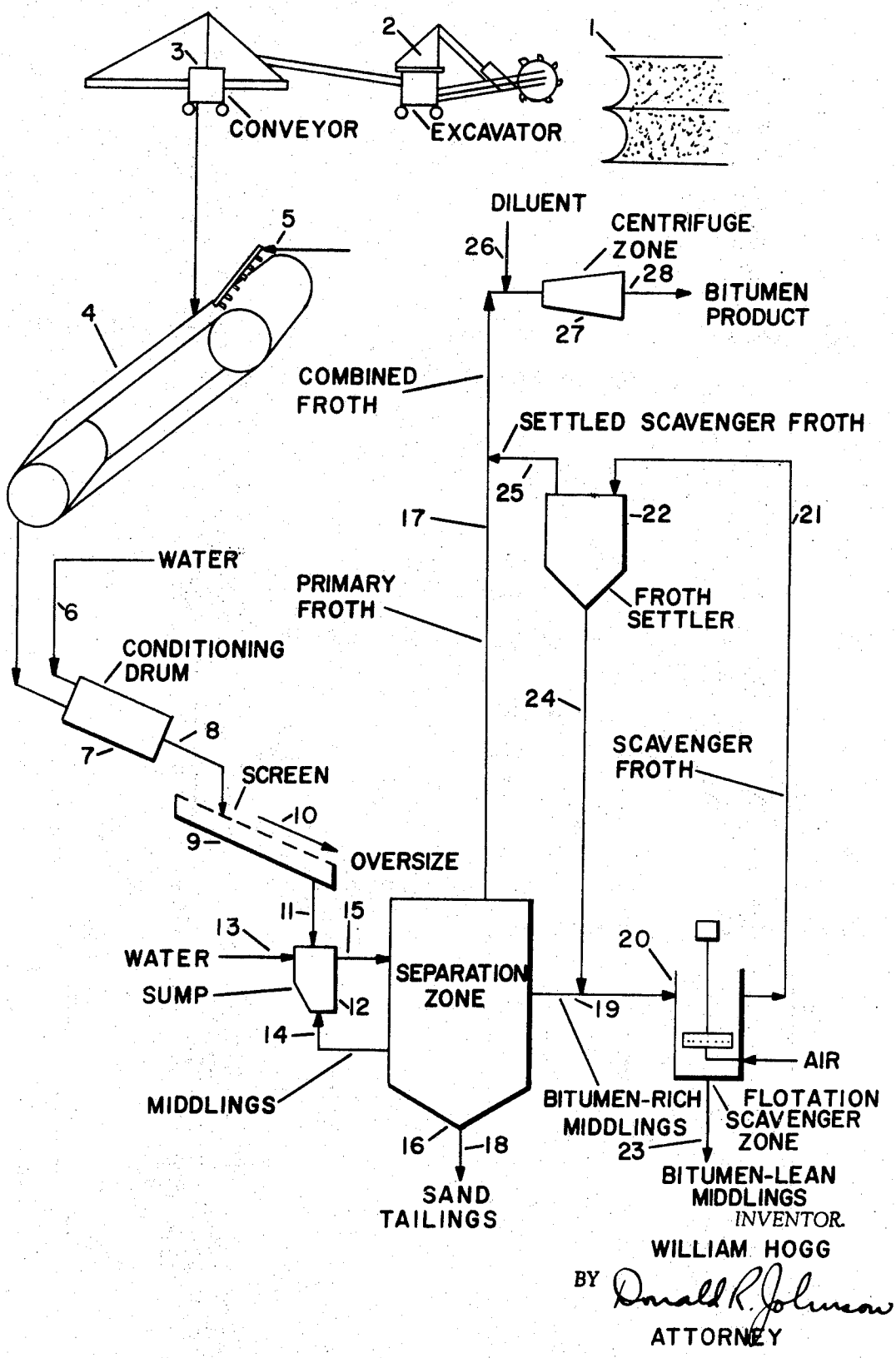
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TAR SANDS CONVEYOR BELT OPERATION

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# TAR SANDS CONVEYOR BELT OPERATION

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## ABSTRACT OF THE DISCLOSURE

This invention relates to a method of transporting bituminous tar sands by belt conveyors. Specifically the invention is an improvement to such methods whereby a spray of an aqueous liquid medium is directed onto the belt to form a water layer thereon thus reducing the tendency of sands to stick at the discharge end of the belt. The invention also relates to a conveyor belt transmission system in combination with a water delivery unit.

