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ONDERWERP:
SUBJECT: THE SPONTANEOUS COMBUSTION LIABILITY INDEX OF ANGLO POWER KRIEL COAL

AFDELING:
DIVISION: ENGINEERING/PILOT PLANT

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THE SPONTANEOUS COMBUSTION LIABILITY INDEX OF ANGLO POWER KRIEL COAL

1. The so-called reactivity index, a diminution for spontaneous combustion liability index, gives an indication of a coal's liability towards spontaneous combustion.

   The coal (ca 12 tons) is loaded into a thermally insulated test bunker and aerated at a constant rate, generally very much in excess of that encountered in the practical situation. The reactivity index is evaluated from the temperature history of the coal, as measured at the geometric centre of the pile. Details of this are given in a subsequent section.

   To date, little is known about the effect of the aeration rate on the reactivity index. It was, therefore, decided to perform two simultaneous tests on the coal submitted by Anglo Power Collieries, Kriel section, viz. a test at the normal aeration and a test at reduced (ca 30 per cent of the normal) aeration rate.

2. During the loading of the test bunkers, samples of the coal were secured for size analysis, the results of which are reproduced below:

Size Distribution

Size range	Fractional percentage	
	normal aeration	reduced aeration
+¾"	7,0	6,7
-¾" + ½"	14,4	13,5
-½" + ¼"	22,4	24,0
-¼" + 1/8"	20,4	21,0
-1/8"	35,8	34,8

2/...

Other analytical details of the samples are as follows:

Analyses of air-dry samples

Aeration	Cal.Val.	Moisture	Ash	Vol.Mat.	Fixed Car.
	MJ/kg	%	%	%	%
Normal	22,2	5,1	23,2	22,4	49,3
reduced	22,4	4,5	23,0	22,7	49,8

3. The temperature histories of the samples, obtained during the tests, are reproduced in Figures 1 and 2. These are used to evaluate the reactivity index, M, according to the method set out in detail in the Institute's Information Circular No. 14.

In essence, this entails the solution of the following equation:

$$M = W_o A t_m / (A V_m + \ell n (W_o / E V_m))$$

wherein the symbols are:

M : reactivity index

A : a constant equal to 0,03 ($^oC^{-1}$)

E : a constant equal to 1/60 (day^{-1})

W_o : the initial rate of temperature rise (^oC/day)

V_m : the difference between the maximum and the initial coal temperature, V_o (^oC)

t_m : the time required for the maximum coal temperature to occur (days)

The data for W_o, V_m, V_o, and t_m, as well as the results of the computations are reproduced below

Reactivity Data

Aeration	Wo	Vm	tm	Vo	M
	^{o}C/day	^{o}C	days	^{o}C	
Normal	1,4	39	30 - 40	23	0,65 - 0,86
Reduced	0,95	21,7	50 - 60	24,5	0,87 - 1,05

3/...

Note The time required for the maximum coal temperature to occur is not clearly defined, and it was assumed that the respective values of t_m can vary within the ranges indicated. The reported limiting values of the reactivity index, M, correspond to the limiting values of t_m.

4. The interpretation of the results is as follows: In the light of theoretical considerations and of practical experience, it can be stated that coals for which $M<0,63$ can be considered safe. Coals for which $M \leq 1$ can normally be stored for a limited period. When $M > 1$, special precautions are required.

5. The value of the reactivity index depends on the initial temperature. Its value at temperatures other than that prevailing during initiation of the test, can be had from

$$M_2 = M_1 \exp (A (V_{02} - V_{01}))$$

wherein the subscripts 1 and 2 refer to the different initial temperatures.

It can thus be shown that the most favourable index reported, i.e. $M = 0,65$ at $V_o = 23^{\circ}C$, will exceed unity if the initial temperature were to exceed $37^{\circ}C$.

The sample tested is thus considered reactive and prone to spontaneous combustion. If it is borne in mind that in practice fresher and therefore more reactive coal will be stockpiled, special precautions are indicated.

Compaction, to minimize air penetrating the stockpile, and the routine monitoring of the temperature at strategic points within the pile, are considered essential.

