclosed herein relate to a system for reducing heat exchanger fouling, the system including: a first heat exchanger for cooling a process stream from a continuous or semi-continuous process to form a cooled effluent comprising a gaseous fraction and a foulant fraction; a flow conduit for transferring the cooled effluent through to a second heat exchanger; a branch in the flow conduit, wherein the branch causes (i) flow of the gaseous fraction to change direction before entering the second heat exchanger and (ii) flow of the foulant

fraction to continue into a foulant collection device; the foulant collection device, wherein the foulant collection device has a volume for accumulating an amount of the foulant fraction; and means for isolating and emptying accumulated foulant fraction from the foulant collection device.

[0015] ~~In another aspect,~~Other embodiments disclosed herein relate to a process for producing olefins, the process including: during a cracking cycle, passing a hydrocarbon feed and optionally steam through a heat exchange tube in a radiant heating chamber of a heater at conditions to crack at least a portion of the hydrocarbon to form an effluent comprising olefins and byproducts including heavier hydrocarbons and coke; during a decoking cycle, passing at least one of nitrogen, steam, air, and oxygen through a heat exchange tube in a radiant heating chamber of a heater at conditions to decoke at least a portion of the heat exchange tube to form a decoke effluent; cooling the effluent or the decoke effluent in a primary transfer line exchanger to form a cooled effluent comprising a gaseous fraction and a foulant fraction; transferring the cooled effluent through a flow conduit to a secondary transfer line exchanger, wherein the flow conduit branches, causing (i) the flow of the gaseous fraction to change direction before entering the secondary transfer line exchanger, during at least the cracking cycle, and (ii) the flow of the foulant fraction to continue into a coke catcher; accumulating an amount of the foulant fraction in the coke catcher or a first portion thereof; and emptying accumulated foulant fraction from the coke catcher or a second portion thereof without shutting down the heater.

[0016] ~~In another aspect,~~Other embodiments disclosed herein relate to a system for producing olefins, the system including: a heater; one or more heat exchange tubes for (a) during a cracking cycle, passing a hydrocarbon feed and optionally steam through a radiant heating chamber of the heater at conditions to crack at least a portion of the hydrocarbon to form an effluent comprising olefins and byproducts including heavier hydrocarbons and coke; (b) during a decoking cycle, passing at least one of nitrogen, steam, air, and oxygen through the radiant heating chamber of the heater at conditions to decoke at least a portion of the heat exchange tube to form a decoke effluent; a primary transfer line exchanger for cooling the effluent or the decoke effluent to form a cooled effluent comprising a gaseous fraction and a foulant fraction; a flow conduit for transferring the cooled effluent to a secondary transfer line exchanger; a branch in

the flow conduit, wherein the branch causes (i) the flow of the gaseous fraction to change direction before entering the secondary transfer line exchanger, during at least the cracking cycle, and (ii) the flow of the foulant fraction to continue into a coke catcher; the coke catcher, wherein the coke catcher has one or more sections having a volume for accumulating an amount of the foulant fraction; and means for emptying accumulated foulant fraction from the coke catcher or a section thereof without shutting down the heater.

[0017] Other ~~aspects~~ embodiments and advantages will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0018] Figure 1 is a simplified process flow diagram of a prior art method for hydrocarbon cracking.

[0019] Figure 2 is a simplified process flow diagram of a prior art method for hydrocarbon cracking.

[0020] Figure 3 is a simplified process flow diagram of a process for reducing heat exchanger fouling according to embodiments disclosed herein.

[0021] Figure 4 is a simplified process flow diagram of a process for reducing heat exchanger fouling according to embodiments disclosed herein.

[0022] Figure 5 is a simplified process flow diagram of a process for reducing heat exchanger fouling according to embodiments disclosed herein.

[0023] Figure 6 is a simplified process flow diagram of a process for reducing heat exchanger fouling according to embodiments disclosed herein.

DETAILED DESCRIPTION

[0024] In one aspect, embodiments herein relate generally to a process for hydrocarbon cracking. More specifically, embodiments disclosed herein relate to systems and processes for cracking ethane and propane to produce ethylene and propylene, as well as the efficient maintenance of these systems during normal cracking operations and during periodic decoking of the system.

[0025] Overall, fouling of heat exchangers is a common problem within the petrochemical industry. As noted above, upsets or intentional changes in cracking conditions during normal operation can result in cooling and contraction of radiant section tubes, breaking off of coke or spalling, and flow of the coke or spalling

CLAIMS

What is claimed:

1. A process for reducing fouling, the process comprising:

   transferring a process stream from a continuous or semi-continuous process, the process stream comprising a gaseous fraction and a foulant fraction, through a flow conduit to a process device, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering the process device and (ii) flow of the foulant fraction to continue into a foulant collection device or portion thereof;

   accumulating an amount of the foulant fraction in the foulant collection device or portion thereof;

   isolating and emptying accumulated foulant fraction from the foulant collection device; and

   wherein the process device comprises at least one of a pump, a heat exchanger, a valve, and a compressor.

