The invention relates to a method for depolymerising raw materials containing hydrocarbons, such as residues in a continuous process. To achieve a uniform operation using a comparatively simple technique, the raw material, which has been pre-heated to a liquid or pulpy consistency, is continuously injected under pressure into a reactor (4), which has been heated to a decomposition temperature and a gaseous fraction is continuously withdrawn from the reactor for further processing, whilst a bottom fraction is continuously removed or removed at intervals. The raw material is preferably pre-heated, liquefied and injected by an injection pump or exterior screw. A high degree of availability is guaranteed in conjunction with a mixer or doctor head, which cyclically removes deposits on the interior walls of the reactor.

Key:
A  Exhaust air
B  Top condenser
C  Reactor
d e.g., road construction
E  Consumer
1  Plastics
Additive
2  Waste oils/scavenged oils
3  Preheating
4  Injection
5  Heating oil/diesel
6  Bituminous residues
9  Distillation column
Key:
A  Exhaust air
B  Top condenser
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D  e.g., road construction
E  Consumer
1  Plastics
   Additive
   Waste oils/scavenged oils
2  Preheating
3  Injection
6  Heating oil/diesel
7  Bituminous residues
9  Distillation column
Key:
A  Liquid raw material
B  to distillation
C  Residue
D  Air
METHOD FOR DEPLOYMERISING RESIDUES CONTAINING HYDROCARBONS AND DEVICE FOR CARRYING OUT SAID METHOD

[0001] The present invention relates to a method for the depolymerization of hydrocarbon-containing residues, especially for the production of diesel oil and heating oil, according to the preamble of claim 1. The invention also relates to a device for performing this method according to the preamble of claim 15.

[0002] For the depolymerization of hydrocarbon-containing residues, especially for generating diesel oil, plastics, oils, grease, dried refuse, electrical cables, wood, paper, digested sludge, agricultural residues, natural fibers, and many other old or discarded or residue materials are depolymerized catalytically with the goal of obtaining the fewest possible solid and gaseous conversion products. These processes run at peak temperatures in the treated material between 300°C and 450°C, in most cases at a temperature in the region of 400°C, i.e., 340-440°C. For the presence of ion-exchanging catalysts, the depolymerization process, i.e., the molecule-shortening of the long-chained hydrocarbon compounds, takes place relatively quickly due to catalytic cracking. Here, the hydrocarbon molecules settle on the catalysts until they have reached the reaction temperature—dependent on the type of residue—and the degradation products vaporize. Typically, a fluid/catalyst mixture is conducted in a cycle between the evaporation temperature and the raw-material feed-in temperature. By feeding in raw material, the mixture temperature is lowered. The evaporation temperature of the desired and lower boiling fractions are reached again in a heater, such as a tubular heat exchanger, following in the cycle. The components remaining as a liquid are fed back to the raw-material feed-in. The agglomerations forming from catalyst material and higher boiling components of the raw material in this cycle process are transferred outward for further processing. The vapor fraction leaving the cycle is fractionated in a distillation system, producing, e.g., diesel oil or heating oil. Gaseous components are combusted under the production of hot combustion gases, which provide the energy necessary for evaporation, and the process temperature (cracking temperature) in the liquid cycle. If the raw material contains chlorine, sulfur, phosphorus, and/or other components that are not desired in the product (diesel oil or heating oil), these are removed in the cycle process. This takes place, e.g., through the use of calcium aluminum silicate or sodium aluminum silicate as an ion-exchanging catalyst and through the addition of, e.g., lime for the purpose of binding the chlorine, sulfur, or phosphorus components to be removed from the raw material.

[0003] For performing this known catalytic depolymerization method, various cycle methods have been described, for example, in DE 100 49 377 A1 and DE 103 16 969 A1. In the first case, shredded fine-particle raw material is transferred via a metering screw from above into a first reactor, in which recycling oil, catalyst, and raw material already fed into the cycle are mixed. The fluid-vapor mixture is fed from a heater to this reactor. The gaseous fraction and the forming solid fraction are discharged from the reactor. The raw material mixed well with the liquid is then warmed and led to the heater via a pipeline as a fluid mixture (DE 100 49 377 A1).

