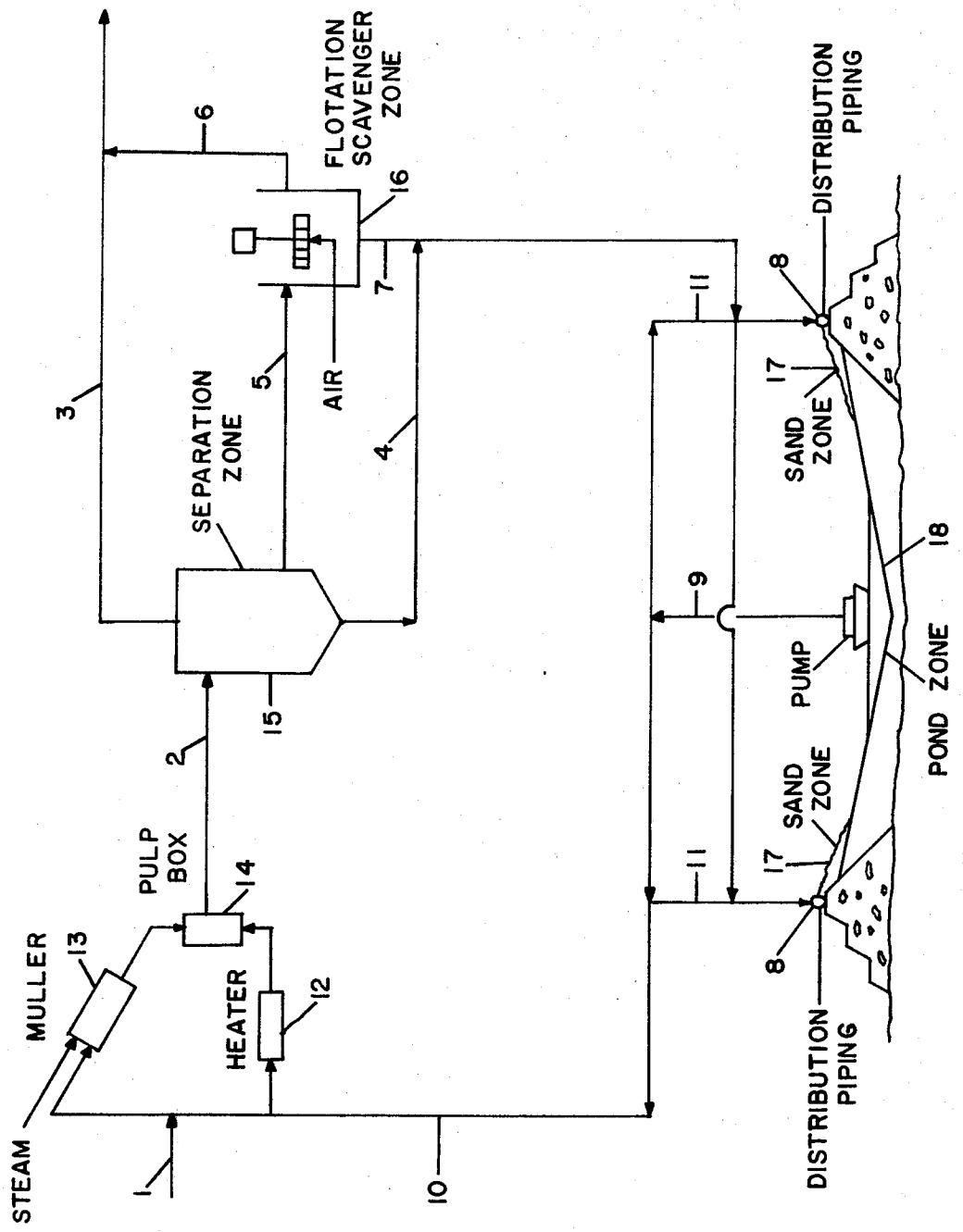
July 16, 1968 R. A. BAILLIE 3,392,833

PROCESS FOR RECOVERING A CLARIFIED EFFLUENT FROM THE DISCHARGE OF A HOT WATER PROCESS TREATMENT OF BITUMINOUS SAND

Filed July 22, 1966



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3,392,833

Patented July 16, 1968

3,392,833

PROCESS FOR RECOVERING A CLARIFIED EFFLUENT FROM THE DISCHARGE OF A HOT WATER PROCESS TREATMENT OF BITUMINOUS SAND

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Filed July 22, 1966, Ser. No. 567,232
8 Claims. (Cl. 210—65)

ABSTRACT OF THE DISCLOSURE

A process for recovering a clarified effluent from the discharge of a hot water process treatment of bituminous sand. The discharge is passed to an inclined sand pile zone where a silt and clay free effluent is recovered at the lower end of the zone.

This invention is concerned with an improvement in the hot water process for treating bituminous sands such as Athabasca tar sands, and the like. The invention is especially concerned with an improved method for the storage and treatment of tailings and middlings discharged from the process and the preparation of recycle water.

