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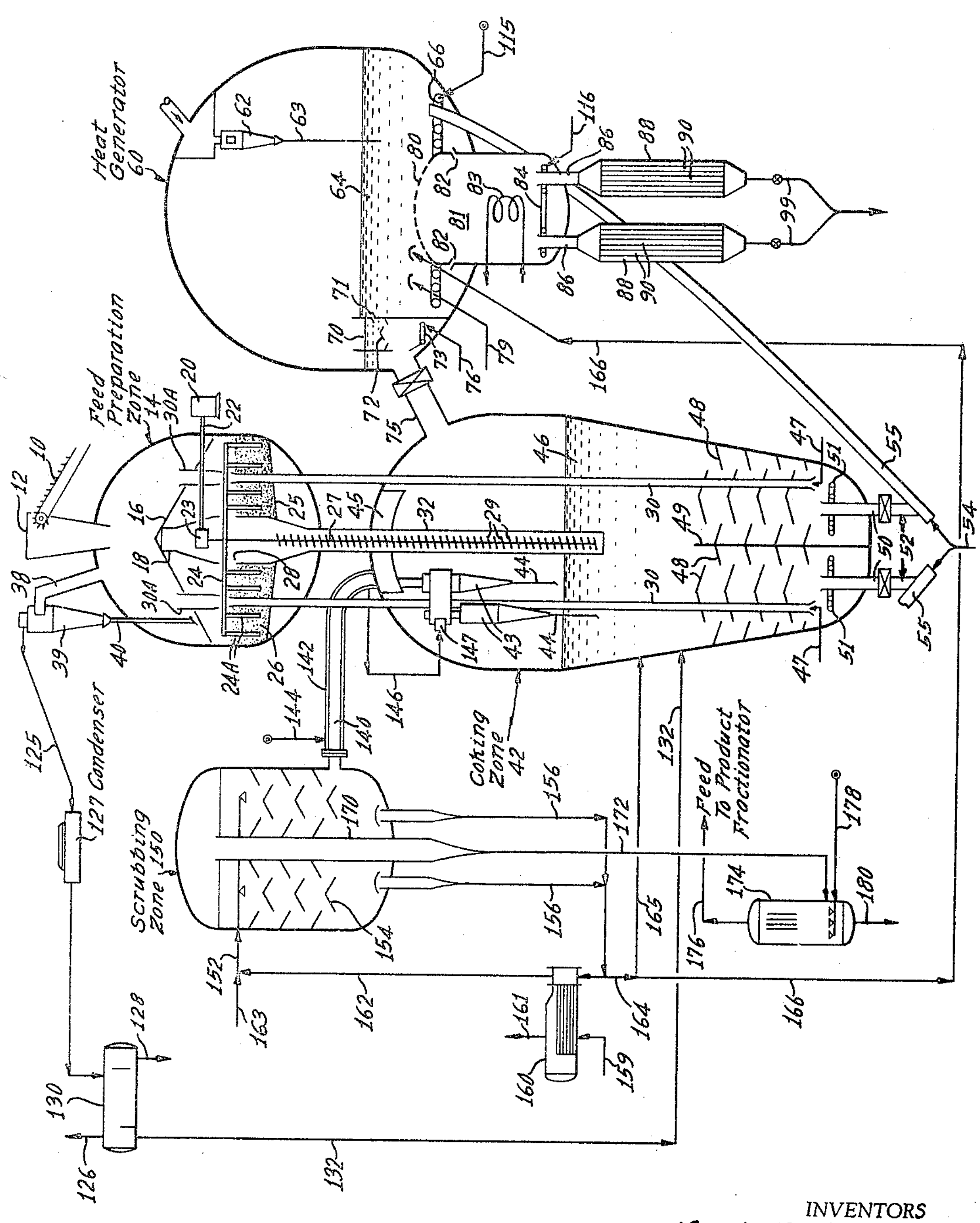

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FLUID COKING OF TAR SANDS

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The present invention relates to the recovery of hydrocarbons from tar sands, and, more particularly, the invention relates to the recovery of hydrocarbons from tar sands by fluid coking of the tar sands. Still more particularly, this invention relates to a novel and efficient method for introducing tar sands containing hydrocarbon as well as solid material into a fluid coking zone.

