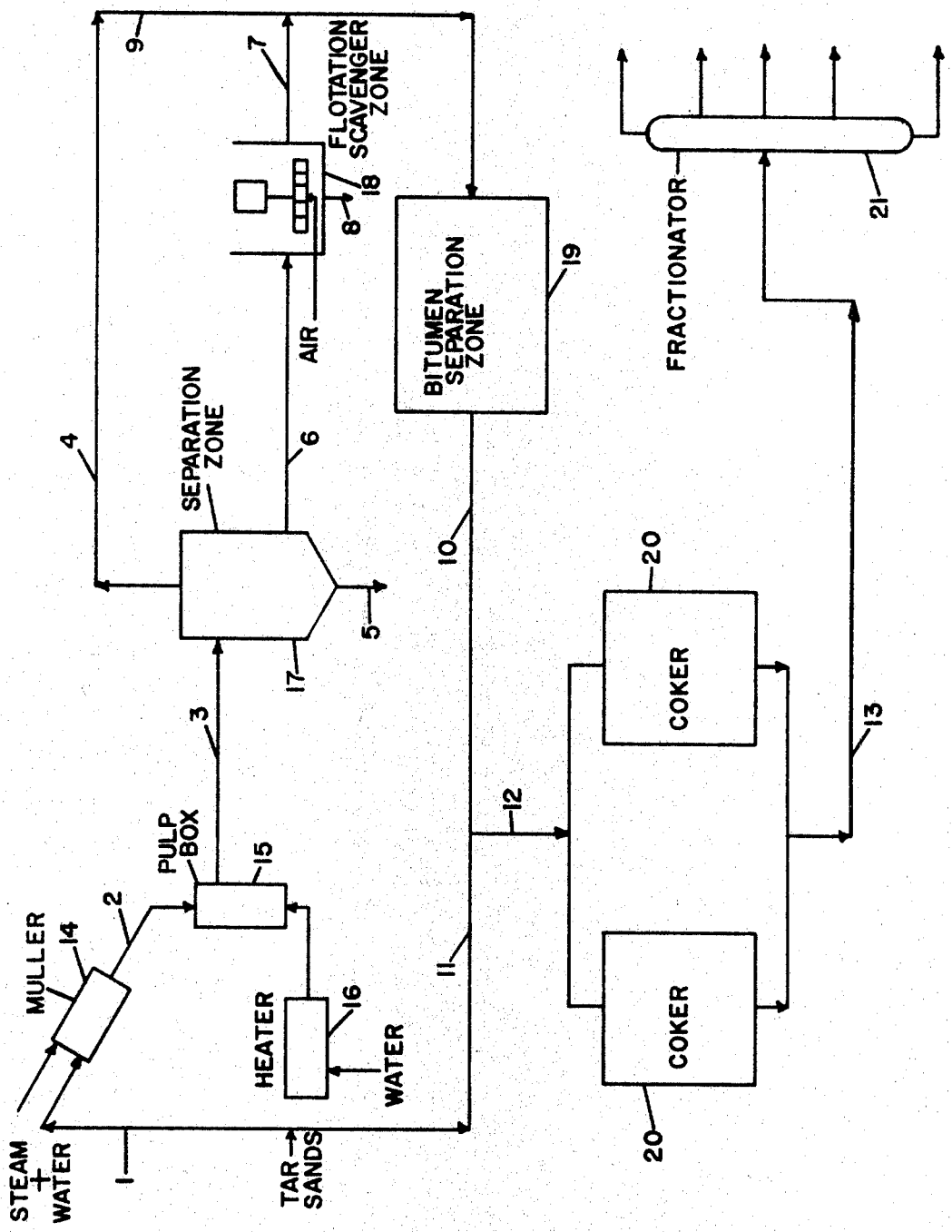
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COKING A MIXTURE OF TAR SAND AND FROTH PRODUCT

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COKING A MIXTURE OF TAR SAND AND FROTH PRODUCT

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ABSTRACT OF THE DISCLOSURE

Bitumen extracted from tar sands by the hot water process or the like, can be mixed with fresh tar sands and used as a feed for direct coking. The proportion of added bitumen in the feed can be adjusted so that regardless of the proportion of bitumen in the fresh sands, the mixed feed will always contain the same amount of cokable material.

