

[54] **TREATMENT OF MIDLINGS STREAM FROM HOT WATER PROCESS FOR RECOVERING BITUMEN FROM TAR SAND**

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[56] **References Cited**

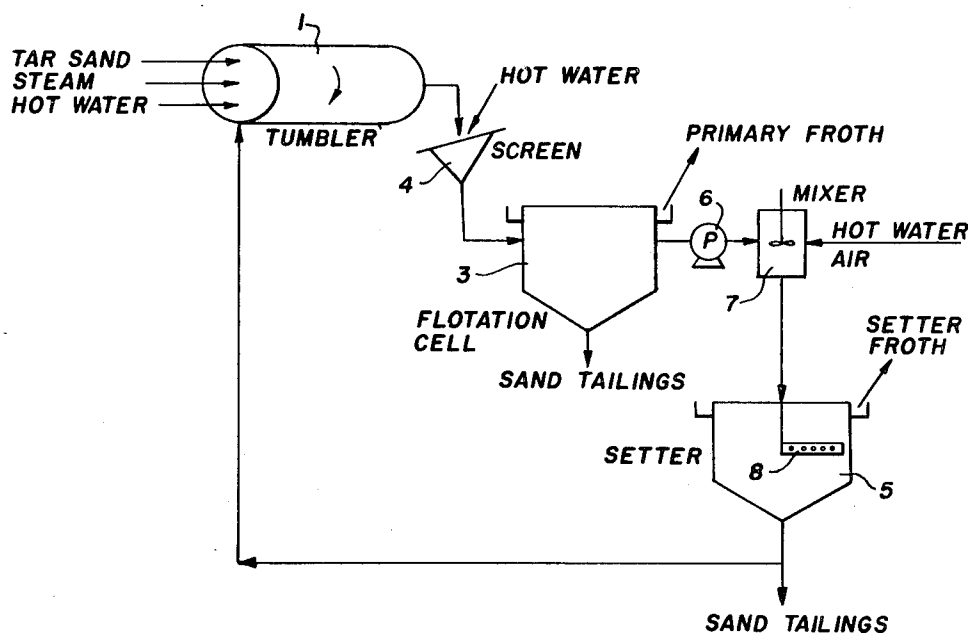