Tar sands exist in various areas of the world and contain appreciable quantities of hydrocarbons. The Athabaska tar sands of Canada is one example of a deposit of such sands which comprise a vast reserve of hydrocarbon constituents. It is known that the oil content of such sands may vary from about 5% to about 21% by volume, the gravity of the oil ranging from about 6° to about 10° API. These sands may lie from about 200 to about 300 feet below an overburden and the beds may range from about 100 to about 400 feet in depth. As mined and received for processing, the tar sands are generally present as agglomerates or lumps consisting essentially of fine grain sand and clay, water, and viscous hydrocarbonaceous material called bitumin. These agglomerates may range in size from about ½ to 4 inches in diameter, depending upon the mining method and equipment employed. A typical oil recovered from the sands has an initial boiling point of about 300° F., 1% distilled to 430° F., 20% distilled to 650° F. and 50% distilled to 980° F.

Unfortunately, the tar sands received from the mine in an agglomerated condition are apparently unsuited for direct introduction to a fluid bed conversion zone to recover the hydrocarbon values. Moreover, the Athabaska sands, for example, cannot be recovered readily by conventional water techniques, since an amount of clay exists in the sands sufficient to retard the recovery of the oil. For these reasons, prior art methods have proceeded by treating tar sands in accordance with solvent extraction techniques to prepare hydrocarbons for introduction to a suitable conversion zone. In accordance with one such solvent extraction technique, the tar sand agglomerates are contacted with a suitable solvent such as a gas-oil boiling range fraction to produce a solution of bitumin and gas-oil. Such solution is separated from the sand and is passed to a conventional hydrocarbon conversion unit, such as a fluid coking or cracking unit. Another extraction technique requires the addition of water to the tar sands and passage through a shearing-mixing zone in order to separate an oil phase from a water phase, the oil phase then being passed to a conventional hydrocarbon conversion unit. Unfortunately, the pretreatment of the tar sands by such techniques in order to separate an enriched hydrocarbon stream from the sand material substantially increases the recovery costs; and it is therefore desired to introduce tar sands directly into a suitable hydrocarbon conversion unit.

It is, therefore, an object of the present invention to overcome the inherent disadvantages of the prior art and to provide efficient method and means for the recovery of hydrocarbons from tar sands.

Another object of this invention is to provide an efficient method for the introduction of tar sands to a hydrocarbon conversion zone wherein a fluidized bed of solid material is maintained at an elevated temperature.

Another object of the present invention is to provide a method for introducing tar sands into a fluid coking zone and maximizing the recovery of hydrocarbon oil.

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Further objects and advantages of the present invention will become apparent to those skilled in the art from the following description and disclosure.

The objects are generally accomplished in accordance with the present invention by the introduction of tar sands agglomerates consisting essentially of sand particles and inert material, hydrocarbon material, and water, essentially as mined into a feed preparation zone, admixing relatively hot contact material with the agglomerates in the first zone in order to drive off water and reduce the viscosity of hydrocarbon material and thereby providing a fluidizable mixture of sand particles and hydrocarbon material. A portion of the fluidizable mixture is then passed through a pressure developing zone, e.g., such as a pressure developing column of the fluidizable mixture maintained in a standpipe, and introduced into a second zone, which is a reaction zone containing a fluidized bed of solid particulate material, e.g., such as a hydrocarbon conversion zone maintained under conditions suitable for carrying out thermal coking of the hydrocarbon material introduced thereto.

The term "relatively hot contact material" as employed in the specification includes solid contact material such as sand particles, for example, as well as gaseous material, such as hydrocarbon vapors, flue gas, steam, or mixtures thereof, such contact material being at a substantially elevated temperature relative to the temperature of the tar sand agglomerates. The term "tar sands agglomerates" refers to the tar sands feed material essentially as it is received from the mining operation. The agglomerates consist essentially of sand particles and other inert material, e.g., clay, held together in lumps of irregular size and shape by the viscous hydrocarbon material and water. The agglomerates are unsuited for handling by conventional fluidization techniques by reason of their large and irregular sizes and shapes ranging, for example, between ½ and 4 inches in diameter. The agglomerates are preferably reduced in size prior to introduction to the feed preparation zone in which they are admixed with relatively hot contact material in order to provide a uniform top size which is preferably about 1 inch in diameter. The temperature of the agglomerates fed into the feed preparation zone is usually ambient temperature, although it is apparent that the feed can be preheated prior to introduction to the preparation zone. The term "fluidizable mixture" employed in this specification to denote the product of the feed preparation zone encompasses mixtures of hot contact material with sand and hydrocarbons derived from the feed agglomerates which have lost the characteristics of separate agglomerates having been flowed together by the action of the elevated temperature contact material. Such fluidizable mixtures can be flowed downwardly as a pressure developing column of solid material employing mechanical agitation as needed to prevent bridging in the column. It is pointed out that the term "fluidizable mixture," as employed herein, is not limited to those mixtures which may be fluidized by means of gaseous material, alone, but include flowable mixtures of sand and hydrocarbons which are fluidizable by means of gaseous material in conjunction with mechanical fluidization aids, e.g., such as hereinafter described, and by mechanical means, alone.

