

# DECOMPOSITION STUDIES OF THE IRON PYRITES OF BIHAR WITH A VIEW TO THEIR UTILISATION

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The importance of pyrites as an alternative raw material to sulphur for manufacture of sulphuric acid has been forcibly brought to public notice due to recent shortages of world supplies of sulphur. Sulphuric acid manufacturers in this country are anxiously exploring possibilities for installation of pyrites-roasting units, and for securing local supplies of iron pyrites. Although it appears possible to import all the requirements of pyrites for Indian industry, the exorbitant freight rates as well as possibilities of being cut off from the sources of supply make it desirable to plan on the utilisation of local deposits to the fullest extent possible. Further, the installation of a pyrites-roasting unit as an adjunct to an existing contact acid-plant utilising sulphur, calls for an additional capital outlay which is at least as large as that on the original acid plant. The above factors have been responsible for the non-existence even to-day in India of any contact acid plants utilising iron pyrites.

Since the Government of India have organised intensive field investigations by Geologists and Mining Engineers with a view to obtain reliable estimates of the extent of pyrites deposits in the country and promising results have been obtained, it was thought worthwhile to study the chemical behaviour of the iron pyrites from one of the best known among them which occur in the Amjor and adjacent areas in the Shahabad District of Bihar. Although official estimates of the reserves in this area are not yet available, knowledgeable circles consider that a few million tons is more than probable. The utilisation of this mineral which has a few special properties, as indicated later, demands adequate knowledge of its behaviour during usual reactions, in order that plant and equipment suitable for processing it may be designed for minimum cost and little wastage on unnecessary equipment. The investigations summarised below were carried out with the abovementioned objects in view.