[0004] The catalytic depolymerization according to DE 103 16 969 A1 also leads to a catalyst suspended in recycling oil in the cycle. This is formed by the depolymerization reactor, a hydrocyclone, and a sediment container. The heating is realized in a reactor constructed in a special way through electrical wall heating. This reactor has a central feed tube for raw material, fresh catalyst, lime, and recycling oil, which are led downward with a feed screw and are there mixed with the recycling fluid flowing back from the sediment container. Within the reactor, the central tube is surrounded by several rising tubes, which allow the mixture appearing in the reactor sump to rise via feed screws. Electrical wall heating of the rising tubes ensures that the cracking temperature is reached, so that a liquid-vapor mixture is drawn away at the top reactor end.

[0005] It was found that the heating of the raw material and the fluid containing the raw material to the cracking temperature is extremely critical because only very careful heating can prevent the pyrolysis of components of the mixture due to local overheating of the liquid mixture and the baking of carbon on reactor walls or reactor baffles, especially on heat-exchanger surfaces. This has led to the result that, especially for pipe reactors, the pipes become clogged and the process stops. In general, this sediment is rock hard, so that the reactor cannot be used again.

[0006] Starting from these conditions, for a depolymerization method according to the class for improving the raw material feed-in and heat feed-in, a method with the features of claim 1 and a device with the features of claim 15 are proposed. The invention concerns the fundamental concept of injecting raw material with a liquid or slurry-like consistency preheated and under pressure, into a reactor heated to the cracking temperature.

[0007] By means of the invention it is possible, on one hand, to produce, in particular, diesel oil/heating oil in a simple way and with high yield from various organic materials, and it is possible, on the other hand, to avoid the production of by-products, such as dioxin, methanol, and others with this method of waste and residue recovery. The gas production is extremely low and can be reduced, e.g., to approximately 4.5% of the raw material. With under-grate firing, this gas can be otherwise reused in the process. The use of catalysts is possible; advantageously, the method, however, allows the avoidance of catalysts and the associated difficulties and costs in processing.

[0008] It has been pointed out that in this way the raw-material handling is significantly simplified and the risk of sticking in transport—and in the feed-in system—as well as the risk of caking in the cracking reactor are significantly reduced. Another advantage consists in that tested standard components for the pressurized injection can be used, such as those known from the injection-molding technology of plastics.

[0009] According to the invention, a wide range of different hydrocarbon-containing raw materials (here also designated in a consolidated way as residues) can be processed into liquid products, such as, in particular, diesel oil. The raw material (residues) can be primarily old, recycled, and waste material, such as plastics, oils (also waste oil and scavenged oil), grease, dried waste, electrical cables, wood, paper, digested sludge, agricultural residue, natural fibers, and many other old or waste or residue materials, and also renewable raw materials and types of rubber. Especially advantageous is the processing of plastics and waste oils. The process of
cracking or depolymerization can thus be used to produce a high-quality commercial product, namely heating oil or diesel fuel.

[0010] Especially preferred is preheating of a mixture made from plastics and waste oils, with this preheating being performed, especially preferred, to temperatures above 200°C, especially to temperatures between approximately 250°C and 300°C. Here, an essential advantage is that the water content of the charge mixture evaporates and is not led into the reactor. In addition, all of the other low-boiling materials are discharged too, which thus do not have to be transferred out by the system. The waste heat of the cracking reactor can be used for this purpose.

[0011] The plastics to be introduced are preheated, e.g., through recuperative, regenerative, or frictional heating, fed to an injection nozzle, e.g., of an extruder, and there injected into the reactor under a fixed or set pressure. Through the proper selection of the pressure build-up and/or the injection nozzle, which can also be formed by the opening of a pipeline, this process can be performed continuously, i.e., the raw material feed into the reactor is continuous and approximately constant. Keeping a constant fill state in the reactor naturally requires that the drawing off of gases and solid and liquid components and that the raw material feed-in are adapted to each other. This leads to constant processing conditions, which guarantee a constant product quality. Waste oil can be introduced into the reactor in the same way. In the reactor, the raw material is further heated, wherein the long-chained hydrocarbons are broken down into shorter-chained molecules. At this temperature, these molecules have the energy to leave the bath as gas and rise in a distillation column. According to their length, they are captured at different stages of the column. If the processing parameters of the column are set properly in a known way, then the product—diesel oil or heating oil—is obtained in an accumulator with, e.g., water cooling. Up until now, the charge material was fed into the reactor in a finely divided state without special measures.