2. The process of claim 1, wherein the isolating and emptying are performed without discontinuing one or more portions of the continuous or semi-continuous process.

3. A process for reducing heat exchanger fouling, the process comprising:

   cooling a process stream from a continuous or semi-continuous process in a first heat exchanger to form a cooled effluent comprising a gaseous fraction and a foulant fraction;

   transferring the cooled effluent through a flow conduit to a second heat exchanger, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering the second heat exchanger and (ii) flow of the foulant fraction to continue into a foulant collection device;

   accumulating an amount of the foulant fraction in the foulant collection device or a first portion thereof; and

   isolating and emptying accumulated foulant fraction from the foulant collection device.

4. The process of claim 3, wherein the isolating and empting are performed without discontinuing one or more portions of the continuous or semi-continuous process.

5. The process of claim 3, wherein the accumulating step comprises accumulating an amount of the foulant fraction in a first portion of the foulant collection device, the process further comprising:

transporting the accumulated foulant to a second portion of the foulant collection device;

wherein the isolating step comprises isolating the first portion of the foulant collection device from the second portion of the foulant collection device.

CLAIMS

What is claimed:

1. A process for reducing fouling, the process comprising:

transferring a process stream from a continuous or semi-continuous process, the process stream comprising a gaseous fraction and a foulant fraction, through a flow conduit to a process device, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering the process device and (ii) flow of the foulant fraction to continue into a foulant collection device or portion thereof;

accumulating an amount of the foulant fraction in the foulant collection device or portion thereof; and

isolating and emptying accumulated foulant fraction from the foulant collection device.

2. The process of claim 1, wherein the process device comprises at least one of a pump, a heat exchanger, a valve, and a compressor.

3. The process of claim 1, wherein the isolating and emptying are performed without discontinuing one or more portions of the continuous or semi-continuous process.

4. A system for reducing fouling, the system comprising:

a flow conduit for transferring a process stream from a continuous or semi-continuous process, the process stream comprising a gaseous fraction and a foulant fraction, through the flow conduit to a process device,

a branch in the flow conduit, wherein the branch causes (i) flow of the gaseous fraction to change direction before entering the process device and (ii) flow of the foulant fraction to continue into a foulant collection device or portion thereof;

the foulant collection device, wherein the foulant collection device has a volume for accumulating an amount of the foulant fraction in the foulant collection device; and

means for isolating and emptying accumulated foulant fraction from the foulant collection device.

5. The system of claim 4, wherein the process device comprises at least one of a pump, a heat exchanger, a valve, and a compressor.

6. The system of claim 4, wherein the means for isolating and emptying are configured to allow isolation and emptying without discontinuing one or more portions of the continuous or semi-continuous process.
7. A process for reducing heat exchanger fouling, the process comprising:
   cooling a process stream from a continuous or semi-continuous process in a first heat exchanger to form a cooled effluent comprising a gaseous fraction and a foulant fraction;
   transferring the cooled effluent through a flow conduit to a second heat exchanger, wherein the flow conduit branches, causing (i) flow of the gaseous fraction to change direction before entering the second heat exchanger and (ii) flow of the foulant fraction to continue into a foulant collection device;
   accumulating an amount of the foulant fraction in the foulant collection device or a first portion thereof; and
   isolating and emptying accumulated foulant fraction from the foulant collection device.
8. The process of claim 7, wherein the isolating and empting are performed without discontinuing one or more portions of the continuous or semi-continuous process.
9. The process of claim 7, wherein the accumulating step comprises accumulating an amount of the foulant fraction in a first portion of the foulant collection device, the process further comprising:
   transporting the accumulated foulant to a second portion of the foulant collection device;
   wherein the isolating step comprises isolating the first portion of the foulant collection device from the second portion of the foulant collection device.
10. A system for reducing heat exchanger fouling, the system comprising:
    a first heat exchanger for cooling a process stream from a continuous or semi-continuous process to form a cooled effluent comprising a gaseous fraction and a foulant fraction;
    a flow conduit for transferring the cooled effluent through to a second heat exchanger;

a branch in the flow conduit, wherein the branch causes (i) flow of the gaseous fraction to change direction before entering the second heat exchanger and (ii) flow of the foulant fraction to continue into a foulant collection device;

the foulant collection device, wherein the foulant collection device has a volume for accumulating an amount of the foulant fraction; and

means for isolating and emptying accumulated foulant fraction from the foulant collection device.

