DEVICE AND METHOD FOR CRACKING HYDROCARBONS AND METHOD FOR CLEANING SUCH A DEVICE

The invention relates to a device for cracking hydrocarbons, which device is provided with a casing and contains at least a convection section and a cracking section, and the convection section of which consists of one or more feed heaters which are connected in series and each comprise one or more pipes connected in parallel.

A device of this kind is known from Ullmann's Encyclopedia of Industrial Chemistry (Fifth Completely Revised Ed. Vol 10A pp 61-66, 1987). Ullmann here describes a furnace for cracking hydrocarbons, one or more feed heaters being positioned in series in the convection section and each feed heater consisting of four to eight pipes connected in parallel.

In the process of cracking hydrocarbons, contamination arises, primarily in part of the final feed heater, and more particularly in that part of the final feed heater where the temperature rises from about 300 to about 600°C. This contamination in the form of carbon deposits leads to blockage. The carbon deposits also reduce the heat transfer to the hydrocarbons flowing through the pipes, as a result of which the pipes are cooled to a lesser extent. As a result, the pipes become overheated and, in the long term, damaged.

In order to avoid or remedy the abovementioned problems, the contaminated part of the pipes of the final feed heater is regularly cleaned. For this purpose, the device is taken out of operation, and all the pipes affected are sawn through and the pieces of the pipes situated between the saw cuts are

removed. The pipes are cleaned internally via the openings thus formed therein. After cleaning, the pieces removed from the pipes (after having also been cleaned) are welded back in between the cleaned pipe parts, after which the device can be put back into operation.

A disadvantage of the known device is that a cleaning operation as described above can take up a relatively large amount of time.

The object of the invention is to create a device which does not have this disadvantage, or only has it to a reduced extent.

This object is achieved by the fact that at least part of the pipes of the final feed heater is situated outside the casing of the device and the pipes contain means there via which at least part of the interior of the pipes is accessible. This has the effect that cleaning the device according to the invention takes up less time than cleaning the known device for cracking hydrocarbons, so that the device according to the invention has to be taken out of operation for less time for cleaning purposes.

When, in the above text and the following text, the final feed heater is mentioned, this is understood as meaning that feed heater which is positioned directly before the cracking section.

If the interior of the pipes of feed heaters other than just the final feed heater also has to be accessible, in order to be cleaned, the measures according to the invention also apply thereto.

As in the known devices for cracking hydrocarbons, which are provided at least in part with a casing, the final feed heater of the device according to the invention likewise comprises a number of pipes, in general from 4 to 8, which are connected in parallel. As a rule, each of these pipes consists of a

number of horizontal loops lying beneath one another. The parallel-connected pipes are then situated in an equal number of parallel vertical planes, which number is dependent on the number of parallel pipes.

When, in the preceding text and the following text, a part of the pipes of the final feed heater which is situated outside the casing of the device is mentioned, this is understood as meaning that part of at least one of the parallel-connected pipes is situated outside the casing of the device.

In the above-described configuration of pipes which are connected in parallel and lie in loops in vertical planes, it is possible, for example, to extend the first loop of each of the pipes until it is situated outside the casing of the device, and for it there to contain means via which the interior of the first horizontal loop of the pipe in question is internally accessible. It has been found that the contamination occurs primarily in the first horizontal loop of each pipe.

In the known devices, an ever larger piece is removed from the final feed heater for the purpose of cleaning, in order to avoid a weld having to be made at the same place as the weld which was made following a previous cleaning operation. As a result, it is inevitable that, after a number of cleaning operations, all the pipes of the final feed heater have to be replaced in their entirety. Since, in the device according to the invention, no welds are made in the pipes after the cleaning operation, they therefore do not have to be replaced after a number of cleaning operations, which is a further advantage compared to the known devices.

Means via which at least part of the final feed heater is accessible in order to be cleaned internally can, for example, consist of screw covers,

clamping couplings or flange couplings, optionally in combination with an additional extension of the contaminated horizontal part of the pipe to past the bend located outside the casing of the device, extending the said contaminated part of the pipe.

