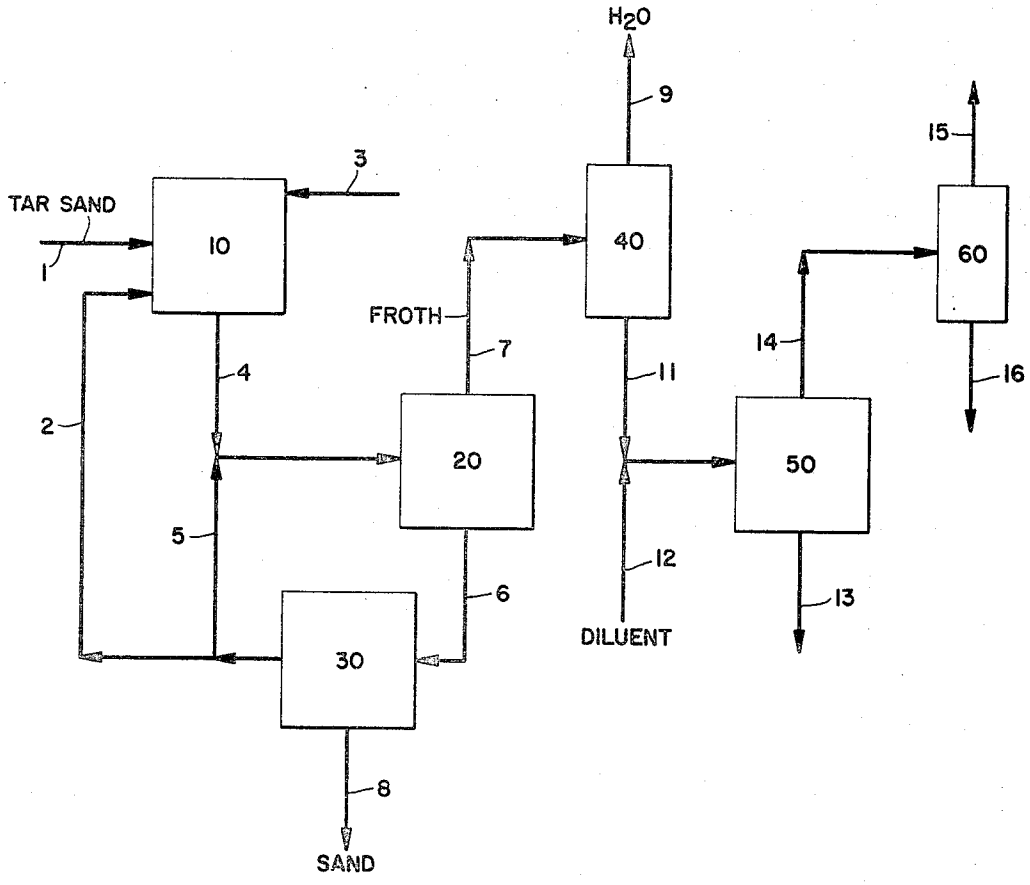
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PHOSPHATE ADDITIVES IN A TAR SAND WATER SEPARATION PROCESS

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PHOSPHATE ADDITIVES IN A TAR SAND WATER SEPARATION PROCESS

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ABSTRACT OF THE DISCLOSURE

The process is concerned with the recovery of oil from tar sands using an integrated process which comprises a plurality of stages. A particular sodium phosphate compound is utilized wherein in the first stage a relatively small amount of water is used and in a secondary stage a relatively greater amount of water is used. An oil-rich froth is separated from the secondary stage, passed to a distillation zone to segregate the oil, which is mixed with a diluent to separate the final traces of soilds.

The present invention is broadly concerned with the recovery of hydrocarbons from tar sands. The invention is more particularly concerned with an improved technique for the maximum removal of oil from tar sand utilizing a particular combination of phosphate additives. In accordance with the present invention by utilizing critical amounts of particular phosphate additives, a maximum amount of oil is removed from the sand which is associated with the froth separated from the treated sand.