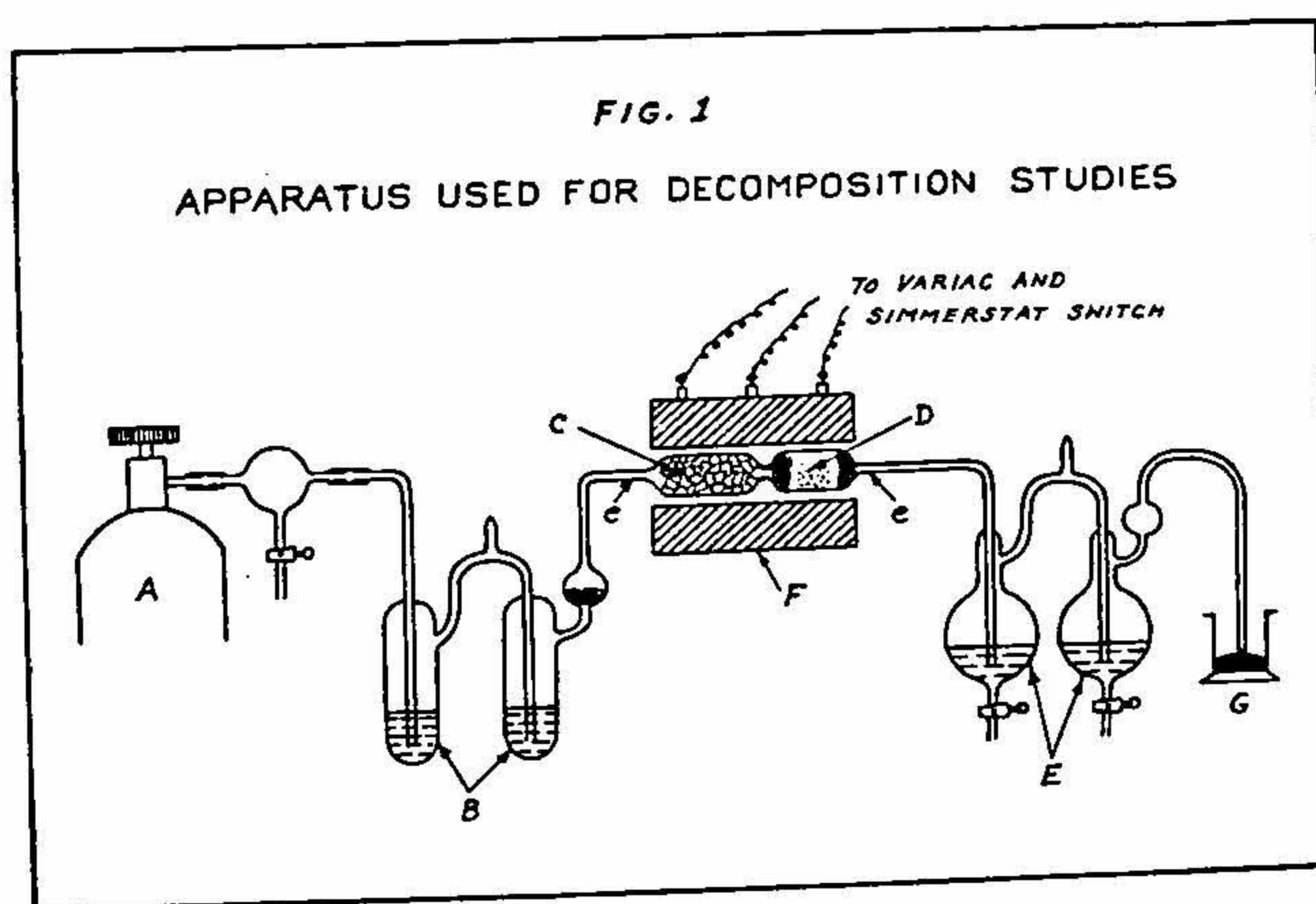
## EXPERIMENTAL

Several hundredweights of the mineral obtained during blasting of the ore body for driving adits as well as core samples got during drilling operations were secured due to the kindness of the Director of Industries, Bihar. The samples had to be preserved in air-tight containers owing to their susceptibility to weathering.

It was noticed very early during these studies that the ore which had been exposed for long periods and subjected to weathering tended to go into fine powder containing significant quantities of ferrous sulphate. Storage of the lumpy mineral under water, thereby restricting oxygen supply to that derived from the dissolved air, appeared to minimise the deterioration.

The sample employed for these studies gave the following results on analysis: Fe = 47.30 per cent.; S = 51.06 per cent.; SiO<sub>2</sub> and insolubles = 1.63 per cent. It was almost free from other heavy metals. Delicate tests established its freedom from precious metals as well as of arsenic.

The apparatus employed for these studies is shown diagrammatically in Fig. 1. It was of all pyrex glass avoiding rubber connections or corks.



The required gas or air was obtained from a cylinder containing it at a pressure of 25-100 atmospheres. It was first dried by bubbling through concentrated H<sub>2</sub>SO<sub>4</sub> kept in B, and then preheated by passage over pieces of unglazed porcelain in C. The powdered specimen of pyrites was kept heated between two pyrex glass-wool plugs in D, and the exit gases were

scrubbed by a 15 per cent. solution of KOH kept in E. The unabsorbed gases were allowed to escape after bubbling through the small mercury trap G.

About 10 g. of pyrites ground to — 100 mesh was employed for each experiment. The temperature of the electric furnace, as measured by a calibrated thermocouple (not shown in figure), could be steadily maintained to within  $\pm 10^\circ\text{C}$ . by adjustments of the 'Variac' transformer and the simmerstat switch.

At the end of each experiment, the tube was cut off at the two places marked *e* in Fig. 1, and the contents of E as well as the residue in tube D taken out for examination and analysis. Estimations of sulphide, sulphite and sulphate in the KOH solution were carried out volumetrically according to Sutton.<sup>1</sup> The residue was analysed for its iron and sulphur contents by the usual methods. The typical results obtained during several sets of experiments are presented below in Table I.

TABLE I  
*Recovery of Sulphur from Iron Pyrites by Thermal Treatment in Different Atmospheres*

Atmosphere and rate of passage	Period of heating	Temp. °C.	Recovery % S
I. Air 6 L/hr.	.. 6 hrs.	300	4.73 as SO <sub>2</sub>
	.. "	400	10.52 "
	.. "	450	96.1 " and < 1% SO <sub>3</sub>
	.. "	600	97.2 " — "
II. Nitrogen 6 L/hr.	.. 1 hr.	500	12.73 as S
	.. 8 hrs.	500	25.28 as S
	.. 1 hr.	600	44.67 "
	.. 1 hr.	700	46.1 "
III. Hydrogen 6 L/hr.	.. 6 hrs.	300	3.2 as H <sub>2</sub> S
	.. "	450	34.7 "
	.. 4 hrs.	600	48.3 "
IV. Hydrogen and Steam	1 hr.	500	23.6 as H <sub>2</sub> S and SO <sub>2</sub>
	"	600	69.1 " " along with some free S

It can be seen from the results given in the table that roasting in air at a temperature of about 600° C. is sufficient to effect almost quantitative

conversion of the combined sulphur into sulphur dioxide for utilisation for acid manufacture. Since the gas obtained is practically free (less than 0.01%) from arsenic, its elaborate purification is not called for. Further work is being undertaken with a view to quantitative recovery of the sulphur in the pyrites in the form of elementary sulphur.

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#### REFERENCE

1. Sutton .. *Volumetric Analysis.*