11. The process of claim 10, wherein the means for isolating and emptying are configured to allow isolating and emptying without discontinuing one or more portions of the continuous or semi-continuous process.

12. The process of claim 10, wherein the foulant collection device comprises:

a first portion having a volume for accumulating an amount of the foulant fraction:

a second portion for receiving accumulated foulant fraction from the first portion; and

a valve for isolating the first portion from the second portion to allow isolating and emptying of accumulated foulant from the second portion without discontinuing one or more portions of the continuous or semi-continuous process.

13. A process for producing olefins, the process comprising:

during a cracking cycle, passing a hydrocarbon feed and optionally steam through a heat exchange tube in a radiant heating chamber of a heater at conditions to crack at least a portion of the hydrocarbon to form an effluent comprising olefins and byproducts including heavier hydrocarbons and coke;

during a decoking cycle, passing at least one of nitrogen, steam, air, and oxygen through a heat exchange tube in a radiant heating chamber of a heater at conditions to decoke at least a portion of the heat exchange tube to form a decoke effluent;

cooling the effluent or the decoke effluent in a primary transfer line exchanger to form a cooled effluent comprising a gaseous fraction and a foulant fraction;

transferring the cooled effluent through a flow conduit to a secondary transfer line exchanger, wherein the flow conduit branches, causing (i) the flow of the gaseous fraction to change direction before entering the secondary transfer line exchanger, during at least the cracking cycle, and (ii) the flow of the foulant fraction to continue into a coke catcher;

accumulating an amount of the foulant fraction in the coke catcher or a first portion thereof; and

emptying accumulated foulant fraction from the coke catcher or a second portion thereof without shutting down the heater.

14. The process of claim 13, wherein the accumulating step comprises accumulating an amount of the foulant fraction in a first portion of the coke catcher, the process further comprising:

transporting the accumulated foulant to a second portion of the foulant collection device;

isolating the first portion of the coke catcher from the second portion of the coke catcher prior to the emptying step.

15. The process of claim 14, further comprising contacting the accumulated foulant in the second portion of the coke catcher with at least one of steam, water, and nitrogen prior to the emptying step.

16. The process of claim 14, wherein the transporting the accumulated foulant from the first portion to the second portion is initiated when transitioning from the coking cycle to the decoking cycle.

17. The process of claim 16, wherein, during the decoking cycle, the decoke effluent passes through at least the first portion of the coke catcher.

18. A system for producing olefins, the system comprising:

a heater;

one or more heat exchange tubes for

a) during a cracking cycle, passing a hydrocarbon feed and optionally steam through a radiant heating chamber of the heater at conditions to crack at least a portion of the hydrocarbon to form an effluent comprising olefins and byproducts including heavier hydrocarbons and coke;

b) during a decoking cycle, passing at least one of nitrogen, steam, air, and oxygen through the radiant heating chamber of the heater at conditions to decoke at least a portion of the heat exchange tube to form a decoke effluent;

a primary transfer line exchanger for cooling the effluent or the decoke effluent to form a cooled effluent comprising a gaseous fraction and a foulant fraction;

a flow conduit for transferring the cooled effluent to a secondary transfer line exchanger;

a branch in the flow conduit, wherein the branch causes (i) the flow of the gaseous fraction to change direction before entering the secondary transfer line exchanger, during at least the cracking cycle, and (ii) the flow of the foulant fraction to continue into a coke catcher;

the coke catcher, wherein the coke catcher has one or more sections having a volume for accumulating an amount of the foulant fraction; and

means for emptying accumulated foulant fraction from the coke catcher or a section thereof without shutting down the heater.

19. The system of claim 18, wherein the coke catcher comprises:

a first section having a volume for accumulating an amount of the foulant fraction:

a second section for receiving accumulated foulant fraction from the first portion; and

a valve for isolating the first portion from the second portion to allow isolating and emptying of accumulated foulant from the second portion without shutting down the heater.

20. The system of claim 19, further comprising flow conduits for contacting the accumulated foulant in the second section of the coke catcher with at least one of steam, water, and nitrogen.

21. The system of claim 19, wherein the system is configured to open the valve for isolating to provide for transport of the accumulated foulant from the first portion to the second portion when transitioning from the coking cycle to the decoking cycle.

22. The process of claim 21, further comprising a decoke flow conduit located downstream of the valve for isolating and configured to allow flow of the decoke effluent from the primary transfer line exchanger through the first section of the coke catcher to the decoke line.