FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

TECHNICAL MEMORANDUM NO. 24 OF 1958.

The Influence of Fusion under Pressure of the Rate of Reduction of Alan Wood Magnetite.

by

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It was thought that fusion of ores under pressure might increase the surface area of catalysts through the formation of micro pores, thus increasing the rate of reduction.

A special electric furnace was constructed for this purpose. Fusion was started with the furnace open to the atmosphere as it was frequently found that electrical contact was broken during the initial stages of fusion. Contact could then be restored by tapping the granular ore between the electrodes.

As soon as the fusion proceeded smoothly the pressure inside the furnace was raised by means of nitrogen from a cylinder and the fusion was continued. The fused mass was allowed to solidify, after which the pressure was released. The material was crushed, and a screen fraction, 12 - 20 mesh (Tyler Standard) was used for the reduction experiments in a fixed bed reactor. The following conditions were used:

Vol. of catalyst used	:	40 ml.
Height of column of catalyst (approx.)	:	28 cm.
Temperature	:	371°C.
Pressure	:	17 atm.
Rate of hydrogen flow	:	1.55 cu.ft./hr. (N.T.P.
Percentage reduction	:	99%

The reaction temperature was reached within 4 hours. The water formed during reduction was collected at regular intervals and the weight of the water was used as a measure of the percentage reduction achieved.

Three/.....

Three samples, fused under 10 atm., 20 atm. and 25 - 40 atm. nitrogen respectively, were reduced. (In the last-mentioned case it was difficult to retain the pressure at 40 atm. due to a leak in the furnace and the pressure was mostly ca 25 atm.). The results were compared with that of Alan Wood magnetite fused in air at atmospheric pressure.

Table I gives the analyses of the different samples.

TABLE I.

Analysis of Samples.

	Wt. of 40 ml.	% Tot. Fe	% FeO	% Fe_2O_3
Alan Wood, 1 atm. (air)	99.25 g	72.0	32.4	67.0
" " , 10 atm. N_2	97.74 g	71.6	29.7	69.4
" " , 20 atm. N_2	98.48 g	71.7	29.9	69.3
" " , 25-40 atm. N_2	98.36 "	71.5	29.6	69.3

Tables II and III give the amount of water formed during successive 8 hour periods and the cumulative percentage reduction respectively.

The results are graphically illustrated in Figure 1.

From Table III and Figure 1 it appears that fusion under pressure increases the rate of reduction.