In accordance with a preferred embodiment of the method of the present invention, tar sands agglomerates are introduced into a feed preparation zone and admixed therein with relatively hot particulate material obtained from a reaction zone. The feed preparation zone is maintained under temperature conditions to convert the agglomerates and particulate material into a fluidizable mixture suitable for introduction as feed material into a fluid coking zone and at a pressure suitable for introducing agglomerates into the feed preparation zone.

Mixing in the feed preparation zone is preferably carried out in a fixed bed agitated by suitable method and means to insure adequate intermixing of the agglomerates and hot particulate material, although it is within the scope of the present invention to employ a fluid bed feed preparation zone. The relatively hot particulate material can be obtained at a suitable elevated temperature, which is preferably between about 400 and about 1400° F., from a hydrocarbon conversion zone, e.g., the coking zone, or from a heat generation zone employed in the process as hereinafter described. The ratio of relatively hot particulate material to agglomerates feed is preferably maintained between about 0.5:1 and 2.5:1 in order to regulate the temperature of the bed in the feed preparation zone at the desired level. Hot particulate material, such as sand, is a preferred hot contact material, since it serves as a fluidization promoting diluent for the sand-oil mixtures contained in the agglomerates feed as well as a heating medium to reduce the viscosity of the heavy hydrocarbons in the feed.

The temperature in the feed preparation zone is generally maintained at a level which is sufficiently high to cause reduction in the viscosity and expel water from the agglomerates feed such that the agglomerates are triturated, and yet, preferably, below the level at which any substantial percentage of the entering hydrocarbon material is converted to gaseous material which is not condensable under atmospheric pressure conditions, e.g., dry gas. It is important to minimize dry gas production at this point in order to minimize the cost of recovering hydrocarbon materials leaving the feeder as vapor. For these purposes, the preferred temperature range in the feed preparation zone is maintained between about 250° F. and about 600° F., and most preferably, between about 275° F. and about 450° F. The feed preparation zone is preferably maintained under essentially atmospheric pressure and most preferably under a subatmospheric pressure to prevent loss of gaseous material at the location where agglomerates are introduced. It has been found that agglomerates feed can be converted into a fluidizable mixture employing relatively hot particulate material as the contact agent employing an agglomerates residence time in the feed preparation zone preferably between 1 and 10 minutes, it being understood, however, that a substantially longer or shorter residence time may be employed in such zone, depending upon the nature of the feed and conditions of operation of such zone.

The fluidizable mixture produced in the first zone by the action of the relatively hot contact material admixed with the agglomerates feed is withdrawn from the feed preparation zone into a pressure developing zone for passage into a hydrocarbon conversion zone. The conversion zone preferably constitutes a coking zone containing a dense bed of fluidized solids material operating at an elevated temperature and pressure substantially above the conditions in the feed preparation zone. Preferably, the feed preparation zone is situated at an elevation above that of the thermal coking zone such that the fluidizable mixture can be passed to the upper portion of a standpipe communicating between such zones for passage by gravity into the fluidized bed of the thermal coking zone. Suitable agitation means is provided preferably within the standpipe in order to prevent bridging of the standpipe. It is understood that when it is desirable to locate the feed preparation zone and thermal coking zone in a side-by-side relation, the fluidizable mixture produced in the feed preparation zone can be flowed therefrom into the coking zone by means of a transport line fluidized, for example, by means of steam, air or other inert gaseous material.

