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PROCESS FOR THE MANUFACTURE OF SULPHUR TRIOXIDE

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The oxidation of sulphur dioxide with the object of the preparation of sulphur trioxide is effected industrially in processes called "contact processes" by causing to pass over a very active catalyst a very dilute gaseous mixture containing by volume 7 to 10% of sulphur dioxide and 10 to 15% of oxygen, the remainder of the volume of gas being made up of inert gases such as nitrogen.

The temperature of catalysis must be maintained within rather narrow limits at about 500°C., for above this temperature (which corresponds to the maximum formation of SO_3) dissociation lowers the degree of conversion.

By reason of the low partial pressure of SO_3 obtained in the transformed mixture, the absorption of the sulphur trioxide formed is difficult.

By reason of the large quantity of dilute gases which it is necessary to employ and which can only be treated in a single passage, it is necessary to utilise very large manufacturing and absorption apparatus; the expenditure of energy necessary for the circulation of this large quantity of gas is considerable, and the quantity of catalyst in use is large (3.5 cu. m. to 5 cu. m. of catalyst to produce 1 metric ton of SO_3 per hour).

Up to now technical literature and industrial practice were in agreement in considering that, in the manufacture of sulphur trioxide by contact, it was not possible to exceed with very active catalysts this proportion of 7 to 10% of sulphur dioxide. It was even stated that if sulphur dioxide of 14 to 16% strength were available from a sulphur burner for example, it would be necessary before employing the said gas to dilute it so as to bring its content below 10%.

Now following experiments by Mr. Cathala, it has been observed quite remarkably and unexpectedly that while maintaining very active catalysts it is possible to employ gaseous mixtures the concentration of which in SO_2 and O_2 is equal to the theoretical concentration or at least equal to 50%.

As catalysts may be employed for example catalysts of platinum or of vanadium oxide fixed upon suitable support.

This catalysis, effected with concentrated gases, allows in particular to be treated by catalysis gases arising from the thermal reduction of calcium sulphate such as those obtained by the processes described in the French patent applications of the 24th February, 1937 and the 23rd April 1937, for "Process for the manufacture of sulphur dioxide" and for "Process for the reduction of calcium sulphate." It may likewise be applied to the sulphur dioxide arising from the combustion of sulphur in pure oxygen or in air to which oxygen has been added. It may also be applied to the treatment of the sulphur dioxide extracted by any physical or chemical means from the gases obtained in the industrial roasting of sulphides.

The high concentration in SO_3 of the gases after passing over the very active catalyst allows the SO_3 to be readily separated by any known physical or chemical means. A very large part if not practically the whole of the SO_3 may even be condensed directly by simple cooling and this SO_3 be collected in the liquid state. Likewise the SO_3 may be condensed by injection of water vapour or of water after the passage over the catalyst, while separating if necessary by electric precipitation the acid or the oleum produced. Water vapour may also be injected before passage over the catalyst, experiment having shown that high contents of water vapour in the gases subjected to catalysts do not reduce the yield of the conversion; the condensation of the SO_3 is thus facilitated.

The process according to the invention allows the temperatures to be varied within wide limits, between 500° C. and 750° C. approximately.

Only a small quantity of catalysts is required in use (0.125–0.160 cu. m. to produce one metric ton of SO_3 per hour). Thus a very much increased hourly production is obtained (30 to 40 times greater) with the same volume of catalysts.

In order to increase the efficiency of working of the catalyst and possibly to decrease superheating, catalysis of concentrated gases may be effected in conditions such that the oxidation of the sulphur dioxide by passage over the catalyst is systematically limited to a relatively low degree of conversion. One may then operate in closed circuit by causing the gas to pass several times over the catalyst and by separating or condensing the SO_3 produced by each passage. One may also employ several catalysts in series with separation of SO_3 between each.

The invention is illustrated in the following nonlimiting examples. All these examples correspond to experiments made with the same catalytic mass with a basis of vanadium prepared according to the usual methods. The volume occupied by the catalyst was 35 ccs. and the mass of the catalyst 14 grams.

Example 1

A gaseous mixture containing 30% of SO_2 and

70% of air was subjected to catalysis at a temperature of 535° C. with an hourly output of 13.5 litres. A degree of conversion of 100% was obtained corresponding to a quantity of 14.3 grams of SO_3 formed.

Example 2

With the same gaseous mixture, by increasing the hourly output to 42.3 litres, a production of 36.4 grams of SO_3 was obtained, the degree of conversion being limited to 80%.

Example 3

A gaseous mixture with 50% of SO_2 and 50% of oxygen, subjected to catalysis with an output of 18.8 litres, gave a degree of conversion of 90% and a production of 28.4 grams of SO_3 per hour.

Example 4

A mixture containing 66% of SO_2 and 34% of oxygen with an output of 24 litres per hour gave a degree of conversion of 80% and a production of 41.5 grams.

Example 5

A mixture with 66% of SO_2 and 34% of oxygen saturated with water vapour at a temperature of 23° C. was subjected to catalysis with an output of 27.5 litres per hour. The degree of conversion was 88.5% with a formation of 56.5 grams of SO_3 per hour. In this particular case it was possible to collect by direct condensation at the temperature of the laboratory 51 grams of sulphur trioxide containing 0.6% of water.

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