[0012] The injection is performed in a central region of the reactor for the purpose of careful additional heating.

[0013] For further optimization in the heating of the raw material, it is proposed to form the reactor, in particular, as a rotationally symmetrical pot, e.g., with parabolic or hyperbolic inner contours, in which a multiblade mixer turns. It is advantageous if the ends of the mixing arm are composed of temperature-resistant ceramic or graphite material and/or the inner contours of the reactor are essentially duplicated with especially very small play, in order to prevent or eliminate deposits. In this way, the disruptive carbon is deposited onto the bituminous slurry formed as a waste product and is discarded with this slurry instead of caking onto the heated walls of the reactor.

[0014] If a pot-shaped reactor with stirring arms is used, the heat transfer is made more intense and turbulence is produced in the liquid, which allows the temperature at the top surface to fall, leading to reduced formation of free carbon. The stirring near the surface, or even scraping, prevents deposits and overheating for a simultaneously improved heat transfer through the reactor wall.

[0015] The surface cleaning of the reactor inner wall can also be performed optionally without a targeted mixing effect by means of a cyclical scraping device, which has stand-alone inventive significance and which is guided cyclically along the contours of the reactor inner wall, preferably with minimal or even no lateral play. Rotationally symmetric reactor inner wall contours are preferred for this purpose. In this case, a scraping head of the scraping device carries at least two contour-matching scraping elements driven to rotate. These can be equipped with an exchangeable, closing lining, wherein exceeding the permitted wear play can be detected, e.g., through electrical measurements. If the scraping head makes contact with or is pressed against the reactor inner wall by its own weight or under the effect of a force applied through its rotational shaft, even small agglomerations can be removed from the reactor inner wall and fed, e.g., to a reactor sump for transferring outward.

[0016] Such scraping devices are subject to a certain caking risk under some circumstances, which could limit their effectiveness. For this purpose, the scraping device can be protected by a self-cleaning element, which can be activated from time to time for, in particular, a scraping cleaning of the scraping elements by means of the scraping head. Typical cleaning cycles of a rotating scraping device with two blades equal approximately 1-1000 cleaning cycles per hour; preferably, the rotational speed of a scraping head equals from 1-20, preferably from 5-10 rotations per minute. According to the reactor size and caking susceptibility of the raw material to be depolymerized, the weight of the scraping device, which generates a certain contact pressure, can equal a few grams up to a few thousand kilograms. For a reactor capacity of approximately one cubic meter, typical weights of the scraping head are on the order of magnitude of 10-1000 kg, preferably between 50 kg and 200 kg.

[0017] Under the effect of such a scraping device, which, as preferred, also has a mixing effect, the temperature differences between the average desired temperature in the liquid to be depolymerized within the reactor and on the reactor outer wall can be kept advantageously low and can be held, e.g., on the order of magnitude between 20°C and 80°C.

[0018] Another aspect of the invention is the improvement of a scraping device for depolymerization reactors and the like. In this respect, a self-cleaning element of the scraping head is proposed for occasional cleaning of the scraping element during the continuous depolymerization operation. As one of the practical implementations, the self-cleaning element can move relative to the scraping element under mutual contact on the scraping element. Such movement can be performed both perpendicular to the scraping edge and also along this edge. The activation is performed preferably by means of a rotary shaft, especially through a telescoping motion. Self-cleaning scraping elements are of stand-alone inventive significance.

[0019] Another aspect of the invention is a reactor structure which supports the continuous availability of the depolymerization system. In this respect, the reactor can be separated, together with its heater, from a reactor cover with the distillation column through lowering, and can be exchanged for a new or overhauled reactor. If the reactor is shaped like a pan and can be inserted into a heating jacket, the reactor can be exchanged quickly, e.g., for overhauling purposes. Flow guiding elements on its outer surface permit effective heat guidance for heating, for maintaining the temperature, and also for cooling. This aspect of the invention is also of stand-alone inventive significance.

[0020] The components to be used according to the invention, which have been named above and which are also claimed and described in the embodiments, are not subject to any special exceptional conditions in terms of their size,
shape, material selection, or technical conception, so that selection criteria known in the field of application can be used unrestricted.

[0021] Additional details, features, and advantages of the subject matter of the invention emerge from the subordinate claims and also from the following description of the associated drawing and table, in which—as an example—an embodiment of catalytic depolymerization is shown.