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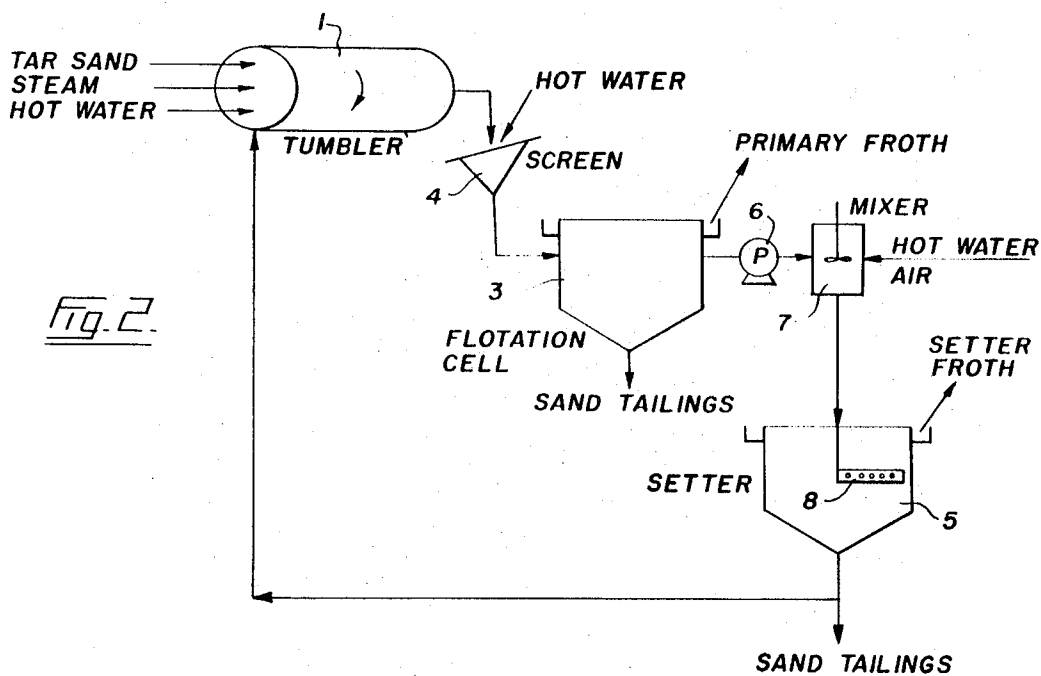
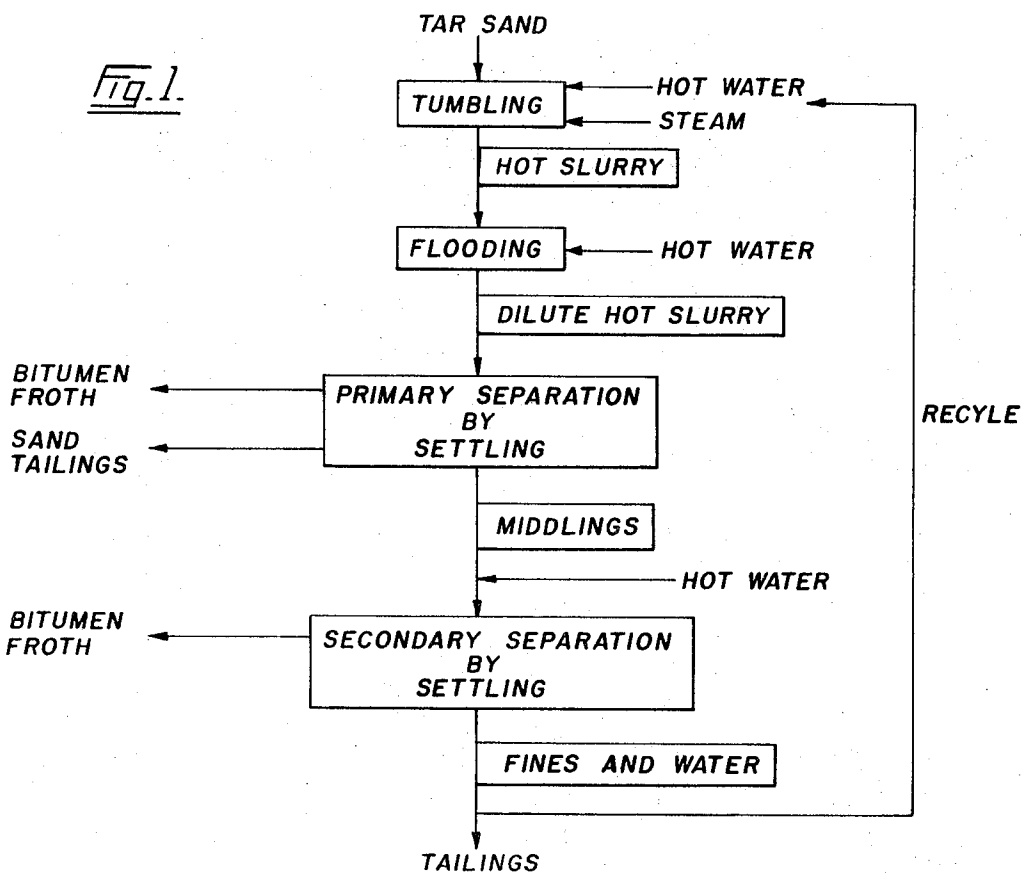
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[57] **ABSTRACT**