Bituminous tar sands comprise a siliceous material, generally having a size greater than that passing a 325 mesh screen, saturated with a relatively heavy, viscous bitumen in quantities of from 5 to 21 weight percent of the total composition. More typically, the bitumen content of the sands is about 8 to 15 percent. This bitumen is quite viscous and contains typically 4.5 percent sulfur and 38 percent aromatics. Its specific gravity at 60° F. ranges typically from about 1.00 to about 1.06. The tar sands also contain clay and silt in quantities of from 1 to 50 weight percent of the total composition. Silt is normally defined as mineral which will pass a 325 mesh screen but which is larger than 2 microns. Clay is mineral smaller than 2 microns including some siliceous material of that size.

There are several well-known processes for effecting separation of bitumen from the tar 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. 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 140° to 210° F. The resulting pulp is dropped into a stream of circulating hot water and carried to a separation cell maintained at a temperature of about 150° to 200° F. In the separation cell, sand settles to the bottom as tailings and bitumen rises to the top in the form of an oil froth. An aqueous middlings layer containing some mineral and bitumen is formed between these layers. A scavenger step may be conducted on the middlings layer from the primary separation step to recover additional amounts of bitumen therefrom. This step usually comprises aerating the middlings as taught by K. A. Clark, "The Hot Water Washing Method," Canadian Oil and Gas Industries 3, 46 (1950). These froths can be combined, diluted with naphtha and centrifuged to remove more water and residual mineral. The naphtha is then distilled off and the bitumen is coked to a high quality crude suitable for further processing. The hot water process is described in detail by Floyd et al. in U.S. Pat. 3,401,110.

The tar sands must be mined from their deposits for charge into the particular process used to effect separation of the bitumen from the sands. In one particular mining operation, overburden is first removed from the deposits. This involves the stripping away of trees, crust and earth which overlie the tar sands. The sands are then mined by giant bucketwheel excavators. The digging



wheels on such excavators have ten buckets, each bucket capable of biting out and holding nearly two tons of sand. Sand dug by the wheel travels the length of the digger by conveyor to the discharge boom and is dropped on the first of three conveyor belts. One particular operation utilizes a first conveyor which is 4,600 feet long, 60 inches wide and made of one-inch thick rubber on steel cords. It travels at 1,050 feet per minute, about 12 miles per hour. Sand is dumped from the first conveyor onto a second which is 60 inches wide and about 100 feet long. As diggers get farther from the initial mining area, the second conveyor is extended and ultimately both conveyors stretch several miles. The second conveyors drops sand onto a third conveyor. This third belt, 72 inches wide, runs 1,350 feet to the operation separation plant.

The present invention relates to the operation of conveyors for the transporting of tar sands. Typical of such operation is that described above but the present invention is not limited to that operation but is generally applicable to the use of belt conveyors for moving tar sands.

Although belt conveyors have been widely used in other mining operations, there are some new problems peculiar to the handling of tar sands. In operation it has been observed that large quantities of the sands stick to the belts causing fouling and a decrease in belt capacity on the conveyor belt surface. Depending on the character of the feed material and the outside temperature, the layer of sticking sands attains a thickness of as much as one-half inch. In warm weather, the belt deposit increases in toughness and thickness. In cold weather, the deposit becomes frozen in transit from the mining area to the processing area. Steam jets and scrapers have been proposed for the purpose of removing the deposit but none of these means has been fully satisfactory.

Accumulation of sands on the conveyor belts causes unbalanced loads, straining problems and additional wear on pulleys, idlers and scrapers. It has been found, by the present invention, that a layer of film of an aqueous liquid medium applied to the belt, before the tar sands are placed on the belt for transportation, substantially reduces the tendency of the sands to stick to the conveyor. Other mediums were tested but only water was found to be of benefit in reducing deposits of sands on the belts.

The present invention can be broadly described as an improvement to a process for transporting bituminous tar sands on a conveyor belt between a receiving area and a discharge area where the improvement comprises applying a layer of an equeous liquid medium onto the surface of the belt before the receiving area to reduce the tendency of the sands to stick to the belt when discharged at the discharge area. The invention can also be described as an improvement to a process for producing bituminous material from bituminous tar sands deposits where the process comprises excavating the tar sands from the deposits in a mining area, placing the tar sands on a conveyor belt and transporting the sands from the mining area to a treatment process area, forming a mixture of the tar sands and water in the treatment process area, passing the mixture into a separation zone to form an upper bitumen froth layer, a middlings layer comprising water, mineral and bitumen and a sand tailings layer and recovering the bitumen froth layer. The improvement comprises applying a layer of an aqueous liquid medium onto the surface of the conveyor belt before the sands are placed on the belt to thereby reduce the tendency of the sands to adhere to the belt at the treatment process area.

