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SULPHUR BURNERS

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About ten years ago we had to face the problem of producing some 500 Kgs per hour of SO^2 as a gas containing more than 17% of SO^2, by direct combustion of sulphur with air.

At that time for so low a capacity of production we could not find, on the world market a simple and reliable burner. Thus we were induced to design such a small unit by ourselves.

The mechanical atomization, the principle of which consists of leading liquid sulphur through an orifice of small diameter, required, for so small a flow of sulphur, a very narrow orifice which would have been plugged by any minute particle.

Therefore we turned towards atomization by air which does not require so small orifices, since a mixture of air and sulphur is forced through in this case.

DESCRIPTION OF THE BURNER.

The molten sulphur arrives in a central channel at low speed. The atomization air, previously heated up to the optimum temperature, enters a jacket around the sulphur channel and passes through orifices which lead it at high speed and tangentially onto the stream of sulphur, resulting in an emulsion of sulphur and air. This emulsion passes through an orifice and the expansion of the air, intimately mixed with the sulphur, gives rise to the atomization of the latter in the combustion chamber where secondary air ensures the complete combustion of the sulphur. The main difficulty encountered was of a thermal character. It is, in fact, necessary to maintain the sulphur at a temperature corresponding to the minimum viscosity of molten sulphur say 150° C approx., up to the point where it leaves the burner. Within a few degrees, the viscosity increases in the proportion of 1 to some 10,000; that means that if the temperature of the burner nose is not well in control, the sulphur may either plug the orifice or shoot out as filaments.

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It is easy to maintain the sulphur at the convenient temperature in the burner itself by a steam jacket and by adjusting the temperature of the atomization air. But at the nose of the burner, the problem is delicate since this nose undergoes the severe radiation of the flame. It can be fitted with steam jacket, but not too large a one, since the larger the external face of the jacket, the more heat it receives.

Screens can also be placed against radiation; and the nose can be cooled by secondary air.

It was in fact by using those three means that we succeeded in ensuring the correct temperature at this point.

Two burners of 250 Kg/hr capacity have been installed in our factories and they both work perfectly well. We have even built a smaller burner for less than 100 Kg/hr for a customer who declared that he was satisfied with it.

RESULTS.

With this type of burner we can get gas at 18% SO^2 with complete combustion of the sulphur.

Its flexibility is very large, a burner designed for 250 Kg/hr can deal with 100 to 400 Kg/hr.

The sulphur purification is very simple, since we only make it settled, in order to protect the sulphur pump (we have chosen the gear-type pump). It is obvious that to produce sulphuric acid from Dark Sulphur, a good filtration is to be preferred, to eliminate undesirable impurities as much as possible.

The amount of atomization air represents roughly 3 to 4% of the total air, and this air is compressed to about 300 gr/sq cm. only.

LARGE BURNERS:

For normal sulphuric acid production units we have been led to extrapolate this type of burner.

For a small sulphur capacity a good air-sulphur mixing is obtained by blowing air onto a small cylinder of molten sulphur; but from one ton of sulphur per hour upwards, we had to operate differently: a thin hollow cylindrical vein of sulphur is formed and air is blown inside and outside the cylinder simultaneously.

This arrangement permits unlimited extension of burner capacity.

We have built and we use burners based on this principle for 1 and 2 tons sulphur per hour and we are making a burner designed for more than 3 tons/hr.

Of course it would have been possible for a 3 ton output for instance, to set up 3 burners of 1 ton, but we discarded this solution, as it leads to a multiplication of equipment and of the means of controlling the air, sulphur and steam flow rates.

We have built a sulphur burner designed to burn H^2S gas as well. In this burner we deal with either sulphur or H^2S, or both simultaneously. This burner is working very satisfactorily in one of our works where H^2S is normally supplied but which must continue to function if there is a failure in the supply of H^2S.

For these high capacity burners, the thermal problems have been more difficult to solve than the mechanical ones. It was only after many trials on fluid flow, and on the arrangements for steam jackets and protection screens that we arrived at a smooth and reliable operation of our burners.

GENERAL INSTALLATION:

These burners, normally used for sulphuric acid manufacture, can be used with advantage to produce liquified SO^2 and SO^2 derivatives, since they can give relatively concentrated SO^2, free of unburned sulphur, on a commercial scale.

Normally the conventional unit comprises the following :-

1) Sulphur melting, with or without stirring.

2) Filtration. This section is unnecessary for Lacq Sulphur but we think it hecessary for H^2SO^4 production from dark sulphur.

3) Molten sulphur storage, which may bring about some ppurification if there is no filtration.

4) Sulphur pumping by means of a gear type pump. This pump is driven by an electric motor with a speed ranger. We have chosen this type of pump because its flow rate is very steady even in the case of a pressure increase due to a change of viscosity. It rotates very slowly and is therefore very sturdy.

5) Compression of the atomization air. This compression is obtained by a Roots type compressor (300 gram/sq.cm. approx.). The compressed air is heated either by steam or by any hot fluid, up to a temperature between that of sulphur melting and that of the sharp increase of viscosity, say 130° C approx.

6) Compression of the combustion air. The pressure is controlled mainly in order to fit in with the pressure drop in the circuit after the burner. This air is generally preheated before entering the burner to get a high temperature and thus increase the combustion rate.

7) Furnace proper - This is cylindrical with a steel casing and refractory brick lining. It is so constructed as to permit the free expansion of materials. Near the exit it is fitted with baffles to ensure the homogeneity of the composition and the temperature of the gas. The construction of the combustion chamber must be specially worked out when 17 or 18% SO^2 gas is to be obtained since the internal temperature is 1400° C approx. The burner is fitted on the front face of the combustion chamber. The furnace is generally followed by a waste heat boiler when its capacity makes it profitable.