In various areas of the world, tar sands exist which contain various types of hydrocarbons as, for example, the heavy oil deposits of Athabaska tar sands existing in Canada. These sands constitute tremendous reserves of hydrocarbon constituents. For example, the oil in the sands may vary from about 5% to 21% by volume, generally in the range of about 12% by volume. The gravity of the oil ranges from about 6° to 10° API, generally about 8° API. These sands lie from about 200 to 300 ft. below an overburden and the beds may range from about 100 to 400 ft. thick. A typical oil recovered from the sands has an initial boiling point of about 300° F. 1.0% distilled to 430° F., 20.0% distilled to 650° F. and 50.0% distilled to 980° F.

However, the recovery of hydrocarbons in the past has not been effective to any great extent due to the deficiencies in operating techniques for the recovery of these hydrocarbons. For example, a relatively small amount of clay (from about 0% to 30%, usually 5%) in the sand greatly retards recovery of the oil utilizing conventional water techniques. Apparently the oil and the clay form skins which envelop small pockets of water often containing finely divided sand; then the enveloped pockets are distributed in water, thus forming a type of emulsion. Since large amounts of material must be treated and handled to recover the oil, any technique or process which improves the yield of oil even slightly will result in great economic benefits.

In accordance with the present invention, a particular class of sodium phosphate compounds is used wherein the sodium concentration is maintained in a critical range from about 0.4 wt. percent to about 0.8 wt. percent preferably about 0.4 to 0.6 wt. percent, such as about 0.5 wt. percent, as compared with the sand in an initial stage wherein the amount of water utilized is in the range from about 15% to 30% by weight based upon the sand. The preferred amount of water is from about 18% to 26% by weight, preferably about 22% by weight. The phosphate compound utilized is selected from the class of sodium phosphate compounds wherein the ratio of phosphorous to sodium varies from about 1:1 to 1:2, preferably about 1:1.7.

The process of the present invention may be readily understood by reference to the drawing illustrating an embodiment of the same. Referring specifically to the drawing, tar sands are introduced into initial stage **10** by means of feed line **1**. Water is introduced into initial stage or mixing zone **10** by means of line **2**. The amount of water utilized in initial stage **10** based upon the sand is in the range from about 15 to 30% preferably in the range of about 20 to 22% by weight.

Initial stage **10** is maintained at a temperature in the range from about 120° to 200° F., preferably at about 140° F., by any suitable means. In accordance with the present invention, a sodium polyphosphate compound is introduced into initial stage **10** by means of line **3**. The amount of sodium polyphosphate utilized is such as to secure a sodium concentration based upon the amount of sand in the range from about 0.4 to 0.8 wt. percent, preferably about 0.5 wt. percent. The sodium polyphosphate compound utilized is selected from the class of compounds wherein the phosphorous-to-sodium ratio is in the range from about 1:1 to 1:2, preferably about 1:1.7. Any suitable means of mixing may be utilized in zone **10** such as stirrers and the like.

The mixture is withdrawn from initial zone **10** by means of line **4** and mixed with additional water which is introduced by means of line **5**. The amount of additional water utilized is sufficient to have from about 100–300% by weight of water, preferably about 200% by weight of water based upon the sand. The mixture is then introduced into a secondary stage or separation zone **20**.

The temperature in secondary stage **20** is in the range of from about 120° to 200° F., preferably about 140° F. Under these conditions sand and water substantially free of oil, is removed from secondary stage **20** by means of line **6** while an aqueous froth containing substantially all of the oil and a relatively small quantity of water is removed from zone **20** by means of line **7**. The water phase and sand removed by means of line **6** is passed into a sand separation zone **30** wherein a water phase free of sand is separated and preferably recycled to the system. Since this water phase contains the added phosphate the sand is removed from separation zone **30** by means of line **8** and disposed of as desired.