The means can, for example, consist of a T-piece which is situated close to or in the bend and is incorporated in the pipe, the free opening of which T-piece is closed off by a screw cover, a cover with a clamping coupling, or is provided with a sealing flange. Preferably, the T-piece is incorporated such that the part which can be opened is aligned with the contaminated part of the pipe.

A means can also consist of two clamping couplings, one of which is fitted before the bend and one after the bend in the part of the loop situated outside the casing of the device. By opening the clamping couplings, the bend can be removed and the interior of the contaminated parts of the pipes is accessible for cleaning.

Preferably, the means consist of two flange couplings per pipe. This means that a piece of the part of the pipes of the final feed heater which is situated outside the furnace can be removed easily.

An advantage of the flange couplings is that they can be fitted easily, even in an existing device, and cause little or no additional turbulence in the gases flowing through the pipes, as a result of which the flow through the pipes remains undisturbed.

If the means consist of two flange couplings and the final feed heater has the configuration described above, one flange coupling can be situated before the bend in a loop and one flange coupling after the bend in a loop, as a result of which the bend can be removed easily.

Since the contamination primarily occurs in

that part of the pipes of the final feed heater where the temperature rises from approx. 300 to approx. 600°C, the means, in particular the flange couplings, should be capable of providing an effective seal over a wide temperature range. Preferably, the flange couplings are provided with gaskets, which consist of the same material as the pipes, and onto which a layer of graphite has been applied. This ensures that the flange couplings do not leak even after a prolonged period at approx. 600°C.

Preferably, the layer of graphite has the shape of a grooved profile. This ensures that the flange couplings can be sealed easily.

Heat loss resulting from the fact that, according to the invention, a portion of the final feed heater is situated outside the casing of the device can be reduced by insulating this portion using, for example, ceramic or mineral wool, for example with a thickness of up to approx. 60 mm.

The invention also relates to a method for the internal cleaning of pipes of a final feed heater in a device for cracking hydrocarbons, use being made of means via which it is possible to gain access to at least part of the interior of the pipes and which are situated on a part of the pipes which is situated outside the casing of the device.

This cleaning consists, for example, of spray-cleaning the pipes using a high-pressure water jet. A water-jet lance with a rotating spray head, which is commonly used for this purpose, is to this end introduced in succession into the contaminated parts of the pipes after they have been made internally accessible via the parts thereof which are situated outside the casing. In the event that means are provided for this purpose in the form of two flange couplings per pipe, one of which is situated before the

bend and one after the bend in the, for example, first loop of each of the parallel-connected pipes of the final feed heater, the pipes are made accessible by removing the bend situated between the flange couplings.

The invention further relates to a method for cracking hydrocarbons, the cracking being carried out in a device according to the invention.

By cracking hydrocarbons in the device according to the invention it is ensured that (e.g. on an annual basis) more hydrocarbons can be cracked, since cleaning the device according to the invention takes up less time than cleaning devices in which the characterizing measures are absent.

In particular, the device according to the invention is suitable for cracking hydrocarbons in which high-boiling fractions are present. By cracking hydrocarbons in which high-boiling fractions are present in the device according to the invention, a decrease in capacity resulting from the need to clean the device more frequently is, on the one hand, reduced by the shorter time required for each cleaning operation, and, on the other hand, compensated by a lower price of the said hydrocarbons, as a result of which the cracking of the said hydrocarbons in the device according to the invention has an economic advantage compared with cracking hydrocarbons in which these fractions are not present.

When, in the preceding text and the following text, mention is made of hydrocarbons in which high-boiling fractions are present, this is understood as meaning hydrocarbons which consist of more than 0.1% by weight of compounds in which the number of carbon atoms varies between 30 and 40 and the boiling point of which at a pressure of 0.1 MPa is more than 400°C. Hydrocarbons of this kind are primarily found in gas

condensates and gas oils. It has been found that the presence of high-boiling fractions of this kind leads to an increased contamination of the final feed heater, as a result of which the latter has to be cleaned more frequently. More frequent cleaning means that a device for cracking hydrocarbons has a lower capacity (e.g. on an annual basis). This reduction in capacity is, however, reduced considerably by the characterizing measures involved in the device according to the invention. Moreover, the reduction in capacity is more than compensated for economically by the cracking of hydrocarbons in which high-boiling fractions are present, since the latter generally cost less than hydrocarbons in which fractions of this kind are not present.