The hydrocarbon conversion zone employed to convert the hydrocarbon material contained in the fluidizable mixture of tar sands and particulate material produced in the feed preparation zone comprises a fluidized bed of particulate material maintained under thermal coking conditions which are well-known in the art. In the coking zone, heavy oil adhering to the solid particles undergoes pyrolysis, evolving lighter hydrocarbon vapors and leaving carbonaceous residue denoted as coke on the solids. Temperatures between about 850° F. and about 1100° F. and pressures between about atmospheric and about 40 p.s.i.g. are preferable. Particulate material bearing coke at the surface thereof is passed from the coking zone into a heat generation zone in which coke is burned thereby raising the temperature of the particulate material to an elevated level. Heated particulate material at a temperature preferably about 200° F. to 300° F. above the temperature in the conversion zone and in the range from about 1050° F. and about 1400° F. is passed from the heat generation zone into the coking zone to supply heat required for the coking operation.

For a better understanding of the present invention, reference is now made to the drawing which shows, diagrammatically, in elevation, a preferred embodiment of the method of the present invention which is described in conjunction with a working example of the operation thereof. Conveyor **10** introduces feed material into hopper **12** situated in an upper portion of mixing vessel **14**. The feed material consists of tar sands agglomerates which have been reduced in size and screened such that the maximum diameter thereof is about 1 inch. The temperature of the feed is about 32° F. and the bulk density is about 100 pounds per cubic foot. The feed composition is about 85% solids, 12% hydrocarbon and 3% free moisture on a weight basis. The diameters of the sand particles in the agglomerates range between about 1–200 microns, and clay particles in the feed may have diameters even below 1 micron.

The agglomerates are introduced into feed preparation zone **14** at the rate of 4,166,500 pounds per hour and are distributed about the periphery of a fixed bed **26** by means of a conical distributor plate **16**. Solid particulate material comprising sand particles bearing a small amount of coke on the surfaces thereof is withdrawn from a bottom portion of coking zone **42** at a temperature of 930° F., and is passed upwardly through risers **30** at a rate of 2,716,000 pounds per hour. The solid particulate material in conduits **30** pass into enlarged conduit sections **30A** for discharge at a reduced velocity above distributor plate **16**. An opening is provided between conduits **30** and **30A** to permit free movement of rake **24**. The hot sand is mixed with agglomerates at the periphery of bed **26** which is maintained at a temperature of about 300° F. A vacuum of about 1 inch Hg is maintained above bed **26** by the evacuation of gaseous material as hereinafter described.

The water and some of the hydrocarbons in the agglomerates are vaporized by the contact of hot solids with the incoming feed in feed preparation zone **14**. Vaporized material, entrained solids, and air leakage through hopper **12** are withdrawn overhead of zone **14** by means of conduit **38** and are passed into cyclone **39** wherein solids material is separated and returned to bed **26** by means of dipleg **40**. Gaseous material separated from cyclone **39** is passed into condenser **127** in line **125** to condense water and hydrocarbons in the gaseous material. A gas-liquid mixture thus obtained is flowed into separator **130** operated at 140° F. and about 14 p.s.i.a. Gaseous material, which comprises inerts, is withdrawn from the separator in purge line **126**, which can be connected to a steam jet ejector, for example, in order to maintain a vacuum. A water layer is separated and discarded in line **128** and the condensed hydrocarbon oil is recycled to coking zone **42** in line **132**.

Returning to the description of feed preparation zone **14**, rake **24** is provided for mixing hot sand withdrawn from zone **42** with the cold feed. Prongs **24A** depend from the rake and are preferably made plow-shaped in order to induce the material of bed **26** to flow inwardly toward standpipe 32. Rake 24 is rotated by means of the motive force supplied by an electric motor 20 connected to gear box 23 through rod 22. The rake 24 is rigidly attached to elongated rod 27 which is rotatably connected to gear box 23. Floor 25 is pitched toward the center of zone 14 such that the material in bed 26 flows generally toward the center under the influence of prongs 24A. Shroud 18 is provided to protect gear box 23. Zone 14 is 35 feet in diameter and bed 26 is maintained at a depth of about 4 feet. The average holding time in bed 26 is about 3.2 minutes which is sufficient to reduce the agglomerate feed material to a mixture of fluidizable particulate and hydrocarbon materials. The mixture flows from bed 26 over the upper edge 28 of standpipe 32 for passage downwardly therethrough.