This invention is concerned with a process for treating tar sands. The invention particularly relates to a method of processing the bitumen recovered from a froth-producing process and to a method of coking raw tar sands together with said bitumen.

Tar sands which are also known as oil sands and bituminous sands are siliceous materials which are impregnated with a heavy petroleum. The largest and most important deposits of the sands are the Athabasca sands, found in northern Alberta, Canada. These sands underlay more than 13,000 square miles at a depth of 0 to 2000 feet. Total recoverable reserves after extraction and processing are estimated at more than 300 billion barrels —just about equal to the world-wide reserves of conventional oil, sixty percent of which is in the Middle East. By way of contrast, the American Petroleum Institute estimated total United States oil reserves at the end of 1965 at 39.4 billion barrels.

The tar sands are primarily silica, having closely associated therewith an oil film which varies from about 5 to 21 percent by weight, with a typical content of 13 weight percent, of the sand. The oil is quite viscous—6° to 8° API gravity—and contains typically 4.5 percent sulfur and 38 percent aromatics.

In addition to oil and sand, the composition of the sands includes clay and silt in quantities of from 1 to 50 weight percent, and more usually 10 to 30 percent, and a small amount of water, in quantities of 1 to 10 percent by weight.

Several basic extraction methods have been known for many years for the separation of oil from the sands. In the so called "cold water" method, the separation is accomplished by mixing the sands with a solvent capable of dissolving the bitumen constituent. The mixture is then introduced into a large volume of water, water with a surface agent added, or a solution of neutral salt in water. The combined mass is then subjected to a pressure or gravity separation.

In the hot water method, the bituminous sands are jetted with steam and mulled with a minor amount of hot water at temperatures in the range of 170 to 190° F. The resulting pulp is dropped into a turbulent stream of circulating hot water and carried to a separation cell maintained at a temperature of about 185° F. In the separation cell, sand settles to the bottom as tailings and oil rises to the top in the form of a froth. An aqueous middlings layer containing some clay, silt and oil is formed between these layers. This basic process may be combined with a scavenger step for further treatment of the middlings layer obtained from the primary separation step to recover additional amount of oil therefrom.

The froth recovered is taken to a final extraction step where it is diluted with naphtha and centrifuged to remove water and residual sand. The naphtha is then distilled off from the naphtha-bitumen mixture and the bitumen is heated and sent to coker drums where coke, gas and a distillate are produced. The latter is fractionated to yield naphtha, kerosene and gas oil.

The present invention relates to an improvement in the method of treating the hot water or cold water process froth. The invention comprises the steps of recovering bitumen from the froth, forming a mixture of said bitumen and tar sands, and coking said mixture to produce coke, gas and a petroleum distillate.

Economically this process is less costly than treating all of a given quantity of tar sands by the hot water or cold water process because it allows for direct retorting of a portion of the tar sands without preliminary treatment.

Furthermore this proposal has several advantages over direct retorting alone. Firstly, a coker feed comprising a mixture of bitumen and sands has a lower mineral content than a feed consisting of only tar sands. This allows a more efficient utilization of heat since a great deal less siliceous and mineral material need be heated compared to that of a feed of only tar sands. Secondly the mixed feed of this invention gives improved combustion characteristics in a moving bed type of operation where it is essential that enough coke is generated to heat the sands so that they can be recycled hot back into the reaction zone.

In short, by adjusting the proportions of bitumen and tar sands in the mixed feed of this invention, the advantages of both an extraction process and a direct retorting process may be maximized and disadvantages minimized. The process is particularly advantageous in that it allows for a uniform coker feed regardless of the composition of the tar sand. For example, with a high tar sand, the amount of bitumen in the feed mixture could be reduced while with a low tar content sand, the bitumen content could be increased making possible a constant composition retort feed.

