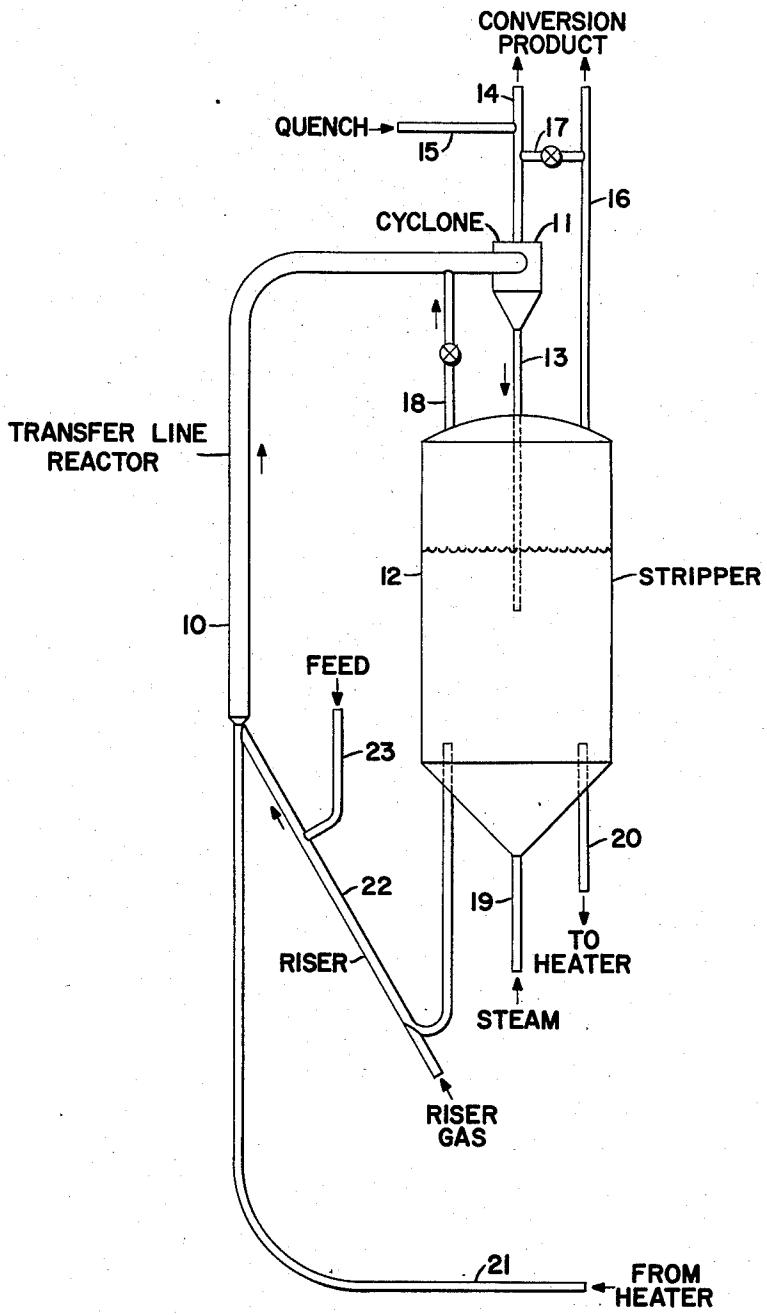
Sept. 8, 1959 W. J. METRAILER 2,903,416

TRANSFER LINE CHEMICALS COKING PROCESS

Filed June 26, 1956



William J. Metrailer Inventor

By L. A. Strimbeck Attorney

United States Patent Office 2,903,416 Patented Sept. 8, 1959

2,903,416

TRANSFER LINE CHEMICALS COKING PROCESS

William Joseph Metrailer, Baton Rouge, La., assignor to Esso Research and Engineering Company, a corporation of Delaware

Application June 26, 1956, Serial No. 594,031

4 Claims. (Cl. 208—127)

This invention relates to a transfer line, residua coking process for the production of chemicals and chemical intermediates. It is more particularly concerned with the conversion of heavy hydrocarbon oils by contact with highly heated solids flowing through an elongated, narrowly confined conversion zone, to predominantly coke, low molecular weight, normally gaseous, unsaturated hydrocarbons and aromatic, unsaturated, low boiling, normally liquid hydrocarbons.