The oil-rich froth is then handled or processed in order to secure an oil phase. One preferred method is to introduce the oil froth into a distillation zone **40** in order to remove overhead water by means of line **9**. It is preferred that the oil phase withdrawn from distillation zone **40** by means of line **11** be at a temperature in the range from about 250° to 400° F. such as about 300° F. A hydrocarbon diluent such as a hydrocarbon fraction boiling in the range from about 250° to 600° F. is added to the oil phase by means of line **12**. Other hydrocarbons may be added such as benzene, toluene, and the like. The amount of diluent added is about 0.5 to 2.0 volumes of diluent per volume of oil. Sufficient pressure is maintained on the system to keep the diluent in the liquid phase. The mixture is then passed into a final solids separation zone **50** wherein the remaining traces of solids separate and are removed by means of line **13**. Separation zone **50** may comprise filters or settling means. A diluent oil phase is removed from separation zone **50** by means of line **14** and introduced into a diluent-heavy oil separation zone **60** wherein the diluent is separated and removed by means of line **15** and preferably recycled to the system. The heavy oil phase is removed by means of line **16** and further processed as desired. Sepa-

ration zone **60** may comprise a distillation zone or a phase separation zone.

In order to further illustrate the invention a number of operations were carried out in accordance with the technique described utilizing sodium tripolyphosphate, sodium pyrophosphate, sodium hexametaphosphate, sodium phosphate, disodium hydrogen phosphate, and monosodium hydrogen phosphate.

The results of these operations are listed in the following table.

OIL REC. IN FROTH, WT. PERCENT

Na con. wt. percent (based on tar sand)	P/Na	0	0.2	0.4	0.6	0.8	1.0	1.2
$Na_5P_3O_{10}$	1/1.7	42	45	82	83	84	83	83
$Na_4P_2O_7$	1/2	42	45	76	------	80	----------	
$(NaPO_3)_6$	1/1	42	45	76	------	80	----------	
Na_3PO_4	1/3	42	45	50	----------			
Na_2HPO_4	1/2	42	48	56	------	70	----------	
NaH_2PO_4	1/1	42	42	----------		52	----------	

From the above it is apparent that the oil froth contained a far greater concentration of oil when utilizing a sodium concentration in the range from about 0.4 to 0.8, and when using a phosphorous-to-sodium ratio as defined by the present invention.

What is claimed is:

1. Improved process for the recovery of oil from tar sands which comprises mixing said tar sand with from about 15 wt. percent to 30 wt. percent of water in an initial mixing zone maintained at a temperature of about 120° F. to 200° F., adding a sodium phosphate compound to mixing zone so as to have a sodium concentration based upon the weight of the tar sand in the range from about 0.4 to about 0.8 wt. percent and to have a phosphorous-to-sodium ratio in the range from about 1:1 to 1:2, withdrawing the mixture from said mixing zone and adding additional water so as to have a water concentration in the range from about 100% to 300% by weight based upon the tar sand, thereafter passing the mixture to a secondary zone maintained at a temperature in the range from about 120° to 200° F., removing an oil-rich froth and a sands-water phase from said secondary zone, passing said froth to a distillation zone and removing water overhead from said distillation zone, removing an oil phase from the bottom of said distillation zone and adding a hydrocarbon diluent boiling in the range from about 250° to 600° F. thereto, passing the mixture to a tertiary zone and separating the final traces of solids therefrom, and thereafter separating said oil from said diluent.

2. Process as defined by claim **1** wherein the sodium concentration in said mixing zone is about 0.5% by weight and wherein the phosphorous-to-sodium ratio is about 1 to 1.7.

3. Process as defined by claim **1** wherein the amount of diluent added is about one volume of diluent per one volume of bottoms oil phase.

4. Process as defined by claim **1** wherein said diluent consists essentially of benzene.

5. Process as defined by claim **1** wherein from about 0.5 to 2 volumes of diluent are added per volume of oil.

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