[0022] Shown in the drawing are:

[0023] FIG. 1, a block circuit diagram of a depolymerization system;

[0024] FIG. 2, an overview of the practical setup of a depolymerization system;

[0025] FIG. 3, a schematic representation of the reactor of a depolymerization system, including the reactor heater, as a principle view in a vertical section through the reactor middle;

[0026] FIG. 4, a detailed view of the coupling of a scraping head to a rotary shaft for a reactor according to FIG. 3;

[0027] FIG. 5, a sectional view (section along the line V-V) from FIG. 3, which shows a scraping element held and moved by a holder, from the same reactor;

[0028] FIG. 6, a perspective view of the outside of the reactor from FIG. 3;

[0029] FIG. 7A, a scraping head in the scraping position for a depolymerization reactor;

[0030] FIG. 7B, the same scraping head in the self-cleaning position;

[0031] FIG. 8A, an alternative embodiment of a scraping head in the scraping position;

[0032] FIG. 8B, an enlarged section view of the same scraping head in a position during the self-cleaning of the scraping head; and

[0033] FIG. 8C, another enlarged detailed view of the same scraping head (in the position according to FIG. 8B).

[0034] The block circuit diagram of FIG. 1 shows that raw material 1 composed of plastics and waste oil is heated in a preheating stage 2 to 250°C and then fed to a device for pressure injection, such as a pressure and feed pump (injection 3) known for the injection molding of plastic. This pump permits the direct injection of the raw material into a craking reactor (reactor 4), whose liquid contents are kept by a heater 5 (with, e.g., oil or gas and an exhaust-gas temperature of approximately 800°C) at a cracking temperature between approximately 300°C and 460°C, preferably between 340°C and 440°C, and especially between 390°C and 420°C, and its waste heat is recovered partially in the preheating stage 2, e.g., a recuperative heater. From the reactor 4, a gaseous fraction is drawn off, which is obtained as product 8 after corresponding handling, like fractionated distillation. Likewise in a known way, the solid matter produced in the reactor is drawn from the reactor 4, usually freed from oil, and obtained as residue 7 and optionally processed further.

[0035] It is understood that the reactor 4 can be built in various ways. Similarly, there are no narrow restrictions for the heater 5.

[0036] FIG. 2 gives a basic representation of the possible structure of a depolymerization system according to the invention. The preheating of the raw material 1 is performed in a feed and compressor screw through external heating and/or friction. Here, different raw materials are fed at different points, such as plastics, oils, especially waste scavenged oils, and optionally additives. After at least partial preheating, the pressure drops. In the expansion stage 2A, water vapor and other gases can be fed via an exhaust-air line, e.g., to a filter. The raw material, which in-between is nearly or almost completely liquid or slurry-like, is transported by means of the outer end of the feed screw, under optional additional heating and also the build-up of internal pressure, and injected into the interior of a pot-shaped depolymerization reactor 4 heated on the outside. The reactor cover 4D carries a distillation column 9, which is connected on the output side to a head condenser and a product tank, e.g., for heating oil/diesel. Sump products are transferred outward at 4B for further processing/reuse. The gaseous cracking products are guided after the outlet from the depolymerization reactor, preferably through a high-speed cyclone with a large safety container. This cleans the vapors of particles carried along by aerosols by means of so-called demisters. From there, the desired cracking products are led into the distillation column. The fill state in the reactor 4 is preferably measured and regulated to a desired value. This is performed with known measurement probes while leaving open a gas space 4A (see FIG. 3).

[0037] Through a mixing/scraping head visible from FIG. 3, the reactor inner wall 4C is cleaned continuously, wherein solid components are fed downward to the reactor sump in a preferably spiral movement. The fill state of the reactor sump with solid components is monitored, preferably using a non-contact method. The reservoir 4B holding the sump product permits the collection of solid components in a steady flow zone.