This process relates to treating the middlings stream from the primary separation cell used in the hot water process for extracting bitumen from tar sand. The middlings stream is diluted with hot water and settled in a quiescent zone. Froth is formed in the settler; this froth is surprisingly low in solids and water. The tailings stream from the settler is recycled to the front end of the extraction process, thereby conserving water. The invention provides an alternative to the conventional sub-aeration cell used for treatment of the middlings stream.

3 Claims, 2 Drawing Figures





TREATMENT OF MIDDINGS STREAM FROM HOT WATER PROCESS FOR RECOVERING BITUMEN FROM TAR SAND

BACKGROUND OF THE INVENTION

This invention relates to a hot water process for recovering bitumen from tar sand.

The invention has been developed using tar sand from the Athabasca deposit at Fort McMurray, Alberta, Can. While it is described with reference to that feed stock, the invention may find beneficial application to tar sands present in other deposits.

Athabasca tar sands comprises sand grains which are each sheathed in a thin layer of water. Bitumen is trapped in the void space between the water-wet grains. By way of example, the composition of the tar sand might be 10 percent by weight bitumen, 4 percent water, and 86 percent solids.

Athabasca tar sands are presently processed using a method commonly referred to as the hot water method. In accordance with this process, tar sand is mixed in a conditioning drum or tumbler with hot water and steam. While in the tumbler, the tar sand disintegrates and at the same time liberated bitumen is aerated. By "disintegrate" is meant that the sand and bitumen particles are dispersed one from another in preliminary way. The tumbler product is a porridge-like slurry which typically might comprise 9.5 percent bitumen, 22.00 percent water and 68.5 percent solids, at a temperature of 185°-190°F.

The slurry is flooded with additional hot water to further disperse the sand and bitumen. This flooding operation is usually carried out at a screen positioned at the outlet from the tumbler. The flooded slurry typically might have a composition of 7 percent bitumen, 43 percent water, and 50 percent solids, and a temperature of 160°F.

The flooded slurry is introduced into a separation cell at about its longitudinal midpoint; this cell is a cylindrical vessel having a conical bottom. The major portion of the solids, particularly the coarse sand particles, settle to the bottom of the cell; most of the bitumen particles, which have preferentially become attached to bubbles of air, rise to the top surface of the cell contents, where they collect in the form of a froth. The sand leaves the vessel through a bottom outlet and is discarded as tailings. The froth overflows the vessel wall into a launder and is removed for further treatment.

A middlings stream is continuously withdrawn from the separation cell at a point intermediate its upper and lower ends. This is done for two reasons. Firstly, a relatively large quantity of water must be added in the flooding stage to ensure that the bitumen and solids particles are sufficiently dispersed from one another in the separation cell to obtain reasonable froth product quality and bitumen recovery. Some of this water must be removed from the cell in the form of a middlings drag stream—otherwise it will report to the bottom tailings stream. If too much water leaves with the sand tailings, bitumen is carried out with it and oil recoveries drop accordingly. Secondly, the solids known as "fines" (i.e., -325 mesh), present in the tar sands, tend to accumulate in the central portion of the cell. If the fines are present in too high a concentration, they tend to form a thick blanket, through which the aerated bitumen particles have difficulty in passing to reach the

froth layer. It is therefore conventional to withdraw some of these fines in the middlings stream to relieve the congestion within the cell.

The middlings stream typically comprises 2 percent bitumen, 15 percent solids and 83 percent water.

The bitumen particles in the middlings stream are a mixed lot — some are non-buoyant, perhaps because they are non-aerated or because they are attached to both solids and air; others are buoyant but were withdrawn through the middlings outlet before reaching the froth layer.

Conventionally, the middlings stream from the separator cell is passed through a sub-aeration cell to recover contained bitumen. In this latter secondary recovery cell, the middlings are turbulently mixed with air to bring the bitumen to the surface of the cell as a froth. This froth is badly contaminated with solids and water — a typical composition might be 16 percent weight solids, 54 percent water and 31 percent bitumen.

Once the bitumen has been extracted from the tar sand in this fashion, the primary and secondary froths are combined, diluted with a specific gravity-altering diluent, such as naphtha, and treated in a centrifuge circuit to separate the solids and water from the bitumen. Erosion of these centrifuges, particularly by the fines present in the froth, is a serious problem. Therefore any reduction in fines content in the feed to the centrifuge circuit is desirable.

SUMMARY OF THE INVENTION

It is therefore one object of this invention to provide a process for treating middlings whereby a product which is comparatively lower in solids content is obtained.

It is another object to provide a process wherein the middlings are diluted by the addition of hot water, to improve secondary froth quality and in which the water added is conserved by recycling to the front end of the process.