The present invention can be applied to any type of belt conveyor usable for transporting bituminous tar sands. Various examples of types of belt conveyors are disclosed in U.S. Pats. 2,566,262, Traxler, Apr. 28, 1951;

2,712,332, Annerhed, July 5, 1955; 2,748,044, Seiler, May 29, 1956; 2,839,651, Erickson, June 17, 1958; 3,144,930, Michels, Aug. 18, 1964; 3,181,690, Jenkins, May 4, 1965; 3,212,627, Beebee, Oct. 19, 1965; 3,221,869, Paasche, Dec. 7, 1965; 3,323,637, Jenkins, June 6, 1967.

The present invention also relates to a conveyor belt transmission system comprising a continuous conveyor belt having a load bearing surface, means for passing the surface between loading and discharge loci, in combination with an aqueous liquid delivery unit positioned with respect to the belt so as to deliver aqueous liquid onto the load bearing surface before the surface passes to the loading area. Preferably the belt is an enforced rubber belt.

The drawing is a schematic representation of the present invention as applied to the transportation of mined tar sands to a hot water process.

In the drawing the tar sands deposit is illustrated by **1**. The tar sands are mined by the giant excavator **2**. In one exemplary operation, the digging wheel on earth of two excavators is 29.5 feet in diameter and has ten buckets, each bucket being capable of holding nearly two tons of tar sands. The excavators are designed for a maximum digging of 215,000 tons of sands per day; operation range, however is about 5,000 to 6,000 tons per hour. Length of the digging boom is 97 feet and the discharge boom 82 feet. Installed horsepower in each wheel is 3,700 H.P. The belt wagon weighs 433 tons and has 1,325 H.P. Length of its loading boom is 88.5 feet and the discharge boom is 105 feet. The sands mined are discharged from the excavator **2** to the conveyor illustrated by **3**. This conveyor is crawler mounted and double boomed and about 197 feet long. It is rotatable to allow for wide increases in minable area. The crawler-mounted conveyor transfers the sands to a belt conveyor system illustrated by **4** for charging to the separation process area. The belt **4** represents a system of conveyors consisting of a first conveyor which is 4,600 feet long, 60 inches wide and made of one-inch thick neoprene rubber on steel cords. It travels at 1,050 feet per minute. The mined tar sands are dumped from the first conveyor onto a second which is also 60 inches wide, and initially about 100 feet long. As the excavator gets farther from the separation process area, the second conveyor is extended and ultimately both the first and second conveyors stretch several miles. The second conveyor drops the tar sands onto a third conveyor which is 72 inches wide and runs about 1,350 feet to the separation process area.

A layer of aqueous liquid medium is applied to each empty belt as illustrated by **5** before sands are placed on that belt for transportation to the next succeeding belt or to the separation process area. This application decreases the tendency of the tar sands to stick to the belt as per the present invention. The aqueous fluid is preferably water and is preferably applied to the belt as a spray from a perforated pipe or in any form or by any means sufficient to coat the conveyor belt with water. The rate of application of water should be not less than 1 gallon per minute and preferably is between 1.5 gallons and 3.0 gallons per minute in the particular described case above. In general the aqueous liquid medium is applied at such a rate that at least 0.15 gallon is applied per 1,000 square feet of belt area, preferably the aqueous liquid medium is applied at such a rate that between 0.22 to 0.67 gallon of medium is applied per 1,000 square feet of belt area.

The aqueous medium of the present invention preferably is water. The medium can comprise water containing one or more processing aids such as monovalent alkaline reagents if the belt is composed of a material which will not be affected by the reagent. Such reagents include sodium silicate and sodium hydroxide.

