Abstract: A fluidized catalytic cracking reactor vessel (1) comprising a stripping zone (49) and at least a primary (7) cyclone separator connected to the downstream end of a dilute phase fluidized cracking reactor riser (3), at least an overhead conduit (11) and a catalyst outlet conduit (57) for discharging catalyst from the reactor, characterized in that the vessel (1) comprises in its stripping zone (49) a sieve (60) having openings which openings have a hydraulic diameter of less than 0.25 m and wherein the total area of the openings in the sieve (60) is greater than 2 times the cross sectional area of the catalyst outlet conduit (57).
Published:

— with international search report
FCC REACTOR COMPRISING A SIEVE IN THE STRIPPING ZONE

The invention pertains to a fluidized catalytic cracking reactor vessel comprising a stripping zone and at least a secondary cyclone separator connected to the downstream end of a dilute phase fluidized cracking reactor riser deleted, at least a overhead conduit and a catalyst outlet conduit for discharging catalyst from the reactor.

Such a vessel is described in US-A-4,961,863. This patent application discloses a fluidized catalytic cracking (FCC) vessel comprising at its upper end cyclone means to separate catalyst particles from an effluent of a dilute phase fluidized catalytic cracking reactor riser, which cyclone means are fluidly connected to the downstream part of the reactor riser, fluidly connected with means to discharge the cleaned reactor riser effluent from the vessel and fluidly connected to dipleg means to discharge the separated catalyst to the lower end of the vessel. A secondary gas discharge opening will be present, generally between or after the separation means, to allow gasses present in the reactor vessel to be discharged from the reactor vessel together with the cleaned reactor riser effluent. Such configurations wherein these means are fluidly connected, resulting in short contact times and low after cracking, are referred to as so-called closed-cyclone or close-coupled FCC reactor configurations.

In use coke tends to form on, for example, the surface of the separator means of an FCC reactor vessel
of for example US-A-4,961,863. This is especially the case when an FCC unit is operating on a heavier feedstock than it was designed for. This is because small amounts of coke precursors, for example heavy hydrocarbons, are not fully separated from the catalysts in the separation means. When these small amounts of coke precursors together with the catalyst are discharged to the lower end of the reactor vessel they will almost immediately separate from the catalyst and flow upwardly in the reactor vessel. Coke will form when these coke precursors come into contact with the hot exterior of for example the separator means.

The problem of excessive coke formation is especially a problem when processing heavy feedstocks in FCC reactor vessels, which have been modified from a conventional non-close coupled design into the so-called close-coupled design. If the coke formation reaches a certain level large fragments of coke can drop down into the lower end of the reactor vessel. These large coke fragments can in turn cause blockage of the means to discharge catalysts from the reactor vessel. Due to such blockage the FCC unit will have to be shut down in order to remove the blockage. It has been experienced that such unscheduled shutdowns occurred already after 1 to 2 years of operations. This is very disadvantageous. Especially considering the fact that an FCC unit is supposed to operate without an unscheduled shut down for many years, for example 4 years.

US-A-5209287 discloses a FCC regenerator provided with an external catalyst cooler provided with a shield to avoid debris entering the cooler from the regenerator vessel.
It is the object of the present invention to provide an FCC reactor vessel which, when in use, can be operated for a prolonged time in the absence of unscheduled shut downs due to the above described coking problems.

5 The object is achieved with the following apparatus. A fluidized catalytic cracking reactor vessel comprising a stripping zone and at least a primary cyclone separator connected to the downstream end of a dilute phase fluidized cracking reactor riser, at least a overhead conduit and a catalyst outlet conduit for discharging catalyst from the reactor, characterized in that the vessel comprises in its stripping zone a sieve having openings, which openings have a hydraulic diameter of less than 0.25 m and wherein the total area of the openings in the sieve is greater than 2 times the cross sectional area of the catalyst outlet conduit.

10 The hydraulic diameter of the openings are preferably smaller than 0.15 m. Preferably the total area (AO) of the openings of the sieve is greater than 5 times the cross sectional area (Al) of the catalyst outlet conduit.

15 It has been found that when such a sieve is used fewer problems due to clogging of the catalyst outlet conduit occur.

20 The sieve can be used to further improve FCC reactor vessels such as have been described in US-A-4502947, which vessel comprise at its upper end means to separate catalyst particles from an effluent of a dilute phase fluidized catalytic cracking reactor riser, which separation means are fluidly connected to the downstream part of the reactor riser, fluidly connected with means to discharge the cleaned reactor riser effluent from the vessel and fluidly connected to means to discharge the separated catalyst to the lower end of the vessel, the
vessel further comprising at its lower end means to discharge catalyst from the reactor vessel.

The invention shall be further elucidated by means of the following figures.

FIG 1. represent a vertical cross section of the fluidized catalytic cracking vessel according the invention.
FIG 2. is a cross sectional view of a convex sieve positioned at or close to the inlet opening of the catalyst outlet conduit.

As well known, a fluid catalytic cracking (FCC) process employs a catalyst in the form of very fine particles, which act as a fluid when aerated with a vapor. The fluidized catalyst is circulated continuously between a reaction zone and a regeneration zone and acts as a vehicle to transfer heat from the regenerator to the hydrocarbon feed and reactor. The FCC process is valuable to convert heavy hydrocarbons into more valuable gasoline and lighter products.

