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SYSTEM AND PROCESS FOR THE HEATING OF WATERS AS FOR SULFUR MINING

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This invention relates to a system and process for the heating of naturally-occuring waters of any and all types of large quantities, and it relates particularly to processes for the heating of sea or other saline water for use as process water in the mining of sulfur by the procedure basically known as the Frasch process.

In conventional processes for heating water for the mining of sulfur, only surface water, well water or other relatively pure waters (in relation to sea waters) are employed, because scale formation and corrosion by saline waters have been insurmountable barriers. The problems of scale formation using the purer waters have been met by chemical treatments. The water is first divided into two streams process-wise, one of which is used as boiler feed water and the other as mine water or water to be pumped into the sulfur deposit.

The first mentioned stream is given a relatively severe treatment to condition it for use as boiler feed water, as by treatment with suitable chemicals such as the conventional hot lime soda process and, after such treatment is complete the thus purified water is fed to steam generating boilers of conventional type.

The second stream constituting the miner water is also treated by chemical means such as lime soda but to a lesser extent, also to remove or lessen the content of scale-forming constituents and the thus treated mine water is then mixed with steam from the boilers under pressure to produce the the water at the desired temperature for the sulfur mining operation contemplated. The equipment ordinarily required for the chemical treatment includes mixing tanks, feed tanks, chemical feeders, water treating tanks, settling ponds or mechanical precipitators, filters, sludge disposal equipment and many auxiliaries.

Since sulfur mining plants require very substantial quantities of hot water, the above described water treating equipment is quite extensive and the operating costs including that of chemicals are very substantial. Prior to the development of the present invention, no sulfur mining operation was conducted without these costly water treating plants.

The general object of the present invention is to provide processes for heating water for sulfur mining purposes which involve very substantial savings in equipment and in operating, chemical and maintenance costs in comparison with conventional plant practice. A primary general objective is to provide a heating system in which water of any salinity can be used for the mine water stream, and in which substantially all water required for the boilers is produced as a "by-product" in the process.

Specific objects are (1) to eliminate hard scale deposition altogether where this is desirable, (2) to lessen corrosion by limiting and controlling deposition of scale to optimum values in the heating equipment and auxiliaries where the same are constructed of non-corrosion resistant materials, (3) to limit the total water to be treated by hot or cold lime-soda processes to an inconsequential amount or to eliminate the step entirely, (4) when the raw water is of high salt content, to cause the scale-forming constituents which unavoidably separate to come down for the most part in the form of a soft gelatinous material which can easily be washed from the system rather than in the form of a hard scale which adheres tenaciously, (5) to reduce the total chemical and labor costs for water treatment and (6) to lessen the amount of plant equipment required, all in relation to the mining of sulfur.

Another important object is to make it possible to use water from sources of higher salinity than heretofore utilizable in conventional sulfur mining equipment. Since the hardness or scale forming constituents present in water normally increase in direct proportion to the salt content, the cost of treatment progressively increases and the use of high salt content water has heretofore been impractical. By the present invention it is possible to use water of high salt content for the mine water stream thereby conserving the limited supply of good water for the boiler water stream.

Broadly stated, the process of the invention relates to the production of hot process water and may be considered to involve a combination of two or more heating steps in which natural, scale-forming or saline water are preliminarily heated by indirect heat exchange with substantially saturated steam through heating surfaces maintained at a temperature below that at which any substantial amount of hard scale forms on the said surfaces, thereby at the same time condensing said steam, then heating the resulting process water under superatmospheric pressure by directly contacting the same with superheated steam under pressure, removing substantially saturated steam from contact with said process water and utilizing the same in said preliminary heating step, collecting the condensate from said first step and converting the same back to superheated steam, and utilizing the resulting steam in said second heating step.

A primary feature of the invention is that scale-forming water is heated to sulfur mining temperatures of from 300–340° C. or higher by a heating treatment in which direct steam is employed rather than indirect steam applied through heat transfer surfaces of tubes or other equipment maintained at high temperature scale depositing levels, such heating being accomplished without requiring any, or any appreciable amount of chemically treated boiler water.

Another feature of the invention involves a preheating or intermediate heating step applied to the scale-forming water, in which step there is employed substantially saturated steam obtained from the subsequently operated heating step utilizing direct superheated steam. The heat applied in the indirect heat exchange step is regulated such that the temperature of the water-side of the exchanger tubes is below that at which hard scale, particularly calcium sulfate, is formed. The details for the regulation of the heating to accomplish this result are disclosed and claimed in copending patent applications filed by the present applicant and his co-worker, Bernard A. Axelrad, now Patents No. 2,756,035 and No. 2,756,207.

Yet another feature of the invention as applied to the mining of sulfur involves a complete mining plant in which balanced quantities of hot water, steam power, electric power, service water, compressed air for pumping the sulfur wells and steam for heating the sulfur handling equipment are provided.

Another feature involves the utilization of the waste flue gases containing carbon dioxide obtained from the boilers and superheaters to preheat saline waters whereby the scale-forming tendencies thereof are reduced in the subsequently employed steam heating steps.

The scale-forming water to which the invention is applicable includes all naturally occurring water, such as sea, river, well, lake and bayou waters which generally