[0038] FIG. 3 shows a principle view (in central vertical section view), for example, of a pot-shaped, rotationally symmetric reactor 4 with a stirrer 8 with several stirring arms 8A and blade-like mixing elements 8B, which can be made at least partially from ceramic or graphite material. The mixer elements 8B are adapted to the domed inner contours, i.e., the inner wall 4C of the reactor 4, wherein a relatively small gap S can be maintained. Therefore, the inner contours of the reactor 4, which is heated preferably on the outside, are constantly freed from caking deposits. In addition, overheating of the reactor contents close to the walls is prevented by means of thorough mixing of the reaction contents. In the embodiment, the reactor outer wall 4E forms part of a blast box of a heater 5. For this purpose, the reactor pot 4G is set with its surrounding opening flange 4G' on a flange 5A' of a box-like heating jacket 5A. Within the heating jacket 5A there is an intermediate base 5B, which has perforations and which is supplied with hot gas at, e.g., 560°C via a flexible line 5C from a mixer 5D. This is produced by mixing the exhaust gases of a gas-heated flame, to which air, e.g., at room temperature (RT) is added by means of a fan 5E. The hot exhaust gases leave the heating jacket via an outlet 5F. The reactor 4 is closed tight by a reactor cover 4D contacting the opening flange 4G'. This cover carries a distillation column 9 and holds the raw-material feed 4H. It is held stationary on a suitable frame. For cleaning purposes and the like, the reactor pot 4G together with the heating jacket 5A can be detached from the reactor cover 4D and lowered, as shown by double arrows A, and can then be moved out of the position beneath the reactor cover 4D, e.g., through pivoting (double arrows R). In this way, the stirrer or scraping head still to be described can be removed at the same time (FIG. 4). The outlet for residue is correspondingly flexible or is connected detachably to a residue line. In the embodiment, the outlet is composed of a reactor sump 4B, which is provided with a heat-insulated
wall 4B' guided outward through the heating jacket or blast box and which can be closed intermittently with a discharge air-lock 4J.

[0039] As is visible from FIG. 4, the rotary shaft 4E of a scraping or mixing head shown in FIGS. 7 and 8 can be decoupled by a pluggable rotary drive connection, so that the head can have vertical play, while the drive motor M remains fixed with its drive shaft on the reactor cover 4D.

[0040] FIGS. 7A-7B show a first embodiment of a scraping head 10D, as it can be used as a stirrer in the embodiment according to FIG. 1. In these figures, two side views are designated with a) and c), respectively, and the view from above is designated with b). The two approximately quarter-circle blades 10B, which together form an approximate half-moon shape and which act or are formed as scraping elements 10C on their radial outside, can be seen from FIG. 7B-a). The scraping elements 10C can contact the inner wall 4C of the reactor 4 under the weight of the scraping head 10D. During the depolymerization process, the scraping head 10D, also acting as a mixer, is rotated slowly, e.g., at 5-10 revolutions per minute. In this way, the reactor walls are kept free from deposits. After a certain operating period, which can be determined through experience or measurement, the scraping head 10D is cleaned under continuous rotation or during a break in the rotational movement by a self-cleaning element 10G. This is duplicated in the embodiment of the sickle shape of the blades 10B and located during the normal scraping operation in a position at a distance from the reactor wall, as shown in FIG. 7B. The self-cleaning element 10G is connected to a drive element 10H, which is guided in a telescoping way in or on the rotary shaft 10E. Through a telescoping movement of the drive element 10H, the self-cleaning element 10D is displaced vertically. Here, its scraping edge 10G' contacts the blades 10B and removes any cake deposits in a scraping way from the blade surfaces on the front side in the rotating direction up to near or against the scraping edge of the scraping element 10C. This scraping self-cleaning step can also be performed through multiple back and forth movements. Alternatively, it is also possible for the self-cleaning to execute the relative movement between the self-cleaning element and the scraping element so that the self-cleaning element remains in its original position and the scraping element is raised by a suitable amount and then lowered again.

[0041] For the embodiment shown in FIGS. 8A to 8C, the scraping elements 10C are provided with profiles which have C-shaped cross sections and which connect to the bottom end of a rotary shaft 10E and which each hold a drive element 10H in a guiding way. A self-cleaning head 10G' can also be guided along the scraping element 10C and is arranged on this element in mutual contact. This self-cleaning head is connected to one end of the associated drive element 10A and is therefore moved along the scraping edge when the drive element 10H is moved in a telescoping way relative to the rotary shaft 10E. The figures show different intermediate positions of the self-cleaning head. In the shown embodiment, this has an approximate U-shape, wherein the U-legs do not project outward past the scraping edge of the scraping element 10C. The possible uses correspond to the embodiment according to FIGS. 7A-7C.