Bituminous sands or tar sands are well known in various parts of the world. One of the most important deposits is found in the north country of Alberta, Canada, along the Athabasca River. These Athabasca tar sands have been estimated to contain 300 billion barrels of recoverable oil, an amount equal to the world's known reserves of crude oil from conventional sources. Deposits of the sands extend over areas of many square miles and may be found below an overburden or at or near the surface of the fields and may be recovered from their naturally existing state by conventional mining methods. The deposits may range in thickness from 100 to 400 feet.

The tar sands are primarily silica, having closely associated therewith an oil film which varies from about 5 percent to 21 percent by weight with a typical content of 13.4 weight percent of a given quantity of the tar sand material. The gravity of the oil in the sands may vary from about 6° to 10° API, and generally is about 7° or 8° API.

The sands may contain, in addition to oil and sand, a mineral material of silt and clay component generally ranging from 1 to 50 percent and more usually 10 to 30 percent by weight of the tar sands. The bituminous sands also contain a small amount of water, in quantities of 1 to 10 percent by weight in the form of a film around the sand grain.

The tar sand deposits are potentially of great value, however, the oil may be separated and recovered from the sand and water components only through difficult and expensive operations. The seemingly insurmountable problem for many years was to find an economical process for separating and refining oil from the sand in quantity. Generally, there have been two main methods in use for the separation: the cold water process and the hot water process, both of which are described in Proceedings, Athabasca Oil Sands Conference, September 1951.

In the cold water method, separation of the oil from the tar sand is accomplished by adding 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 a neutral salt in water, which salt is capable of acting as an electrolyte. 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 comprising clay and slit and some 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 amounts of oil therefrom.

The middlings layer either as it is recovered from the primary process or as it is recovered after the scavenger step comprises water, clay, and oil. The oil content is, of course, higher in middlings which have not undergone secondary scavenger steps.

Hereinafter in this specification, the term "effluent discharge" will be used to describe middlings material of depleted oil content which has undergone final treatment and which comprises clay dispersed in water, the sand tailings layer and other discharged water-containing fractions which are not the primary products of the hot water process. The effluent discharge is removed from the process plant as a slurry of about 35 to 55, typically 45 percent, solids by weight. Included in the slurry is sand, silt, clay and small quantities of bitumen. In this specification, sand is siliceous material which will not pass a 325 mesh screen. Silt will pass 325 mesh but is larger than 2 microns. Clay is material smaller than 2 microns including some siliceous material of that size.

Because the effluent contains oil emulsions, finely dispersed clay with poor settling characteristics and other contaminants, water pollution considerations prohibit discarding the effluent into rivers, lakes or other natural bodies of water. The disposal of the effluent discharge has therefore presented a problem. It has been proposed that it be stored in evaporation ponds but this proposal would involve large space requirements and the construction of expensive enclosure dikes. It has also been suggested that the water in the effluent discharge be recycled back into the process as an economic measure to conserve both heat and water. However, it has been found in practice that the dispersed silt and clay content of the recycled water can reduce primary froth yield by increasing the viscosity of the middlings layer and retarding the upward settling of oil flecks. When this occurs, the smaller oil flecks and those that are more heavily laden with mineral matter stay suspended in the water of the separation cell and are removed from the cell with the middlings layer.

The present invention relates to a process for treating effluent discharge which overcomes many of the above discussed difficulties. The process provides increased economic storage space and at the same time provides for conditioning of the water in the effluent for subsequent recycle or discard. The process comprises feeding effluent discharge to an upper portion of a sand pile zone which is inclined downwardly to a pond zone. The feeding, to best utilize the advantages of this invention, should be conducted continuously and uniformly so that the pile is

maintained dampened with water. If the effluent discharge is insufficient to maintain the sand in a dampened or wetted condition, additional water from the pond may be recycled to the top of the pile. The sand pile to which the effluent is fed is preferably formed by distributing an initial effluent down a slope whereby coarse sand settled to form the pile and water collects at the pile's base to form the pond.

The recycled water (which is actually effluent containing less sand, silt and clay than the effluent discharged directly from the hot water process to the sand pile) and/or the effluent discharge is percolated down through the sand pile and along its base surface to the pond. This percolation helps to reduce the mineral fines contained in the water so that storage times in the pond, required for mineral fines to settle, are substantially reduced. Furthermore, while the effluent is percolating through the sands, substantial surface area of water is exposed for evaporation. Evaporation reduces the amount of effluent to be stored in the pond and thus reduces space requirements and the expense of pond enclosure dikes.

Since such large amounts of water are involved in the hot water process, both the amount of effluent to be stored and the amount of effluent to be treated for recycle are quite substantial. With the present invention, storage requirements are reduced, as indicated above, by evaporation during percolation. Furthermore, the sand pile itself acts as a storage area for water while the effluent finds its way through the interstices between the grains of sands on its way to the pond. Maintaining the sand in a dampened state maximizes this storing capacity and reduces conventional storage requirements.