T C ERASMUS
ASSISTANT DIRECTOR

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1976 March 17th
Pretoria

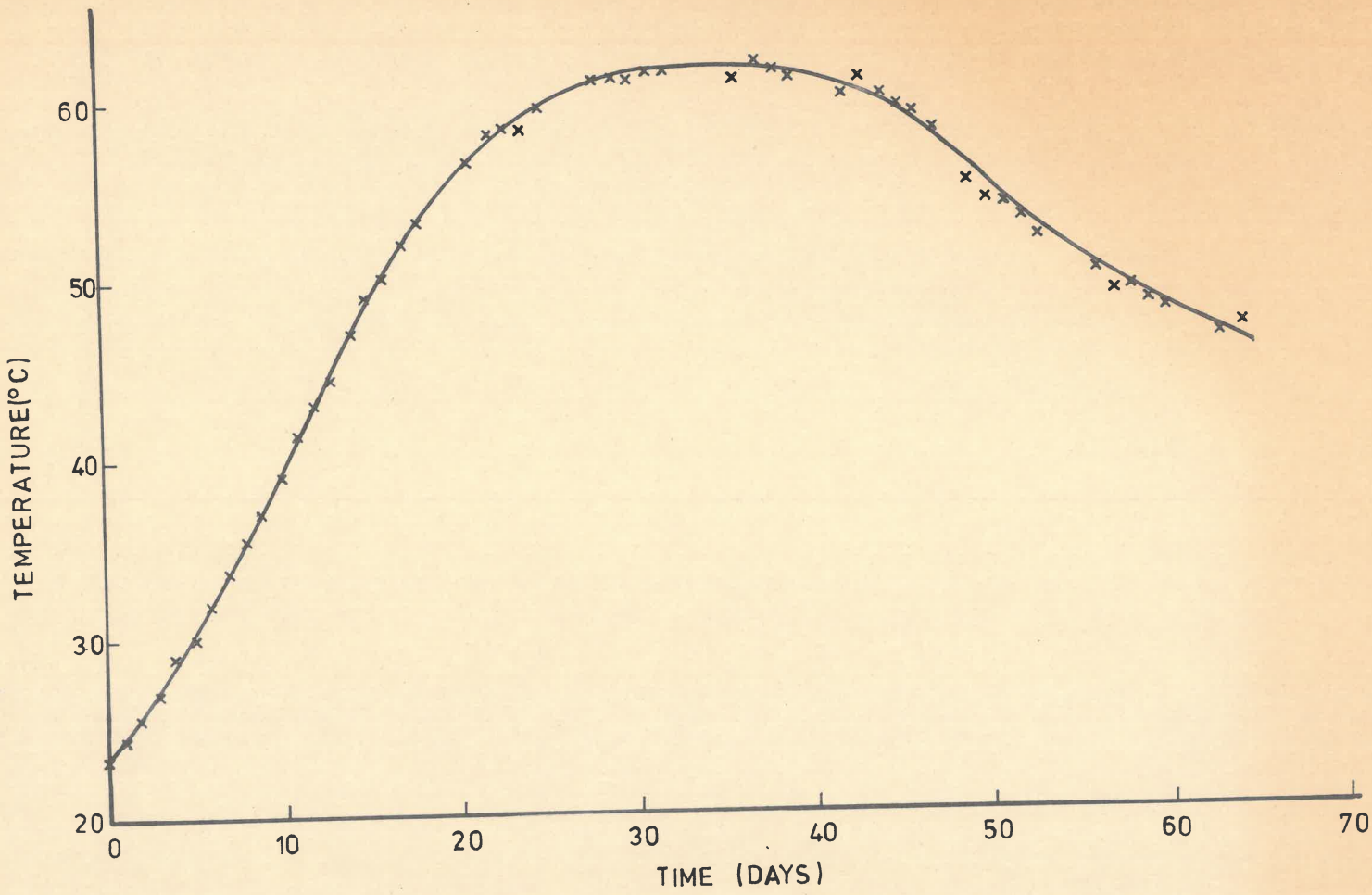

FIGURE 1:

