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# PROCESS FOR REMOVAL OF DEPOSITS FROM SULFUR MINING PIPES USING HOT CAUSTIC SODA SOLUTION

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This invention relates to the mining of sulphur and is concerned more particularly with procedures for the removal of obstructive deposits which after a time accumulate in sulfur conveying pipes and in bleedwater pipes employed in bringing sulfur or bleedwater from the formation at the bottom of the well to the surface. The sulfur pumping rate is thereby increased or restored to its original volume of flow.

It has been known for a long time in the mining of sulfur by the Frasch process using a concentric pipe system that there comes a time in the operation of the mines that the sulfur cannot be pumped out of the mine as fast as it is melted at the bottom of the well. This condition has, in the past, been attributed to the plugging of the sulfur inlet holes around the end of the sulfur conveying pipe or sulfur line at the bottom of the well by sand or pieces of formation rock which naturally would impede the flow of sulfur into the pipe. The reduction in pumping rate is now known to be caused in part by the formation of scale, of the character hereinafter described, in the well equipment and in the sulfur line both in the lower sections in the bottom of the well and in the upper sections near the surface.

When reduction of pumping rate of sulfur mines has been attributed to plugging, it has been the conventional procedure to force substantial amounts of hot water at the normal temperature used in mining, as 325–350° F. down into the sulfur formation at the bottom of the well both through the outside eight inch concentric pipe (the water pipe or line) and through the inner four inch pipe (the sulfur pipe or line). Usually this operation is successful in partially restoring the the sulfur pumping rate when mining is resumed, but the increased rate cannot be maintained and the cleaning treatment must be repeated every few weeks and at decreasing intervals.

As far as is known, no other practical method has been successfully employed for removing the obstructive materials causing the reduction in pumping rate. Replacement of pipes on which the deposits occur is possible but too costly.

In wells where the sulfur-bearing strata contains a relatively high content of crude oil, the rate of diminution of sulfur pumping is relatively high and investigation has now revealed that it is caused by formation of deposits composed of various mixtures of inorganic substances as sulfides and oxides of iron and calcium carbonate, together with carbon, various carbon-sulfur complexes, as tars and asphaltic materials and occluded elemental sulfur which will not melt at mining temperatures. Since these substances are insoluble in water, the back washing treatment hereinbefore described can be only partly effective. Hence much or most of the deposit is not removed. For some reason the slight benefit of the washing that is obtained persists only for a short while. Even when the innermost 1¼ inch concentric pipe (the compressed air line) which is encrusted on its exterior wall is replaced with a clean one, the benefit is soon lost.



The primary object of the invention is to provide a process capable of restoring sulfur mines to the original or high sulfur pumping rate when reduction in this rate has been caused by the deposition of scale or other obstruction in the sulfur mine. A specific object is to provide a practical process for the removal of obstructive deposits which accumulate within the sulfur lines in sulfur mines.

In accordance with the process of the present invention, the obstructive deposits in the mine are removed and the sulphur pumping rate restored by subjecting the deposits to the action of caustic soda under conditions and for a time which loosens and removes the same, after which the solution containing the deposit is flowed out of the pipes.

The action of the caustic in loosening and removing the deposits is not fully understood, but it appears that it reacts with or dissolves that part of the deposits acting as bonding agents for the other components which are insoluble in the solution and that when the caustic is subsequently flowed from the pipes the solution takes with it the soluble components in solution and the insoluble components in temporary suspension. The caustic appears to dissolve or react with some of the carbon-sulphur complexes, the tars and asphaltic materials and with the hardened or frozen sulphur. The carbon, the inorganic materials and other carbon-sulphur complexes come off in the form of particles of various sizes and shapes after being released by dissolution of the bonding material.

In accordance with a preferred embodiment of the invention, the action of the caustic soda solution upon the deposits within the sulfur-conveying pipe is aided by heat. Hot water at the temperatures used in the mining of sulfur as from 310° to 365° F. is pumped down the surrounding water line into the formation, the sulfur line and the air line being closed off at their top ends. The hot water in the surrounding pipe heats the caustic soda solution to its boiling point at atmospheric pressure or to a higher temperature. The action of the caustic soda solution in reacting with or dissolving the frozen sulfur and the intermediate sulfur-carbon complexes is facilitated and increased by the action of the heat, and as a result, the deposits are more completely loosened and removed and the operation is made effective in a shorter period of time.

Although the caustic soda solution may be introduced into the sulfur-conveying pipe either in hot or cold condition, it is introduced in a hot condition, in a specific embodiment of the invention, the heat being derived from the heat of solution resulting from the admixture of caustic soda flakes with water immediately before the solution is pumped into the sulfur mine. The heat of solution will provide a solution at 140° F. or higher.

The concentration of the caustic solution may be varied within wide limits. There is no upper limit in concentration, for highly concentrated and saturated solutions effectively remove the deposits. When a concentration lower than about five percent is employed the effectiveness of the solution decreases and utilization of such weak solutions is not practical. Solutions of from 10–25% are preferred.

Since the action of the caustic soda upon the deposits is a time reaction the solution must be kept in contact with the deposits for an adequate period of time and when a 20% caustic solution is employed one or more treatments of a total time of one hour is usually sufficient. A series of treatments of one-half hour can be employed and such procedure may be preferred where excessive amounts of heavy solids are present in the deposit to be removed.