In accordance with the invention, the middlings stream is diluted with hot water, preferably contacted with minute air bubbles to aerate non-buoyant bitumen, and introduced into a settler vessel. In the quiescent and dilute environment within this vessel, the buoyant bitumen forms a froth product which is reduced in solids and water content in comparison to the prior art secondary recovery froth obtained by sub-aeration flotation. Solids, water and traces of bitumen are withdrawn from the vessel through the tailings outlet. Part of this tailings stream may be recycled to the front end of the process for repeated treatment in the separation cell. In this manner, hot water is conserved within the process. The remainder of the tailings stream may be discarded or otherwise processed for recovery of contained bitumen. The froth product from the settler is preferably combined with the primary froth from the separation cell and forwarded on to the froth treatment circuit.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating the steps of the process; and

FIG. 2 is a schematic illustration of the equipment used in the process.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention and its benefits are illustrated in the following example;

1360 pounds per hour of Athabasca tar sand, comprising 11 percent by weight bitumen, 4 percent water, and 85 percent solids, including 12 percent fines, is fed to a tumbler 1. Sufficient fresh hot water, approximately 290 pounds per hour, is added to the tar sand in the tumbler 1 to produce a slurry containing 22 percent by weight water. The product slurry is observed to have a temperature of 160°F. The residence time in the tumbler is approximately 3½ minutes.

The slurry is fed from the tumbler 1 into a separation cell 3. Water at 180°F is added to the slurry at the screen 4 to raise the water content to approximately 42 percent. The separation cell 3 and settler 5 are both filled with clear water at 180°F at the time that the test run is initiated. Froth, comprising 70 percent bitumen, 6 percent solids, 24 percent water, is produced at the surface of the separation cell at a rate of 170 pounds per hour. A tailings stream, comprising 70 percent solids, 0.8 percent bitumen and 29.2 percent water, is produced from the cell at a rate of 1,180 pounds per hour.

A middlings stream, comprising 2 percent bitumen, 15 percent solids, and 83 percent water, is withdrawn from the separation cell by a pump 6 at a rate of 900 pounds per hour. This stream is mixed with 200 pounds per hour of water and approximately 0.1 CFH air in a mixer 7 and is then pumped to the settler.

The diluted middlings stream is introduced to the central portion of the settler through a rotating, perforated distribution pipe 8. A froth product is continuously formed and withdrawn at the rate of 19 lbs. per hour from the settler. This froth product comprises 77 percent bitumen, 5 percent solids, and 18 percent water. A stream of dilute solids and water is continuously withdrawn through the tailings outlet of the settler vessel and is recycled to the front end of extraction.

By way of comparison, the same middlings stream, when fed directly to a sub-aeration secondary recovery cell, gives a froth product comprising 52 percent bitumen, 13 percent solids and 35 percent water.

5 Obvious variations in the specific details described may be made without departing from the spirit of the invention and such embodiments of the invention as come within the scope and perview of the appended claims are to be considered as part of this invention.

10 What is claimed is:

1. In a continuous process for recovering bitumen from tar sand comprising combining the tar sand with air and hot water in a tumbler to disintegrate the tar sand and produce a hot slurry, diluting the slurry with water, introducing the dilute slurry into a separation cell wherein coarse solids settle out to form a tailings product, aerated bitumen rises to the surface of the cell contents and forms a froth product, and a middlings stream is withdrawn from the cell, said stream comprising bitumen, fine solids and water, the improvement which comprises:

diluting the middlings stream with hot water; and introducing the diluted middlings stream into a settler vessel and holding it therein for a sufficient period of time to allow the major portion of the bitumen in the stream to rise to the surface of the vessel contents and form a froth product;

withdrawing the froth product; and

withdrawing a tailings stream from the base of the vessel, said tailings stream comprising the major portion of the fine solids and water introduced into the vessel.

2. The process as set forth in claim 1 wherein: at least part of the tailings stream from the settler vessel is recycled for repeated treatment in the separation cell.

3. The process as set forth in claim 1 wherein: the middlings stream is aerated prior to entry into the settler vessel to facilitate bitumen flotation.

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