Standpipe 32, centrally disposed within zone 14, provides a passageway for the fluidizable material obtained from fixed bed 26 into the dense bed of fluidized particulate material 46 maintained in coking zone 42. The standpipe comprises means for flowing a pressure developing column of fluidized solids material from a feed mixing zone 14 operated at essentially atmospheric pressure into a fluid coking zone 42 operated at a relatively higher pressure. In this example, the standpipe has an inside diameter of about 4 feet. Elongated rod 27 rotatably connected to gear box 23 rotates within the standpipe 32. A plurality of bars 29 are angularly mounted on rod 27, although other suitable agitation means for the prevention of solids bridging of the standpipe can be employed such as, e.g., a screw feeding means. The aforementioned fluidizable tar sands mixture is discharged from standpipe 32 into dense fluid bed 46. In this example, bed 46 is operated under coking conditions including a temperature of about 930° F. which is maintained by the introduction of solids material obtained from two separate heat generation zones, such as zone 60, at the rate of 10,675,000 pounds per hour per generator through valved conduits 75. The temperature of the solids introduced from the heat generators is about 1200° F. The pressure above dense bed 46 in vessel 42 is maintained at about 10 p.s.i.g. while the pressure below baffles 48 is about 30.8 p.s.i.g. Residence time of about 5.2 minutes is provided in dense bed 46 and further residence time is provided in the region of baffles 48 in the lower portion of coking zone 42. Fluidization gas is provided below baffles 48 by the introduction of steam through distributor rings 51. Additional fluidization is provided in bed 46 by reason of dry gas generated during the coking operation. Baffles 48 which can be made in any suitable shape and arrangement, such as the staggered inverted V-shaped baffles shown in the drawing, aid in stripping hydrocarbon vapors from the outlet solids and in minimizing by-passing of fresh feed material to the outlet at the bottom of zone 42.

Risers 30 depending into the lower baffled portion of zone 42 comprise means for conveying stripped hot contact material into the feed preparation zone. Lift steam is supplied to the base of risers 30 by means of injection lines 47 situated at the bottom thereof. Vertical baffle 49 disposed within the bottom central portion of zone 42 divides the baffled section into essentially two equal parts. Stripped solid particulate material having coke deposited on the surface thereof is withdrawn to the heat generators 60 through valved standpipes 50 and transport lines 55. Aeration steam is introduced into standpipes 50 by means of lines 52 and lift air is introduced into transport lines 55 by means of lines 54.

Staged cyclones 43 are provided in the upper portion of coking zone 42 to reduce the solids content of the gaseous effluent of the reactor. Solid material is returned to bed 46 by means of diplegs 44. Effluent vapors and entrained solid material pass from cyclones 43 into plenum chamber 45 and then through withdrawal conduit 140 for passage to the vapor recovery system. Conduit 140 is heated by means of steam jacket 142. Superheated steam is introduced into steam jacket 42 by means of line 144. To minimize the formation of coke in the cyclones and vapor outlet line 140, the superheated steam in jacket 142 is injected by means of line 146 into cyclone inlet 147. The steam injection is regulated such that steam introduced reduces the partial pressure of the heavy hydrocarbons in the effluent, i.e., the 850°+hydrocarbons in the coker effluent vapor, from saturation to a condition about 30° F. above the dew point. In this example, about 63,000 pounds per hour of steam at about 930° F. and 600 p.s.i.g. are introduced by means of line 144 into jacket 142 and then into the cyclones via line 146.

The coker effluent vapors are passed from conduit 140 into effluent scrubbing zone 150 wherein the effluent is contacted with circulating oil introduced at about 600° F. in line 152 in order to cool the effluent and to remove solids therefrom. The circulating oil consists essentially of 850°+material. Scrubbing is achieved by flowing the circulating oil downwardly over baffles 154 in intimate countercurrent contact with the upflowing effluent vapors. Substantially all of the entrained solids are scrubbed from the effluent and are withdrawn with the circulating oil fraction at the bottom of scrubber 150 in lines 156. The circulating oil which is heated to about 700° F. in scrubber 150 is cooled in a steam generator 160 which generates 600 p.s.i.g. saturated steam in line 161 from boiler feed water introduced in line 159. The cooled circulating oil is recycled to the scrubbing zone in lines 162 and 152. Make-up oil is added in line 163 as needed. A portion of the oil from line 156 is recycled for conversion into reactor 42 by means of lines 164 and 165. In this example, the quantity of recycle oil comprises 125,000 pounds per hour, and the solids content of this recycle oil is approximately 5 weight percent. Another portion of the 850°+oil is fed to the heat generators in line 166 for use as torch oil.