The tar sands on the water-wet belts are discharged to each next succeeding belt without accumulation of deposit on the belts until the sands are fed into a conditioning drum **7** of a hot water process. Water and steam are introduced into the conditioning drum from **6** and mixed with the sands. Enough steam is introduced to raise the temperature in the conditioning drum to above 170° F. Monovalent alkaline reagent can also be added to the conditioning drum to maintain the pH of the middlings layer in separator zone **16** within the range of 7.5 to 9.0. Mulling of the tar sands produces a pulp which then passes from the conditioning drum as indicated by line **8** to a screen indicated at **9**. The purpose of screen **9** is to remove from the tar sand pulp any debris, rocks, or oversized lumps as indicated generally at **10**. The pulp then passes from screen **9** as indicated by **11** to a sump **12** where it is diluted with additional water from **13** and a middlings recycle stream **14**. The pulped and diluted tar sands are pumped from the sump **12** through line **15** into the separation zone **16** which comprises a settling cell which contains a relatively quiescent body of hot water which allows for the formation of a bitumen froth which rises to the cell top and is withdrawn via line **17** and a sand tailings layer which settles to the bottom to be withdrawn through line **18**. An aqueous middlings layer between the froth and tailings layer contains silt and clay and some bitumen which failed to form froth.

A relatively bitumen-rich middlings stream is withdrawn from separator **16** through line **19** and is sent to a scavenger zone **20** wherein an air flotation operation is conducted to cause the formation of additional bitumen froth. The processing conducted in the scavenger zone involves air flotation by any of the air flotation procedures conventionally utilized in processing of ores. The air causes the formation of additional bitumen froth which passes from the scavenger zone **20** through line **21** to a froth settler zone **22**. A bitumen-lean middlings stream is removed and discarded from the bottom of the scavenger zone **20** via line **23**.

In settler zone **22**, the scavenger froth forms into a lower layer of settler tailings which is withdrawn and recycled via line **24** to be mixed with bitumen-rich middlings for feed to the scavenger zone **20** via line **19**. In the settler zone an upper layer of upgraded bitumen froth forms above the tailings and is withdrawn through line **25** and is mixed with primary froth from line **19**. The combined froths are at a temperature of about 160° F. They are heated with steam and diluted with sufficient naphtha or other diluent from **26** to reduce the viscosity of the bitumen for centrifuging in zone **27** to produce a bitumen product **28** suitable for further processing.

What is claimed is:

**1.** In a process for transporting bituminous tar sands on a rubber surface conveyor belt between a receiving area and discharge area, the improvement which comprises; applying a layer of an aqueous liquid medium onto the surface of said conveyor belt immediately prior to contacting said surface with said bituminous tar sands thereby reducing the tendency of said sands to stick to said belt when discharged at said discharge area.

**2.** The process of claim **1** in which said aqueous medium is applied at a rate such that at least 0.15 gallon of medium is applied per 1,000 square feet of belt area.

**3.** The process of claim **1** in which said aqueous medium is applied at a rate such that between 0.22 to 0.67 gallon of medium is applied per 1,000 square feet of belt area.

**4.** The process of claim **1** in which said aqueous medium is water containing a monovalent alkaline processing aid selected from the group consisting of sodium hydroxide, sodium silicate and combinations thereof.

**5.** The process of claim **2** in which said aqueous medium is water containing a monovalent alkaline processing aid selected from the group consisting of sodium hydroxide, sodium silicate and combinations thereof.

**6.** The process of claim **3** in which said aqueous medium is water containing a monovalent alkaline proc-

essing aid selected from the group consisting of sodium hydroxide, sodium silicate and combinations thereby.

7. In a process for producing bituminous material from a bituminous tar sands deposit which comprises: excavating said tar sands from said deposit in a mining area; placing said tar sands on a rubber surfaced conveyor belt and transporting said sands from said mining area to a treatment process area; forming a mixture of said tar sands and water in said treatment process area; passing said mixture into a separation zone to form an upper bitumen froth layer, a middlings layer comprising water, mineral and bitumen, and a sand tailings layer; and recovering said bitumen froth layer; the improvement which comprises: applying a layer of an aqueous liquid medium onto the surface of said conveyor belt immediately before said sands are placed on the belt to thereby reduce the tendency of said sands to adhere to the belt at the treatment process area.

8. The process of claim 7 in which said aqueous medium is applied at a rate such that at least 0.15 gallon of medium is applied per 1,000 square feet of belt area.

9. The process of claim 7 in which said aqueous medium is applied at a rate such that between 0.22 to 0.67 gallon of medium is applied per 1,000 square feet of belt area.



10. The process of claim 7 in which said aqueous medium is water containing a monovalent alkaline processing aid selected from the group consisting of sodium hydroxide, sodium silicate and combinations thereof.

11. The process of claim 8 in which said aqueous medium is water containing a monovalent alkaline processing said selected from the group consisting of sodium hydroxide, sodium silicate and combinations thereof.

12. The process of claim 9 in which said aqueous medium is water containing a monovalent alkaline processing aid selected from the group consisting of sodium hydroxide, sodium silicate and combinations thereof.

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