The particular process used in the coking step of this invention is not critical. Various such processes are well known in the art. In one known process, oil is recovered from tar sand by passing the sand directly into a hot sand bed which is maintained in the fluidized state by passing a gas upwardly therethrough at a high velocity. In the fluidized bed, bituminous sand lumps, which may have been previously crushed to fairly small size, break down to free-flowing sand particles. Some cracking of the oil contained in the bituminous sand occurs, together with the formation of process gas. The oil flashed from the sand is carried by the fluidizing gas through a hot cyclone to remove dust, then through an electrical precipitator and finally into one or more condensors to recover the oil. After the removal of oil therefrom, the bituminous sand is withdrawn from the fluidized bed down a standpipe and is blown by air into a burner where coke is burend off the sand, the sand being heated up thereby. A portion of the hot decoked sand is then recycled directly to the fluidized bed as a heat source, while the remainder of the hot decoked sand is discarded.

Another process employes a special type of particulate material of controlled size and shape as a heat transfer medium. Such particulate material usually comprises ceramic or metal balls. In the process, the balls are first heated by hot combustion gases and are then mixed in a still directly with crushed shale or sand to accomplish the desired heat transfer and to bring about oil removal. The balls are then removed from the reaction zone, and

usually screened two or three times in order to remove from them the shale or sand. The coke is burned off the separated spent retort solids to produce hot combustion gases which are required to reheat the balls for reuse.

The proportion of tar sands to bitumen in the coker feed of the present invention may vary from a feed comprising tar sands and only a minor amount of added bitumen to a feed comprising added bitumen mixed with only a minor amount of tar sands. If it is desired to maintain a feed of constant cokable material content, the proportion of bitumen in the mixture may be a certain value when mixed with a low content tar sand and relatively lower when mixed with high bitumen content tar sands. For example, if it is desired that the feed contain 55 weight percent cokable material, the percent of added bitumen in the feed when the tar sand contains 10 weight percent bitumen would be 50. If the bitumen content of the tar sands charged into the feed were to increase to say 15 percent, the proportion of added bitumen could be adjusted to about 47 weight percent to maintain a constant feed containing 55 weight percent cokable material.

The drawing is a schematic representation of one aspect of the present invention.

Referring to the drawing, bituminous tar sands are fed into the system through line **1** where they first pass to a conditioning drum or muller **14**. Water and steam are introduced and mixed with the sands. Mulling of the tar sands produces a pulp which then passes from the conditioning drum as indicated by line **2** to a pulp box **15** which serves as a zone for diluting the pulp with additional water from the heater **16** before passage to primary separation zone **17**.

The pulped tar sands are continuously flushed from the pulp box through line **3** into the separator **17**. The settling zone in separator **17** is relatively quiescent so that oil froth rises to the top and is withdrawn via line **4** while the sand settles to the bottom as a tailings layer which is withdrawn through line **5**.

A middlings layer which contains some oil that failed to separate is withdrawn from the cell through line **6** to a flotation scavenger zone **18**. In this zone an air flotation operator is conducted to cause the formation of additional oil froth which passes from scavenger zone **18** through line **7** and thence to line **9** for further processing in admixture with the froth from the primary zone. An oil-lean water middlings stream is removed and discarded from the bottom of scavenger zone **18** via line **8**.

The mixture of froths from the primary and scavenger zones is directed via line **9** to the bitumen separation zone **19** where bitumen is recovered and removed through line **10**. Any process known in the art may be used here for separating bitumen from the froth. For example, United States patent, Coulson, 2,968,603 teaches dilution and the application of centrifugal force in a single or plural stage to effect the separation. This patent also discloses that dilution plus the use of settling tanks or thickeners is also known and useful.

The separated bitumen is mixed with raw tar sands from line **11** and fed through **12** into the coker zones **20**. Although two coker zones are shown in the drawing, it should be noted that the process of the invention may be conducted with one coker or with two or more units. In the coker zones, the mixture of bitumen and tar sands is processed to give coke, gas and a distillate. The latter is removed at **13** and fractionated at **21** to yield naphtha, kerosene and gas oil.