Product effluent vapor is withdrawn from scrubber 150 by means of withdrawal conduit 170 and passed in line 172 into an electrostatic precipitator 174 to insure substantially complete removal of the solids from the product vapor feeding the product fractionator (not shown in the drawing). Water is introduced to the base of the electrostatic precipitator in line 178 at 70° F. and water containing solids material is withdrawn from the base of the precipitator and passed to waste in line 180. Product vapors are withdrawn from precipitator 174 in line 176 at a temperature of about 600° F. and a pressure of about 9 p.s.i.g. The composition and flow rate of the feed to the product fractionator is shown below in Table 1.

TABLE 1

Product sent to final fractionation

Components:	Pounds per hour
Dry gas	57,500
C_4's	8,800
C_5–380	53,700
380–850	248,950
850+	74,050
Recycle oil	125,000
H_2O	129,000
	697,000

The coke make in reactor 42 is about 57,000 pounds per hour.

In this example, two heat generation zones 60 are employed to supply the heat requirements for coking zone 42. In order to supply the required heat for the process, the heat generators combust coke formed in the coker introduced in transport line 55, a portion of the 850°+ liquid product introduced in line 166, and about 20% of the dry gas product introduced in line 79. The heat generators, in this example, are maintained at a temperature of about 1200° F. by the combustion and at a pressure of about 7 p.s.i.g. In order to provide fluidization gas in dense bed 64, and oxygen for combustion of coke and hydrocarbonaceous material in the heat generation zone, air is preheated to about 944° F. and introduced by means of line **115** to distributor ring **66** situated in the bottom portion of the heat generators. The coke content of the solids is reduced to about 0.4 weight percent operating at an oxygen concentration in the flue gas of about 0.5 mol percent. Since 0.4 weight percent of the solids represents about 25% of the total coke make, it is desirable to employ a secondary coke burner **81** to reduce coke loss to about .2 weight percent or about 12 weight percent of the total coke make. The air feed in line **116** to the secondary gas distributor ring **84** comprises about 10% of the total combustion air while about 85 percent is fed to distributor **66**. The remaining air is introduced into the heat exchangers, hereinafter described, and the transport lines **55**. Entrance slots **82** are provided in the upper portion of the walls of secondary coke burner **81** to permit egress of the solids from bed **64** into secondary coke burner **81**. Combustion gases rising from the secondary coke burner pass upwardly through grid **80** into the lower portion of dense bed **64**. To control the temperature of the secondary burner at the desired temperature, which in this example, is about 1050° F., cooling coil **83** is provided in the secondary burner. Preferably, coil **83** is employed to generate steam at an elevated temperature.

A portion of the solids in dense bed **64** are passed into stripping zone **70** through slot **71**. Steam is introduced in line **76** through distributor ring **73** situated in a lower portion of the stripping zone and the steam passes upwardly through baffles **72** to strip inerts from the solid material. Employing the above-described stripping operation, the concentration of inerts recycled with solids to the reactor are reduced such that they represent about 1 mol percent in the final dry gas product. Hence, such stripping operation is advantageous where hydrogen production is contemplated.

Spent solids flow by gravity downwardly from secondary coke burner **81** through conduits **86** into fluidized solids heat exchangers **88** containing tubes **90** to recover high temperature level heat imparted to the solids. Cooled solids are withdrawn from the system in valved lines **99**. The flue gas produced at an elevated temperature in heat generators **60** is separated from solids in cyclone **62** having dipleg **63** depending therefrom. It is to be understood that any number of cyclones may be employed as needed in staged or parallel arrangement to reduce the solids content of the flue gas to an acceptable level.