There has been an increasing demand for low molecular weight, normally gaseous, unsaturated hydrocarbons such as ethylene, propylene and butadiene. One of the means of producing these materials is by the coking of heavy hydrocarbon oils. Typical heavy hydrocarbon oils utilized are reduced crudes, vacuum bottoms, pitch, asphalt, other low value heavy hydrocarbon residua or mixtures thereof. Typically, such feeds have an initial boiling point above about 700° F., an API gravity of about 0° to 20°, and a Conradson carbon residue content of about 5 to 40 wt. percent (see ASTM test D–189–41).

One method of coking such heavy oils has been to contact the oils with solids at a temperature above 1200° F. in what has been termed a "transfer line reaction zone." The solids are passed rapidly through the transfer line zone, and the injected residual oil, upon contact with the solids, undergoes pyrolysis—depositing coke on the solids and evolving lighter hydrocarbon products.

One of the troubles associated with this type of operation has been obtaining good distribution of the injected residual oil on the solids. The contact times in such a transfer line operation are usually below about 5 seconds, contact times beyond this resulting in poor product distributions and yields. With such a short contact time, it is difficult to assure good contacting of the liquid viscous oil feed and the highly heated solids. Besides a loss in coking efficiency, maldistribution of the feed often results in coking of the equipment at or near the point of feed injection.

This invention provides an improved method for coking residual oils in a transfer line system, with special provision for assuring proper feed distribution. This improved method comprises first premixing the feed with flowing, relatively cool, particulate solids, recovered from the transfer line reaction zone effluent, so that the temperature of the resulting mixture is subtantially below, i.e., 50° to 500° F. below the reaction zone temperature. This lower temperature permits longer contacting times to be realized and thus adequate and uniform distribution of the feed on the solids can be obtained. After obtaining good distribution of the liquid feed on the cool solids, the temperature of the admixture is raised to the desired reaction temperature by the injection of freshly heated solids.

It will be appreciated by those skilled in the art that with heavy residua boiling predominately above 900° F., this problem of feed distribution is most acute. With

lighter materials, such as gas oils, that are readily vaporizable, the problem of feed distribution rarely occurs.

This invention will be better understood by the following description of the drawing attached to and forming a part of this specification.

The drawing illustrates a transfer line reactor conversion system comprising a transfer line reactor **10**, a cyclone or solids separating system **11**, and a stripping zone and solids reservoir or holdup chamber **12**. The conversion products and entrained solids issuing from reactor **10** are separated in cyclone **11**, the separated solids being passed by line **13** to the stripping zone. The conversion products are removed overhead from cyclone **11** by line **14**. A quench medium, preferably a liquid, is injected into the conversion products by line **15**.

The solids separted in cyclone **11** are retained in the stripper **12** to permit further cracking of any heavy hydrocarbonaceous material retained in the solids. These secondary conversion products are removed from the stripper by line **16**. Because a seal must be maintained between cyclone **11** and stripper **12**, it is desirable in many cases to either pass the secondary conversion products by lines **16** and **17** to line **14** before the quench point, or by line **18** to the inlet of the cyclone. This arrangement stabilizes the seal between the vessels so that it does not change with changes in the pressure drop across the quench point.

Steam or other fluidizing or stripping gas can be admitted to the base of vessel **12** by line **19**.

A portion of the solids in stripper **12** is passed by line **20** to an external heating means or system not shown. This heating means may comprise a burner such as a fluid bed or a transfer line burner for consuming a portion of the coke deposited on the circulating solids. In cases where the value of the coke is greater than other extraneous liquid or gaseous fuels, the latter may be burned to supply part or all of the heat required. The solids are heated to a temperature 100° to 400° F. above the desired chemicals coking temperature. The solids so heated are returned to the base of reactor **10** by line **21**, being conveyed by suitable conveying gas such as steam, nitrogen, CO_2, etc.

According to this invention, the heavy viscous residual oil feed is injected into the reactor **10** by premixing it with relatively cooler flowing solids in a riser **22**. The cooler solids are withdrawn from stripper **12** by line **22** and circulated to the feed injection point by means of a suitable riser or conveying gas such as steam, CO_2, light hydrocarbons, etc. Relatively dense phase conditions are maintained in the riser such that the feed injected by line **23** has a sufficient amount of solids available upon which to be distributed, and the density of the solids is such as to prevent undue contacting of the fresh feed with the riser walls. Because the temperature of the resulting admixture is substantially below the chemicals coking temperature, preferably at least 50° F. below, more time is permitted in the riser for the natural agitation and mixing of the fluidized particles to properly distribute the feed. Contact times in the range of 0.1 to 5 seconds are ordinarily realized in the riser before the heated solids are injected.