After percolating down through the sand pile zone, the effluent is recovered and stored in a pond which forms at the sand pile's lower end. This effluent is substantially decreased in silt and clay content compared to the effluent discharge delivered directly from the hot water process. The effluent in the pond may be combined with fresh water, so that clay concentration is further reduced to such a degree that the mixture is suitable as feed water to the bituminous sand treatment process.

The drawing is a schematic diagram of the water flow in a hot water process for treating Athabasca tar sands.

Recycle effluent water from line **10** is added to fresh water from line **1** and fed to the heater **12** or muller **13**. In the muller the water is mixed with tar sands and steam so that the total water added, either in the form of liquid or vapor, is a minor amount based on the weight of the tar sands processed. The tar sands conditioned with water pass to the pulp box **14** which serves as a zone for diluting the pulp with additional water from the heater **12** before passage to the separation zone **15**.

The pulped tar sands are continuously flushed from pulp box **14** through line **2** into separator **15**. The settling zone in separator **15** is relatively quiescent so that oil froth rises to the top and is withdrawn via line **3** while the sand settles to the bottom as a tailings layer which is withdrawn through line **4**.

A middlings layer which contains some oil that failed to separate is withdrawn from the cell through line **5** to a flotation scavenger zone **16**. In this zone an air flotation operation is conducted to cause the formation of additional oil froth which passes from scavenger zone **16** through line **6** and thence to line **3** for further processing in admixture with the froth from the primary zone. An oil-lean water middlings stream is removed from the bottom of scavenger zone **16** via line **7** and is mixed with tailings from line **4** to form the effluent discharge. The discharge is delivered to the sand pile zone **17** via distribution piping **8** which provides for continuous and uniform wetting of the sand zones **17**. The water in the effluent discharge percolates through the sand pile zone **17** to the pond zone **18**. Water is withdrawn from the pond zone by line **9** for recycle back into the primary process via line **10** for mixture with fresh water or for recycle via lines **11** to the effluent discharge to assure adequate wetting of the sand pile zone **17** from lines **8**.

The following example illustrates the invention:

Example

An effluent of composition as given in column 1 of the table is collected from the oil lean middlings and sand tailings from the hot water process and is uniformly added along the upper periphery of a 6% slope, 300 acres in area. At the base of the slope is a 200 acre flat pond area enclosed by the slope and by constructed dikes. As water from the effluent percolates to the pond area, some water is recycled and added to the effluent discharging to the pile so that the total rate of discharge is about 209,000 tons of material per day, representing 56,500 tons per day of recycle and 152,500 tons per day of new effluent. About 132,000 tons per day of material, primarily sand and silt, are deposited on the bed and 77,000 tons per day of material, primarily water, are added to the pond area, representing a net addition to the pond of 20,500 tons per day.

After operating the process for one day, discharge is discontinued and the pile allowed to drain. An additional 13,500 tons of material flow into the pond. The sand pile is therefore effective in reducing the water storage required in the pond area by about 40 percent [13,500/(20,500+13,500)].

Percolation is resumed at the same rates and continued for about six months. Analyses of samples taken from the effluent and the water pond are given in the table.

TABLE

	1	2	3	4
	Effluent	Pond Water One Day	Pond Water 5 Weeks	Pond Water 6 Months
Water	48	91	90	92
Sand and Silt	42	0	0	0
Clay	9	8	9	7
Bitumen	1	1	1	1

Since all the sand and silt is removed from the effluent it would be expected that the clay concentration of the pond would be greater than that of the effluent. The table shows that the concentration of the pond is the same or less illustrating the effectiveness of the pile in reducing clay.

What is claimed is:

1. A process for treating effluent discharge from a hot water process for treating bituminous sands which comprises:

(a) feeding said effluent discharge to an upper portion of an inclined sand pile zone;

(b) percolating said effluent discharge downwardly through said inclined sand pile zone to a pond at its lower end; and

(c) recovering at the lower end of said sand pile zone and storing in said pond, an effluent, decreased in sand, silt and clay content.

2. The process of claim **1** additionally comprising recycling a portion of the effluent stored in said pond to the effluent discharge.

3. The process of claim **2** additionally comprising recovering said effluent decreased in silt and clay content from said pond and adding a portion of said effluent to the feed water of a hot water process for treating bituminous sands.

4. The process of claim **1** additionally comprising recovering said effluent decreased in silt and clay content from said pond and adding a portion of said effluent to the feed water of a hot water process for treating bituminous sands.

5. The process of claim **1** which comprises percolating in step (b) to maintain said sand pile zone substantially uniformly dampened with water.

6. The process of claim **5** additionally comprising recovering said effluent decreased in silt and clay content

from said pond and adding a portion of said effluent to the feed water of a hot water process for treating bituminous sands.

7. The process of claim 5 additionally comprising recycling a portion of the effluent stored in said pond to the effluent discharge.

8. The process of claim 7 additionally comprising recovering said effluent decreased in silt and clay content from said pond and adding a portion of said effluent to the feed water of a hot water process for treating bituminous sands.

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