[0042] Incidentally, the scraping elements can be formed in very different ways. In the embodiment from FIG. 5, the scraping element 10C is composed of a material profile held by a holder 10F with the intermediate position of a separating layer 12A, wherein the material can be selected according to the desired wear resistance or reactor wall protection. In the embodiment, the wear is already far advanced, so that the holder 10F nearly touches the reactor wall. When the wear is advanced so far that such contact occurs, the holder 10F and the scraping element 10C are bridged in an electrically conductive way by the reactor wall 4C. An evaluator circuit then determines the permitted limiting wear and reports that the scraping element 10C is to be replaced.

[0043] From FIG. 6 it can be seen that the reactor pot 4G is provided on its outer wall 4E with flow-guiding elements 4F, which promote effective heating or cooling. In particular, a circulating flow of hot air can be achieved. The heating jacket 5A of the heater 5 can be shaped accordingly for further promotion of this purpose. Likewise, the flow-guiding elements can be adapted to the inner contours of the heating jacket 5A. Through a fixed connection of the flow-guiding elements to the reactor outer wall, an especially quick exchange of the reactor pot is possible, because this can be separated easily from the heating jacket.

LIST OF REFERENCE SYMBOLS

[0044] 1 Raw material
[0045] 2 Preheating stage
[0046] 2A Expansion stage
[0047] 3 Injection
[0048] 4 Reactor
[0049] 4A Gas space
[0050] 4B Sump
[0051] 4B' Wall
[0052] 4C Inner wall
[0053] 4D Reactor cover
[0054] 4E Outer wall
[0055] 4F Flow-guiding element
[0056] 4G Reactor pot
[0057] 4G' Opening flange
[0058] 5 Heater
[0059] 5A Heating jacket
[0060] 6 Product
[0061] 7 Residue
[0062] 8 Stirrer
[0063] 8A Arm
[0064] 8B Mixer element
[0065] 9 Distillation column
[0066] 10 Scraping device
[0067] 10A Arm
[0068] 10B Blade
[0069] 10C Scraping element
[0070] 10D Scraping head
[0071] 10E Rotary shaft
[0072] 10F Receiver
[0073] 10G Self-cleaning element
[0074] 10G' Scraping edge
[0075] 10G'' Self-cleaning head
[0076] 10H Drive element
[0077] 12 Wear detecting device
[0078] 12A Separating layer

1. Method for the depolymerization of hydrocarbon-containing raw materials, such as residues, in a continuously operating process, characterized in that the raw material is continuously injected under pressure in a preheated state and with a liquid or slurry-like consistency into a reactor heated to the cracking temperature and a gaseous fraction is continu-
ously drawn out of the reactor for further processing and also a sump fraction is transferred outward from the reactor continuously or at intervals.

2. Method according to claim 1, characterized in that the injection is performed under pressure by means of an injection pump or extruder screw, especially one like those known from plastic injection molding.

3. Method according to claim 1, characterized in that the raw material in an injection pump or extruder screw is exposed to a pressure between 100 and 1 bar, preferably between 100 and 2 bar.

4. Method according to claim 1, characterized in that the preheating is performed to a temperature above approximately 100°C, preferably above approximately 250°C.

5. Method according to claim 1, characterized in that the preheating is performed in two stages, wherein, in a first stage, raw material reaches a temperature of approximately 100-150°C under kneading and compression for removing gases and interstitial spaces, and in a second stage, preheating to approximately 200-300°C is performed while simultaneously building up the pressure.

6. Method according to claim 5, characterized in that a pressure expansion stage for separating gases, such as water vapor, is initially performed in connection with the first preheating stage.

7. Method according to claim 1, characterized in that the raw material contains at least one plastic.

8. Method according to claim 1, characterized in that the raw material contains at least one oil.

9. Method according to claim 1, characterized in that heated wall zones of the reactor are cooled through stirring of the reactor contents close to the wall.

10. Method according to claim 1, characterized in that the reactor temperature at the inner wall is kept at a temperature between 300°C and 460°C, preferably between 340°C and 440°C, and very especially preferred between 390°C and 420°C, during the depolymerization.

11. Method according to claim 1, characterized in that the raw material is fed at a distance from the reactor wall, especially into a central region of the reactor, to the fluid subject to the depolymerization.

