EFFLUENT DISCHARGE BITUMEN RECOVERY BY SETTLING

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Abstract of the Disclosure

The specification discloses a process for recovering bitumen from the effluent discharge from a hot water process for treating bituminous tar sands. The effluent discharge comprises water, sand, silt and bitumen. The effluent is discharged into a quiescent bitumen flotation zone, is settled to form a bitumen layer on top of the water and the bitumen layer is then separately recovered.

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 a method for the recovery of bitumen from the effluent discharged from the hot water process.

The bitumen which are also known as oil sands and bituminous sands are massive 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 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 silicas, having closely associated therewith an oil film which varies from about 5 percent 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.

The sand contains, in addition to the oil and sand components, clay and silt in quantities of from 1 to 10 percent by weight, more usually 10 to 30 percent. The 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 grains.

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 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 muller with a minor amount of hot water at temperatures of 170° to 190° F, and the resulting pulp is then dropped into a turbidulent 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 mid-
The present invention relates to a process for treating the effluent discharge from the hot water process to recover this scum forming bitumen. The steps of the process generally comprise discharging the effluent into a quiescent settling zone, settling the effluent in a bitumen flotation zone to form a bitumen layer on top of the water in the effluent and then removing the bitumen layer from the top of the water for recycle to the hot water process or some other treating step.

The settling step may be conducted by any method well known in the art. About 25 percent of the bitumen contained in the effluent floats to the top of the water almost immediately. After about two weeks the bitumen consists of about 50 percent of the total bitumen contained in the effluent.

The scum may be skimmed by froth wiper devices to a pump and pumped back into the process or collected by any usual method so long as it is collected separately from the pond water. The recovered bitumen may be recycled back into the process to be added into the separation cell, the pulp box, or preferably added to the froth from the separation cell for further treatment.

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

Oil sand is fed into the system through line 1 where it first passes to a conditioning drum or muller 12. 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 13 which serves as a zone for diluting the pulp with additional water before passage to primary separation zone 14.

The separation zone 14 typically comprises a large cylindrical or rectangular tank, or battery of tanks, which may, if desired, be provided with heating coils for maintaining processing temperature. The separator is supplied with an oil froth withdrawal line 4 adjacent to the top and a sand tailings removal line 5 at the bottom. The separator also has a withdrawal line 6 through which a stream of middlings layer is removed.

The pulped tar sands are continuously flushed from the pulp box through line 3 into the separator 14. The settling zone in separator 14 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 15. In this zone an air flotation operation is conducted to cause the formation of additional oil froth which passes from scavenger zone 15 through line 7 and thence to line 4 for further processing in admixture with the froth from the primary zone. An oil-froth water middlings stream is removed from the bottom of scavenger zone 15 via line 8 and is mixed at 16 with tailings from line 5 to form the effluent discharge. The effluent discharge is fed through line 9 to a quiescent bitumen flotation zone 17 which may be pond areas, settling tanks, etc. The bitumen layer which forms on top of the water in the settling zone 17 is withdrawn and fed via line 10 to be mixed with the froth or may be withdrawn via line 11 and fed to the pulp box 13 and mixed with feed tar sands or withdrawn and added during any other step in the hot water process.

The following example illustrates the invention:

**EXAMPLE**

An effluent of composition as given in the table is collected from the oil-lean middlings and sand tailings from the hot water process and is percolated through a 300 acre sand slope as described in United States Patent 3,392,833, down to a 200 acre flat pond area enclosed by the slope and by constructed dikes. About 152,500 tons of effluent per day is treated in this way.

The effluent is continually added at about this average rate. Two weeks after initial addition about 8,400 tons of bitumen has accumulated in the form of a scum on the surface of the water in the pond. At this time removal of the scum is initiated by skimming the bitumen with wiper blades into a pump. The skimmed bitumen is then pumped to the froth processing area where it is added as a diluent to the froth.

The total bitumen scum on the surface of the pond and the amount recycled is calculated and it is determined that 600 tons per day of scum forming recoverable bitumen is distributed into the pond.

What is claimed is:

1. A process for recovering bitumen from the effluent discharge from a hot water process for treating bitumen sands to recover the bitumen therefrom as a froth product, said effluent discharge comprising water, sand, silt and bitumen, the steps of which comprise:
   (a) discharging said effluent into a quiescent bitumen flotation zone;
   (b) settling the said effluent in said bitumen flotation zone to form a bitumen layer on the top of the water of said effluent; and
   (c) separately removing said bitumen layer from said water.

2. A process according to claim 1 which comprises recycling the bitumen removed from said water to the said hot water process.

3. A process according to claim 1 which comprises adding the bitumen removed from said water to the froth product of the hot water process.

4. A process of recovering bitumen from the effluent discharge from a hot water process for treating bitumen sands to recover the bitumen therefrom as a froth product, said effluent discharge comprising sand, silt and bitumen, which comprises:
   (a) percolating the effluent down an inclined sand pile zone to remove the sand from said effluent; and
   (b) discharging said percolated effluent into a quiescent bitumen flotation zone;
   (c) settling the said effluent in said bitumen flotation zone to form a bitumen layer on the top of the water of said effluent; and
   (d) separately removing said bitumen layer from said water.

5. A process according to claim 4 which comprises recycling the bitumen removed from said water to the said hot water process.

**References Cited**

**UNITED STATES PATENTS**

2,980,600 4/1961 Kelley 208-11
3,392,833 7/1968 Baillie 210-65

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