In accordance with another example of operation, tar sands agglomerates at 32° F. are introduced into a feed mixing zone at the rate of 4,166,500 pounds per hour. The agglomerates are contacted with flue gas from a heat generation zone at about 950° F. in the feed preparation zone. The composition and flow rate of the flue gas are indicated in Table 2 below:

TABLE 2

Components:	Flow rate, lbs./hr.
N_2, O_2, CO, CO_2	1,777,540
H_2O	201,000
Solids	500,000
	2,478,540

A fluidizable mixture of oil and solids is obtained at about 300° F. in the feed mixing zone and is withdrawn through a standpipe downwardly into a fluid coking zone. Such mixture consists of about 3,541,500 pounds per hour of solids, and about 500,000 pounds per hour of oil. Gaseous material is separated overhead of the fluid mixing zone at the rate of about 2,603,540 pounds per hour at about 300° F.

It is, likewise, contemplated that other hot contact materials in the gaseous state can be employed in the operation of the feed preparation method of the present invention such as, for example, hydrocarbon vapor condensable under conditions in the feed preparation zone **60** and steam. Many modifications and alterations will become apparent to those skilled in the art from the foregoing description and disclosure of the present invention which should be limited in scope, however, only by the claims.

What is claimed is:

1. A method of recovering hydrocarbons from tar sands which comprises maintaining a first zone containing a supported bed of solid material at a temperature between about 250° F. and about 600° F.; introducing tar sand agglomerates having an average particle size ranging from above about ½ inch to about 4 inches into said zone and admixing relatively hot contact material therewith under conditions to reduce the viscosity and expel water from the agglomerates thereby producing a fluidizable mixture comprising sand and hydrocarbons, preferentially withdrawing a portion of said mixture having the smallest particle size, flowing said portion of such fluidizable mixture into a reaction zone containing a fluidized bed of solid material, and passing solids material withdrawn from the fluidized bed into said first zone as hot contact material.

2. A method of recovering hydrocarbons from tar sands which comprises maintaining a first zone containing a supported bed of solid material at a temperature between about 250° F. and about 600° F.; introducing tar sand agglomerates having an average particle size ranging from above about ½ inch to about 4 inches into said zone and admixing relatively hot contact material therewith under conditions to reduce the viscosity and expel water from the agglomerates thereby producing a fluidizable mixture comprising sand and hydrocarbons, preferentially withdrawing a portion of said mixture having the smallest particle size, flowing said portion of such fluidizable mixture through a pressure developing column of such fluidizable mixture into a reaction zone containing a fluidized bed of solid material under temperature and pressure conditions above such conditions in said first zone, and passing solids material withdrawn from the fluidized bed into said first zone as hot contact material.

3. A method of recovering hydrocarbons from tar sands which comprises maintaining a first zone containing a supported bed of solid material at a temperature between about 250° F. and about 600° F.; introducing tar sand agglomerates having an average particle size ranging from above about ½ inch to about 4 inches into said zone and admixing relatively hot contact material therewith under conditions to reduce the viscosity and expel water from the agglomerates thereby producing a fluidizable mixture comprising sand and hydrocarbons, preferentially withdrawing a portion of said mixture having the smallest particle size, flowing said portion of such fluidizable mixture into a pressure developing column of such fluidizable mixture and communicating between said first zone and a reaction zone, providing agitation of such column and flowing the fluidizable mixture into said reaction zone containing a dense fluidized bed of solid material, and passing solids material withdrawn from the fluidized bed into said first zone as hot contact material.

4. A method of recovering hydrocarbons from tar sands which comprises maintaining a first zone containing a supported bed of solid material at a temperature between about 250° F. and about 600° F.; introducing tar sand agglomerates having an average particle size ranging from above about ½ inch to about 4 inches into said zone, introducing relatively hot contact material obtained from a second zone as hereinafter defined and admixing such contact material and agglomerates in said first zone under temperature and pressure conditions to reduce the viscosity of the hydrocarbon and drive off water from the agglomerates thereby providing a fluidizable mixture of sand and hydrocarbon material, preferentially withdrawing a portion of said fluidizable mixture having the smallest particle size into the upper portion of a pressure developing column of such fluidizable mixture, flowing the mixture in the column into a second zone containing a dense fluidized bed of solids material maintained under hydrocarbon coking conditions including an elevated temperature and pressure, and passing solids material withdrawn from the dense fluidized bed at an elevated temperature into said first zone as said hot contact material.

5. The method of claim **4** in which relatively hot contact material is admixed with tar sand agglomerates in a ratio between about 0.5:1 and about 2.5:1.

6. The method of claim **4** in which said first zone is maintained under a pressure below atmospheric pressure.

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