As the content of high-boiling fractions in the hydrocarbons to be cracked increases, the frequency with which the final feed heater has to be cleaned also increases, as a result of which the capacity decreases further (e.g. on an annual basis). Moreover, the price advantage of the hydrocarbons having the high-boiling fractions decreases, since the capacity is lower.

These two mutually reinforcing effects mean that the hydrocarbons therefore preferably will not contain more than 2% by weight of high-boiling fractions.

Surprisingly, the cracking of hydrocarbons in which high-boiling fractions are present in limited amounts in the device according to the invention provides a clear economic advantage over the cracking of hydrocarbons in which these fractions are not present. The limits relating to the percentages by weight of high-boiling fractions within which the cracking of hydrocarbons having high-boiling fractions in the device according to the invention provides an economic advantage are dependent, on the one hand, on

the price advantage of hydrocarbons of this kind, and also on the capacity of the device for cracking them, but they can be determined easily by a person skilled in the art, depending on the price advantage provided at a specific capacity.

The invention is explained further with reference to an example and a comparative experiment:

Example I

In a furnace consisting of a cracking section and a convection section, the final feed heater of which consists of six parallel pipes which are suspended in loop form in six vertical planes, and the first loop of each pipe of which outside the casing of the furnace is provided with one flange coupling before the bend in the loop and one flange coupling after the bend in the loop, the final feed heater was cleaned after the cracking of a gas condensate had taken place for 30 days.

For the cleaning operation, the six bends between the flange couplings situated outside the casing were removed and the pipes of the final feed heater were spray-cleaned via the openings thus formed using a high-pressure water-jet lance having a rotating spray head. The six parts were then put back in place. The time required for disassembling the parts between the flange couplings, cleaning and putting back the parts was 7 hours.

Comparative Experiment A

In a device for cracking hydrocarbons, in which the convection section contains a final feed heater having 6 parallel pipes situated entirely within the casing of the furnace, the final feed heater was cleaned after 30 days of operation, during which the same gas condensate as in Example I was cracked. To

this end, the furnace casing was removed, each pipe was sawn through at two locations, after which the contaminated pipes were spray-cleaned via the openings thus formed using a high-pressure water-jet lance. The sawn-off and cleaned parts were put back in position by making two welds at the location of the saw cuts, the furnace casing was put back and the device was put back into operation.

The time required for sawing through, cleaning and welding back the sawn-off parts was 6 days.

THIS SHEET HAS BEEN REPLACED

C L A I M S

1. Device for cracking hydrocarbons, which device is provided with a casing and contains at least a convection section and a cracking section, and the convection section of which consists of one or more feed heaters which are connected in series and comprise one or more pipes connected in parallel, characterized in that at least part of the pipes of the final feed heater is situated outside the casing of the device and the pipes contain means there via which at least part of the interior of the pipes is accessible.
2. Device according to Claim 1, characterized in that the means consist of two flange couplings per pipe.
3. Device according to Claim 2, characterized in that the flange couplings are provided with gaskets, which consist of the same material as the pipes and onto which a layer of graphite has been applied.
4. Method for the internal cleaning of pipes of a final feed heater in a device for cracking hydrocarbons, characterized in that means are used via which it is possible to gain access to at least part of the interior of the pipes and which are situated on a part of the pipes which is situated outside the casing of the device.
5. Method for cracking hydrocarbons, characterized in that the hydrocarbons are cracked in a device according to one of Claims 1-3.
6. Method for cracking hydrocarbons according to Claim 5, characterized in that high-boiling fractions are present in the hydrocarbons.

This Sheet Has Been Replaced