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MINING OF SULFUR USING HOT SALINE WATER CONTAINING A SMALL PERCENTAGE OF FINELY DIVIDED EARTHY MATERIAL

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This invention relates to the mining of sulfur and especially to processes for providing water heated to the high temperatures required in such mining operations. More specifically it relates to the preparation and utilization of sea and other saline waters having scale-forming properties for said purpose.

In mining by the Frasch process, it is common practice to remove scale-forming constituents from the well water or surface water to be used by means of a lime-soda treatment or other water-softening method prior to introduction of the water into the heating system. If this softening process is not used, the calcium sulfate which has an inverse solubility curve deposits as a hard scale when the water is heated and also the calcium and magnesium bicarbonates in the water decompose at the higher temperatures employed and precipitate calcium carbonate and magnesium hydroxide and form a hard scale on the interior surfaces of the heater, the pipes and valves, thereby rapidly reducing the efficiency of the heater and actually constricting the flow to such a point that the operation becomes uneconomic.

If sea water or other saline water including formation water or bleed water produced in the sulfur mining operation, and in particular, those waters containing appreciable amounts of calcium and magnesium compounds are heated by conventional procedures in the usual equipment to the ultimate temperatures required for the mining of sulfur, the salts contained in the water would rapidly precipitate out and form a hard scale which would make such process wholly uneconomic. The equipment would have to be taken out of service often and cleaned by mechanical means such as turbining or scraping to remove the scale.

The conventional method of preparing fresh water or chemically treated water for use in the Frasch process is to heat it from its naturally occurring temperature to about 140° F. by heat exchange with boiler furnace flue gases through scrubbing of the gases in some form of packed tower; next to heat it to about 200 to 210° F. with low pressure exhaust steam introduced directly into the water, and finally to heat the water to a temperature of from about 330 to 360° F. by mixing the water with high pressure steam while maintaining the water under pressure. If sea water, brackish water or any saline water such as formation water having a high content of calcium and magnesium salts is heated by this conventional procedure, the deposition of scale is so rapid that continuation of the operation becomes impossible within a few hours due to scale deposition upon the valves, pipes and fittings.

Chemical treatment of these saline waters to remove the scale-forming constituents is uneconomic because of the large quantity of chemicals required. Yet in many locations where sulfur deposits are found, fresh water suitable for the purpose is not available, extremely large amounts of water being required.

The cost of the chemicals and equipment necessary to stabilize saline water of high scaling potentialities, by these known procedures, to withstand the elevated temperatures and pressures required for sulfur mining is high and may be prohibitive.

An object of the present invention is to provide large quantities of very hot water at low cost from water of high salt content without utilizing any filtering or other step to remove physically the scale-forming constituents from the water. Another object is to make it possible to heat such water in the conventional equipment used in the mining of sulfur by the Frasch process.

A further object of the invention is to provide a process for heating sea water to sulfur mining temperatures in heating tubes in which the scale-forming constituents do not deposit on the heating surfaces to any appreciable or objectionable extent.

Still another object is to provide an improved mining procedure involving the heating and utilization of a novel heating medium.

The basic procedure of the present invention of primary importance for the provision of hot saline water for sulfur mining processes involves adding to sea water or other scale-forming water a small percentage of a finely divided earthy material, such as mud, of a particle size which forms a suspension in the water and thereafter heating the resulting suspension to the temperature required for the mining of sulfur. In this heating operation the scale-forming salts of said water deposit for the most part upon the earthy particles rather than upon the hot metal surfaces with which the heated water comes in contact. The resulting hot mud suspension containing the scale-forming compounds including magnesium hydroxide, calcium carbonate, calcium sulfate, hydrous oxides of silicon, iron and other metals is then pumped into the sulfur formation in accordance with conventional procedures.

The process of the instant invention is applicable to any water containing salts having an undesirable tendency to form scale on metal surfaces when it is heated to sulfur mining temperatures. It is particularly applicable to sea water including brackish water and may utilize any saline water regardless of its source, such water being formation water or bleed water withdrawn from sulfur mines.

The process of the invention may utilize any finely divided solid material available in sufficiently large quantities at low cost. Preferred materials are alluvial deposits such as mud from the Mississippi Delta region. Clay, gypsum, or silica gel may alternatively be employed if economic considerations permit. As to the particle size of such earthy materials it is essential only that it be fine enough to stay in suspension during the period when the hot water containing the same is being flowed to the sulfur mine. Although the materials are satisfactory when substantially all particles will pass through a 200 mesh screen it is preferable that the material pass through a 325 mesh screen.

In accomplishing the objects of the invention, it is necessary only that a small percentage of mud be incorporated in the water before it is heated to a scale-forming temperature. In most operations the lowest concentration of mud is employed which will effectively prevent the deposition of scale in the sulfur mining equipment. The minimum concentration of mud permissible is almost entirely dependent upon the composition of the water, as to its particular salt content. The optimum concentration in any particular mining operation can be readily determined by trial and error in the specific equipment employed by examining the interior surfaces of the high pressure heaters, pumps and sections of the water-carrying pipes leading to the wells. Ordinarily, concentrations between 1 and 5% are found to be most satisfactory but under special circumstances other concentrations will perform properly as from 0.5 to 10%.