In FIG. 1 the reactor vessel 1 is provided with a conventional catalyst stripping zone 49 in a lower bottom portion of the vessel. The reactor vessel 1 surrounds the upper terminal end of a riser 3, to which are attached a primary cyclone 5, and a secondary cyclone 7. The primary cyclone 5 is attached to the riser 3 by means of an enclosed conduit 17. The primary cyclone 5 in turn is connected to the secondary cyclone 7 by means of the primary cyclone overhead conduit 19. The secondary cyclone 7 is attached to an overhead conduit 11 through which overhead gas exits the reactor vessel 1. The gases, which exit the reactor through the overhead conduit 11 exit through the reactor overhead port 15. Catalyst particles separated from a suspension of hydrocarbon
vapor and catalyst particles by the cyclones 5, 7 drop through cyclone diplegs 29 and 31 respectively and feed the reactor stripper zone 49, which removes hydrocarbons adhering to said catalyst. It will be apparent to those skilled in the art that although only one series connection of cyclones 5 and 7, 9 are shown in the embodiment of FIG. 1, more than one series operating in parallel will suitably be used.

The primary cyclone overhead conduit 19 provides a passageway for catalysts to directly travel from the primary cyclone 5 to the secondary cyclone 7 without entering the reactor vessel 1 atmosphere. However, an annular port 9 is provided to admit stripping gas from the reactor vessel 1 into the conduit 19 to aid in separating catalyst from hydrocarbons adhering thereto. The annular port 9 may be located in a vertical portion of the conduit 19, but the annular port 9 could also be located in a horizontal portion 24. The annular port 9 should be dimensioned to have an area, which allows the stripping gas to pass through the annular port at a velocity between 5-100 feet per second.

The principal purpose of conduits 17, 19 and 11 is to provide a direct passage of the cracked hydrocarbons from the riser 3 to and through the primary cyclone 5 and the secondary cyclone 7 which limits the time the cracked hydrocarbons are exposed to elevated cracking temperatures.

The separated catalyst from cyclones 5 and 7 pass through respective diplegs 29 and 31 and are discharged there from after a suitable pressure is generated within the diplegs by the buildup of the catalyst. The catalyst falls from the diplegs into a bed of catalyst 51 therebelow. Within catalyst bed 51 is a conventional
stripping zone 49, where the catalyst in bed 51 is contacted with a stream of gas such as steam, flowing countercurrently to the direction of flow of the catalyst. The gas is introduced into the lower portion of the stripping zone 49 by one or more conventional conduits 55. Stripped catalyst is removed by a conduit 57.

A sieve 60 may be positioned anywhere in the stripping zone 49, but positioning at the inlet opening 60 of the catalyst outlet conduit 57 is preferred. Sieve 60 does not allow large particles to pass the sieve 60 and enter the catalyst outlet conduit 57 and the total area of the openings in the sieve 60 is greater than 2 times the cross sectional area of the catalyst outlet conduit 57. It is a further advantage when the sieve is positioned at such an angle that accumulation of non-passed particles onto the sieve is prevented. This can be attained by placing a flat sieve under an angle (with respect to the horizontal cross section of the reactor vessel) or to use a convex formed sieve rather than a planar one. Such convex formed sieve, of course, can also be placed under an angle with the horizontal cross section of the vessel.

Figure 2 shows part of the reactor of Figure 1 and a sieve 60". In Figure 2 the sieve is placed closer to the catalyst outlet conduit 57. The upper part is under an angle to avoid accumulation of particles on the sieve. The convex form of the sieve facilitates sliding down of coke from the sieve and thus further prevents clogging of the sieve.

The dimensions of the sieve 60 will be so chosen that while coke particles accumulate in the lower part of the vessel a sufficiently large number of openings are not
blocked in order to allow the separated particles to enter the catalyst outlet conduit. The form of the holes is not very critical. Circular, rectangular holes and slots are possible forms for the openings in the sieve.

The sieve 60 is preferably sufficiently strong to avoid it being damaged by erosion due to the gas-solids moving in the circular housing. Protective linings can be applied to protect the upper part of the sieve.

The inlet means for the gas-solids feed can be axially or tangentially arranged at the upper tubular part of the vessel housing.
CLAIMS

1. A fluidized catalytic cracking reactor vessel (1) comprising a stripping zone (49) and at least a primary (7) cyclone separator connected to the downstream end of a dilute phase fluidized cracking reactor riser (3), at least a overhead conduit (11) and a catalyst outlet conduit (57) for discharging catalyst from the reactor, characterized in that the vessel (1) comprises in its stripping zone (49) a sieve (60) having openings which openings have a hydraulic diameter of less than 0.25 m and wherein the total area of the openings in the sieve (60) is greater than 2 times the cross sectional area of the catalyst outlet conduit (57).

2. The vessel of claim 1 wherein the openings have a hydraulic diameter of less than 0.15 m.

3. The vessel of claim 1 or 2 wherein the total area of the openings of the sieve (60) is greater than 5 times the cross sectional area of the catalyst outlet conduit (57).

4. The vessel of any one of claim 1-3 wherein the sieve (60) is positioned at the lower end of the vessel (1).

5. The vessel of any one of claim 1-4 wherein the sieve (60) is positioned at or close to the inlet opening (60) of the catalyst outlet conduit (57).

6. The vessel of any one of claim 1-5 wherein the sieve (60) is positioned at such an angle to prevent accumulation of non-passed particles onto the sieve (60).
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C10G11/18 B01J3/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C10G B01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search: 10 September 2003

Date of mailing of the international search report: 22/09/2003

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