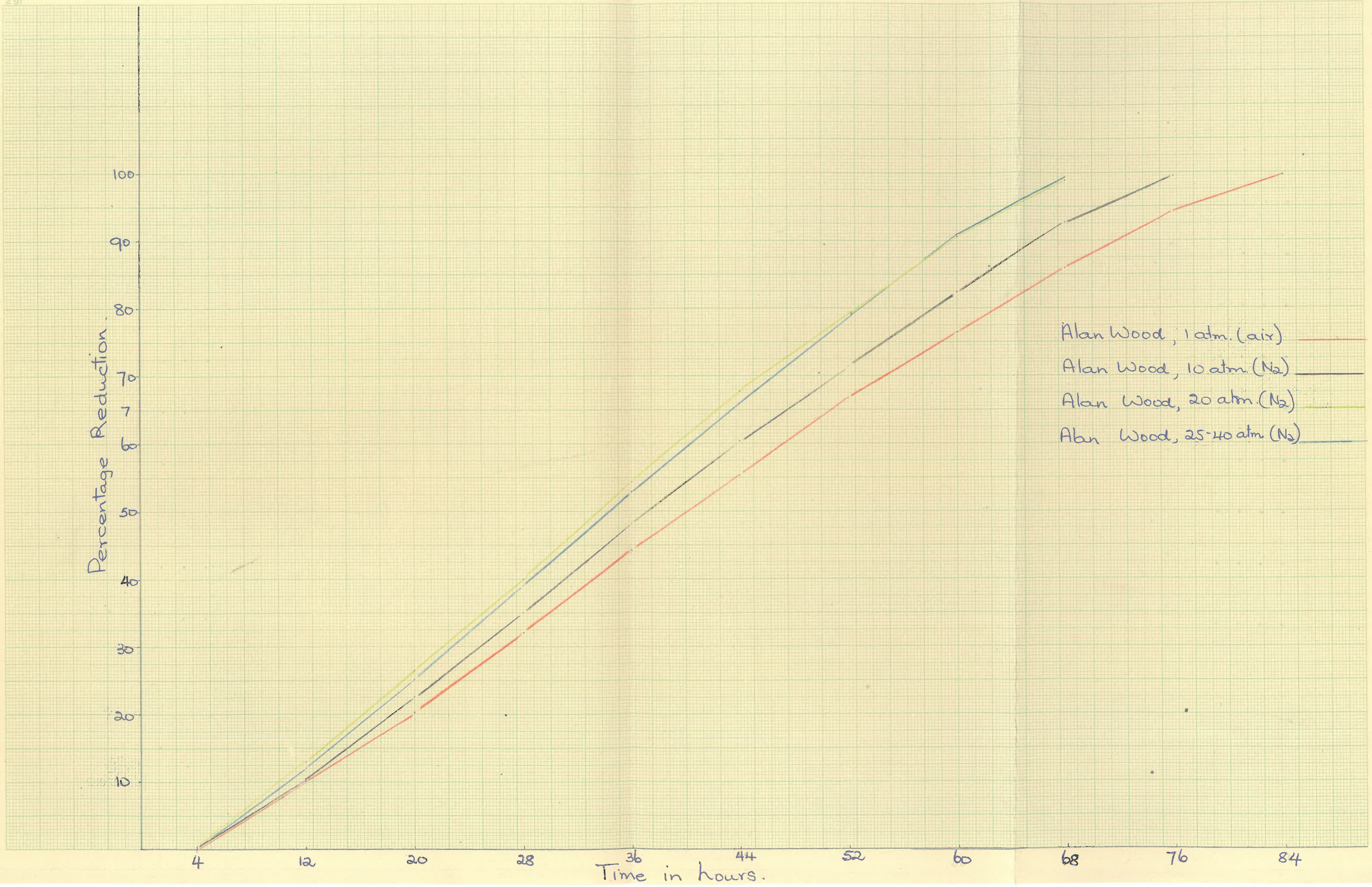
Table/.....

TABLE II.

	Amount of water formed during various 8 hr. periods.										
	0 - 4 Hrs.	1	2	3	4	5	6	7	8	9	10
Alan Wood, 1 atm. (air)	0	3.06	3.08	3.58	3.71	3.37	3.45	2.97	2.87	2.54	1.63
Alan Wood, 10 ats N_2	0.09	3.09	3.79	3.85	4.03	3.74	3.38	3.42	3.17	2.11	-
Alan Wood, 20 ats. N_2	0.09	3.79	4.07	4.10	4.31	4.06	3.51	3.39	2.50	-	-
Alan Wood, 25-40 ats. N_2	0.07	3.54	3.93	4.21	4.10	3.93	3.97	3.54	2.54	-	-

TABLE III.

	Cumulative Percentage Reduction.										
	0-4 Hrs.	0-12 Hrs.	0-20 Hrs.	0-28 Hrs.	0-36 Hrs.	0-44 Hrs.	0-52 Hrs.	0-60 Hrs.	0-68 Hrs.	0-76 Hrs.	0-84 Hrs.
Alan Wood, 1 atm. (air)	0.0	10.1	20.2	32.0	44.2	55.3	66.7	76.5	85.9	94.3	99.6
Alan Wood, 10 ats. N_2	0.3	10.3	22.6	35.1	48.2	60.4	71.3	82.4	92.7	99.5	-
Alan Wood, 20 ats. N_2	0.3	12.9	26.4	40.0	54.3	67.7	79.3	90.6	98.9	-	-
Alan Wood, 25-40 ats. N_2	0.2	12.0	25.1	39.1	52.8	65.9	79.1	90.9	99.4	-	-


Percentage Reduction.
100
90
80
70
7
6
50
40
30
20
10
4
12
20
28
36
44
52
60
68
76
84
Time in hours.
Alan Wood, 1 atm. (air)
Alan Wood, 10 atm. (N2)
Alan Wood, 20 atm. (N2)
Alan Wood, 25-40 atm. (N2)