TEMPERATURE HISTORY OF KRIEL COAL, NORMAL AERATION

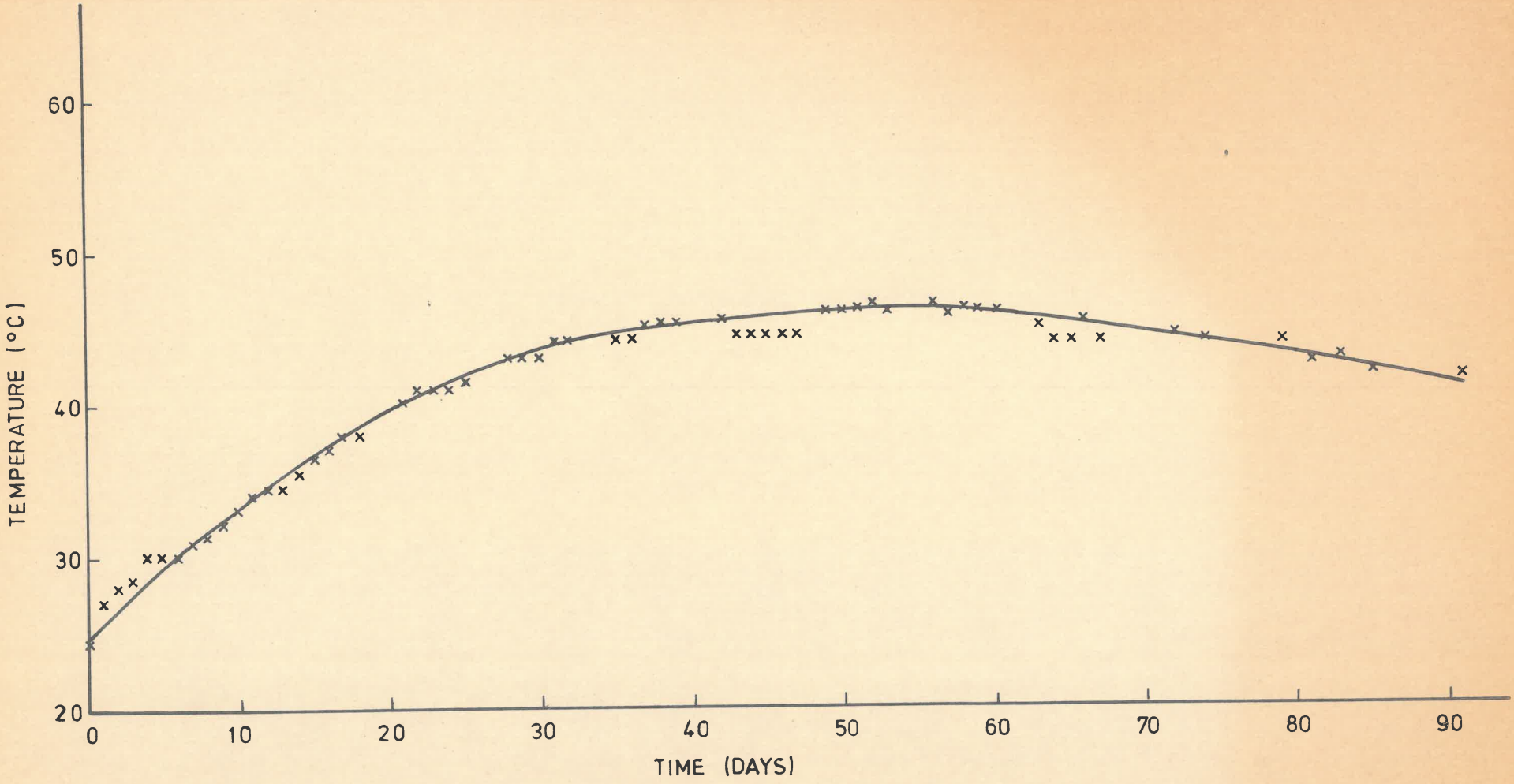

FIGURE 2:

TEMPERATURE HISTORY OF KRIEL COAL, REDUCED AERATION