12. Method according to claim 1, characterized in that heated wall zones of the reactor are cleaned of any caking deposits cyclically over their entire surface during the depolymerization by means of a scraper adapted in shape to the wall contour.

13. Method according to claim 12, characterized in that the scraper is subject to self-cleaning from time to time.

14. Method according to claim 1, characterized in that the reactor is replaced by separating it from its cover and/or from further processing stages, for example, from a distillation column, and lowering it as well as moving it laterally or pivoting it if necessary.

15. Device for the depolymerization of hydrocarbon-containing raw materials, such as residues, in a continuously operating process, comprising a heated cracking reactor, a device for preheating liquid, paste-like, and/or solid hydrocarbon-containing raw materials, a device for feeding the raw material with a liquid or slurry-like consistency into the reactor, a distillation column connected fluidly to a gas space of the reactor, a reactor sump for the outward transfer of sump material, and also a scraping device for the cyclical cleaning of at least the liquid-covered reactor inner walls during the depolymerization process.

16. Device according to claim 15, characterized by a pressure injection device, such as an injection pump or an extruder screw, for preheated raw material, which is connected as a feed-in device to the input of the cracking reactor for injecting the preheated raw material under pressure into the cracking reactor.

17. Device according to claim 15, characterized by a pot-shaped reactor.

18. Device according to claim 17, characterized in that the reactor has a rotationally symmetric inner contour.

19. Device according to claim 18, characterized in that the reactor has an approximately crowned inner contour.

20. Device according to claim 15, characterized by a multi-blade, rotating/rotatable mixer or stirrer with arms and blades.

21. Device according to claim 20, characterized in that the blades consist at least partially of temperature-resistant ceramic or graphite material.

22. Device according to claim 20, characterized in that the blades essentially duplicate the inner wall contour of the reactor.

23. Device according to claim 15, characterized in that scraping elements of the scraping device essentially duplicate the inner wall contour of the reactor.

24. Device according to claim 23, characterized in that the scraping device has a scraping head, which is composed of a rotary shaft and at least two blades, which have scraping elements.

25. Device according to claim 24, characterized in that the scraping head contacts the inner wall of the reactor with its own weight and/or by means of a pressure force maintained by means of the rotary shaft.

26. Device according to claim 25, characterized in that the rotary shaft has an especially pluggable rotary drive connection, which permits movement of the scraping head with increasing wear of the scraping elements for equalizing the wear play.

27. Device according to claim 23, characterized in that the blades of the scraping head have a holder for a scraping element formed as a wear part.

28. Device according to claim 27, characterized by a separating layer for preventing contact between the holder and the scraping element on the blades.

29. Device according to claim 23, characterized by a wear detection device for the scraping elements.

30. Device according to claim 29, characterized by an electrical circuit that detects an electrically conductive bridge between a scraping element and a holder or attachment of the scraping element as a signal for an advanced state of wear of the scraping element.

31. Device according to claim 24, characterized by a self-cleaning element of the scraping head for occasional cleaning of the scraping element, especially during the continuous depolymerization operation.

32. Device according to claim 31, characterized in that the self-cleaning element moves relative to the scraping element under mutual contact on the scraping element.

33. Device according to claim 31, characterized in that the self-cleaning element can be displaced along the scraping element by means of a drive element guided on or in the rotary shaft.

34. Device according to claim 32, characterized by a contour of a scraping edge of the self-cleaning element corresponding essentially to the contour of the scraping elements.
35. Device according to claim 31, characterized in that the self-cleaning element is arranged on the front side of the scraping element in the direction of movement.

36. Device according to claim 31, characterized by a self-cleaning head that can move along the scraping edge of the scraping element.

37. Device according to claim 36, characterized in that the self-cleaning head can be moved along the scraping element by means of an elastic drive element guided along the scraping element.

38. Device according to claim 15, characterized in that the reactor is preferably separated together with its heater from a reactor cover, can be separated from the distillation column by lowering, and can be exchanged for a new or overhauled reactor.

39. Device according to claim 38, characterized in that the reactor can be set deeply in a heating jacket.

40. Device according to claim 38, characterized in that the reactor has flow guiding elements on its outer wall to intensify the heat contact between the reactor and the fluid cooling or heating the reactor outer wall.

41. Device according to claim 40, characterized in that the flow-guiding elements create a circulating fluid flow at least on a partial circumferential surface of the reactor.

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