The following example illustrates the invention more specifically:

The invention is utilized to recover the oil from Athabasca tar sands containing by weight about 10 percent bituminous matter and 89 percent mineral matter. Twenty-five percent of the latter consists of particles having diameters less than 44 microns. On an hourly basis 100 pounds of the tar sands, 30 pounds of water and steam are fed into a conditioning drum and the mixture is heated to about 180° F. while being mulled. The resulting pulp is passed through a screen and then to pulp box **15** as shown in the drawing. Hot water at 190° F. in amount of 270 pounds is passed through the heater and into the pulp box. The mixture is continuously flushed into separator **17** wherein the temperature is maintained at 190° F. From the separator sand tailings are removed at a rate of 78 pounds per hour from the bottom, an oil-lean middlings layer is removed and discarded at the rate of 200 pounds per hour, and froth is removed from the top at a rate of about 10 pounds per hour. The tailings are composed of about 74 percent mineral matter, 25 percent water and 1 percent oil by weight. The froth is approximately composed by weight of 50 percent oil, 10 percent mineral matter and 40 percent water. The oil content thereof coresponds to a recovery of about 50 percent of the oil in the original tar sands. A stream of oil-rich middlings in amount of 112 pounds per hour and composed of about 4 pounds of oil, 27 pounds of mineral matter and 81 pounds of water is withdrawn from separator **17** and is transferred to a scanvenger zone wherein it is subjected to air flotation in a subaeration type air flotation cell **18**. Additional oil froth is obtained here in amount of about 7 pounds per hour and about 105 pounds per hour of oil-lean middlings are withdrawn therefrom and discarded.

The froths from the separation zone and the scavenger zone are combined. About 8.5 pounds per hour of bitumen is recovered from the froth by dilution and settling. This bitumen is mixed with tar sands of the same composition as those fed to the hot water process on a rate basis of 15 pounds of the tar sands added to the bitumen per hour to give a mixture containing about 43 percent bitumen. This mixture is charged into a retort where it is held for an average residual time of 7 minutes at 950° F. while being cascaded 9 times per minute. The mixture in the retort is continuously counter-currently contacted with super heated steam.

Small concentrations of hydrocarbon purge gas are added from time to time to maintain a uniform loading on the cyclones. Stripped vaporized hydrocarbons are passed with the purge gas to a hydrocarbon recovery unit wherein they are washed free of entrained sand and condensed to separate a liquid (oil) fraction. The oil recovery is highly efficient and provides liquid hydrocarbon yields of 90 percent of theoretical.

What is claimed is:

1. A method of treating froth recovered from the hot water process for treating bituminous sands which comprises

(a) separating from said froth a bitumen substantially free from air, water and mineral;

(b) forming a mixture of said bitumen with tar sands; and

(c) coking said mixture to produce coke, gas and a petroleum distillate.

2. The method of claim **1** in which the mixture formed in step (b) comprises tar sands and a minor amount of added bitumen.

3. The method of claim **1** in which the mixture formed in step (b) comprises added bitumen and a minor amount of tar sands.

4. A process for separating oil from bituminous sands which comprises

(a) forming a pulp of bituminous sands with a minor amount of water in a pulping zone;

(b) removing pulp therefrom and mixing the same with water in a dilution zone;

(c) flushing the mixture from the dilution zone into a separation zone;

(d) settling the mixture in the separation zone to form an upper oil froth layer, comprising a major proportion of bitumen and minor but substantial pro-

portions of water and suspended solids, a middlings layer and a sand tailings layer;

(e) separately removing the oil froth layer; and

(f) treating said froth by the method of claim **1** to produce coke, gas and a petroleum distillate.

5. The process of claim **4** in which the mixture formed in the treating step (f) comprises tar sands and a minor amount of added bitumen.

6. The process of claim **4** in which the mixture formed in the treating step (f) comprises added bitumen and a minor amount of tar sands.

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