Patented Mar. 24, 1953 2,632,691

UNITED STATES PATENT OFFICE

2,632,691

PROCESSES FOR THE COOLING OF MOLTEN SULFUR

Henry Blanchet, Ridgefield, N. J., assignor to Freeport Sulphur Company, New York, N. Y., a corporation of Delaware

Application August 14, 1950, Serial No. 179,295

6 Claims. (Cl. 23—224)

1

This invention relates to processes for the cooling of molten sulfur and involves broadly a cooling by means of a volatilizable liquid in direct contact with the molten sulfur which accomplishes cooling primarily by its vaporization.

It has been suggested that liquid sulfur be employed as a medium for the condensation and collection of sulfur from hot gases as in the recovery of labile sulfur given up in the thermal dissociation of pyrite, and for the cooling of sulfur used to scrub the sulfur from reactant gas mixtures containing the same, as a gas mixture containing sulfur derived from dilute hydrogen sulfide gases. The liquid sulfur product increases in temperature and must be cooled for reuse in the process. The peculiar nature of liquid sulfur itself and the presence of dust particles and impurities therein presents a cooling problem for which no very satisfactory answer has been reported. The large volume of sulfur used and the large amount of heat to be dissipated greatly limit further the nature of the cooling procedures which are practically possible.

Of the commonest cooling mediums, air or water surrounding tubes in conventional heat exchange equipment have several disadvantages. Both air and water (surface water) vary in temperature from day to day or from day to night and the danger of excessive cooling leading to solidification of the sulfur in the tubes requires that constant attention and control be exercised. As to water, excessive and frequently unobtainable amounts are required if the water is to be used only once. If the water is to be reused, the cooling of the same by aeration and evaporation in towers leads to concentration of minerals in the water and these deposit and form coatings in the heat exchange equipment requiring periodic shutdowns and cleaning of the towers and the exchanger tubes.

Aeration of the molten sulfur product cannot be employed because of the danger of fire and loss of sulfur in vapor form. The use of water introduced directly into contact with the molten product has been suggested but has not proven satisfactory for the sulfur, although at a temperature above the boiling point of water, entraps a substantial part of the water and will not give it up until a prohibitive time has passed.

An investigation of the cause of this entrapment has now led to the ascertainment of the fact that the water after being broken up into drops formed by stirring the mass to distribute the water through the sulfur mass brings about the formation of solidified sulfur shells surrounding the droplets of water, this effect being due to the transfer of heat to the water from the sulfur causing it to solidify, and since solid sulfur is a good insulator, additional heat from the sulfur surrounding the shells cannot readily penetrate the shells. As a result the water remains encased in the shells for a considerable period of time.

2

Objects of the invention are to provide processes for the cooling of molten sulfur at a higher temperature to molten sulfur at a lower temperature which (1) are low in operating cost, (2) require only simple apparatus, and (3) are little affected by atmospheric temperature changes and which heretofore involved solidification dangers.

Broadly considered, the invention involves the introduction into molten sulfur to be cooled a quantity of water calculated to take up on evaporation the heat necessary to reduce the temperature of the sulfur to the desired lower level, and agitating the resulting mixture to distribute the water throughout the hot sulfur and to produce droplets of a size such that the heat transferable thereto from the molten sulfur added to that of the water causes complete evaporation of the water rather than its encasement by solidified sulfur shells formable by the cooling effect of entrapped droplets of water, whereby said water evaporates and provides cooled sulfur in a condition substantially free of water.

In accordance with a preferred embodiment of the invention, water in the stated amount is introduced into a mass of hot molten sulfur and the water is distributed throughout the sulfur mass and broken up into fine droplet size by a severe agitation accomplished by any thorough agitating device such as a turbine type agitator. This strenuous agitation not only reduces the size of the droplets of water but apparently also prevents formation, in any substantial quantity, of encapsulated droplets of water by solidified sulfur and breaks up any sulfur coated particles which form. The water ultimately becomes divided in such small droplets that the heat transferred thereto from the circulating sulfur is adequate to cause complete evaporation without leaving any encased in the sulfur shells.

In the foregoing embodiment, the water may be introduced at any temperature most convenient for the particular set of conditions prevailing at the plant and may be at its natural temperature as obtained from the ground or other source or may be preheated to any temperature below its boiling point.

In accordance with a second embodiment of