After permitting adequate time for distribution of the feed, the heated solids from line **21** are mixed with the contents of line **22** to raise the temperature thereof above 1200° F. The resulting mixture is then rapidly flowed through reactor **10** to cyclone **11**. The conversion products are quenched with the quench medium supplied by line **15**, preferably to below 700° F., within 0.1 to 5.0 seconds after the heated solids are mixed with the contents of line **22**. This quench can comprise liquids, e.g., water or cooled oils; solids, e.g., cooled coke particles; or gases, e.g., cooled light hydrocarbons or

steam. The conversion products, after quenching, are subjected to further processing to recover the desired products. This further processing can include by way of illustration—fractionation, absorption, crystallization, extraction, extractive or azeotropic distillation, and polymerization.

The following table, with reference to the drawing, summarizes the pertinent operating conditions and presents a specific example thereof.

Operating conditions

	Preferred Range	Example[1]
Riser 22:		
Temp. before feed injection, ° F.	1,200 to 1,600	1,400
Density before feed injection, lbs./cu. ft.	10 to 45	30
Riser gas superficial velocity, before feed injection, ft./sec.	1 to 20	3
Residua feed injection, lbs./lb. solids circulated.	0.1 to 0.4	0.2
Temp., after feed injection, ° F.	900 to 1,200	1,100
Feed contact time in riser, sec.	0.1 to 5.0	1.0
Transfer Line Reactor 10:		
Temp. of Added Solids, ° F.	Above 1,300	1,600
Amount of added solids, percent of total in T.L.	Above 70	80
Temp. after addition of solids, ° F.	1,200 to 1,600	1,400
Density after addition of solids, lbs./cu. ft.	0.5 to 4	1
Riser gas superficial velocity, after addition of solids, ft./sec.	25 to 60	45
Average feed residence time before quench, sec.	0.1 to 5.0	0.25
Pressure at cyclone outlet, p.s.i.a.	5 to 35	25

[1] Based on the contact solid comprising particulate coke produced by the process under 1000 microns in size, 200 microns average size, and using a Hawkins residuum having an I.B.P. of 900° F.

Having described this invention, what is sought to be protected by Letters Patent is succinctly set forth in the following claims.

What is claimed is:

1. In a coking process for converting heavy hydrocarbon oils boiling predominantly above 900° F. to lighter hydrocarbon products by contact with a dispersed suspension of particulate solids at a coking temperature in the range of 1200° to 1600° F. in a transfer line reaction zone, the improvement which comprises mixing said oil in an amount in the range of 0.1 to 0.4 lb./lb. with flowing particulate solids recovered from the transfer line reaction zone effluent to form a dense phase suspension in a riser, the temperature of the resulting mixture being from 50° to 500° F. below said coking temperature in said transfer line reaction zone, and thereafter adding freshly heated solids having a temperature above 1300° F. to said mixture without separating said initially mixed solids from said mixture to raise the temperature of the resulting mixture to said coking temperature of about 1200° F.–1600° F. and passing the thus heated mixture as a dispersed suspension through said transfer line reaction zone.

2. Process of claim 1 wherein said mixture is maintained in the riser for a time in the range of 0.1 to 5 seconds, and said heated mixture is maintained at coking temperature for a time less than 5 seconds.

3. The process of claim 1 wherein said lighter hydrocarbon products are separated from the solids issuing from said transfer line reaction zone, the solids so separated are received and retained in a stripping zone, and a portion of the solids from the stripping zone is directly mixed with the heavy hydrocarbon oil feed in the riser and the remainder of the solids is circulated through a heating zone to supply said freshly heated solids.

4. Process of claim 1 wherein the solids initially mixed with said heavy hydrocarbon oil feed amount to less than 30% of the solids passed through said transfer line reaction zone.

References Cited in the file of this patent

UNITED STATES PATENTS

2,731,508	Jahnig et al.	Jan. 17, 1956
2,734,853	Smith et al.	Feb. 14, 1956
2,735,804	Boston et al.	Feb. 21, 1956
2,737,479	Nicholson	Mar. 6, 1956
2,813,916	Boston	Nov. 19, 1957