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BRANDSTOFNAVORSINGSINSTITUUT

VAN SUID-AFRIKA

FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA

ONDERWERP:
SUBJECT: THE REACTIVITY INDEX OF A SAMPLE OF COAL SUBMITTED BY THE SOMERSET MINING COMPANY.

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DIVISION:

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S Y N O P S I S

A sample of coal, submitted by the Somerset Mining Company, was tested for liability towards spontaneous combustion. Contrary to expectation, the sample was found to be relatively unreactive.

FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

REPORT NO. 18 OF 1974

THE REACTIVITY INDEX OF A SAMPLE OF COAL SUBMITTED BY THE SOMERSET MINING COMPANY

1. A sample of coal, submitted by the Somerset Mining Company, was treated in the Institute's coal preparation pilot plant at Pretoria West. The major portion of the 1,58 relative density float product, prepared in the Drewboy washer, was subsequently subjected to large-scale spontaneous combustion tests.

2. During the loading of the samples into the test bunkers, a sample was secured for size analysis. Test results are reproduced below.

SIZE DISTRIBUTION

Size range	Percentage	
	Fractional	Cumulative
-3"+¾"	56,4	56,4
-¾"+½"	16,3	72,7
-½"+¼"	16,7	89,4
-¼"	10,6	100

/3. .....

3. The temperature history of the sample during the bunker test is reproduced in the accompanying figure. From this curve, the reactivity index, M, of the sample was computed according to the method set out in detail in the Institute's Information Circular No. 14, page 6.

The relevant equations are reproduced hereunder.

$$MN\epsilon = W_o A \qquad (1)$$

$$N\epsilon t_m = AV_m + \ln (MN/AV_m) \qquad (2)$$

In these equations the symbols are:

M : reactivity index

N : an auxiliary parameter

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

ϵ : 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)

Elimination of N from equations (1) and (2) leads to

$$M = W_o A t_m / (AV_m + \ln (W_o / \epsilon V_m)) \qquad (3)$$

/The .....

The data for V_o, W_o, V_m and t_m, as well as the result of the computation, using equation (3), are reproduced below.

REACTIVITY DATA

V_o	W_o	V_m	t_m	M
^oC	^oC/day	^oC	days	
22	3,85	16,1	8	0,29

4. The interpretation of the data 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 to be safe. Coals for which $M \leq 1$, can normally be stored for a limited period. When $M > 1$, special precautions are required.

5. Recently a new type of lagging was fitted to the test bunkers and to date these have not yet been recalibrated. Therefore, some variation in the constant, ε, is likely. To investigate whether this may account for the unexpected low reactivity index, different values for ε were substituted into equation (3). By doubling the value of ε (which is highly unlikely), the reactivity index is increased from 0,29 to 0,38. It must therefore be concluded that the new lagging fitted cannot explain the low result obtained and that some other factor, such as oxidation, is responsible. On the other hand, the sample may be inherently unreactive.

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PRETORIA.
20/9/1974.
TCE/KW.

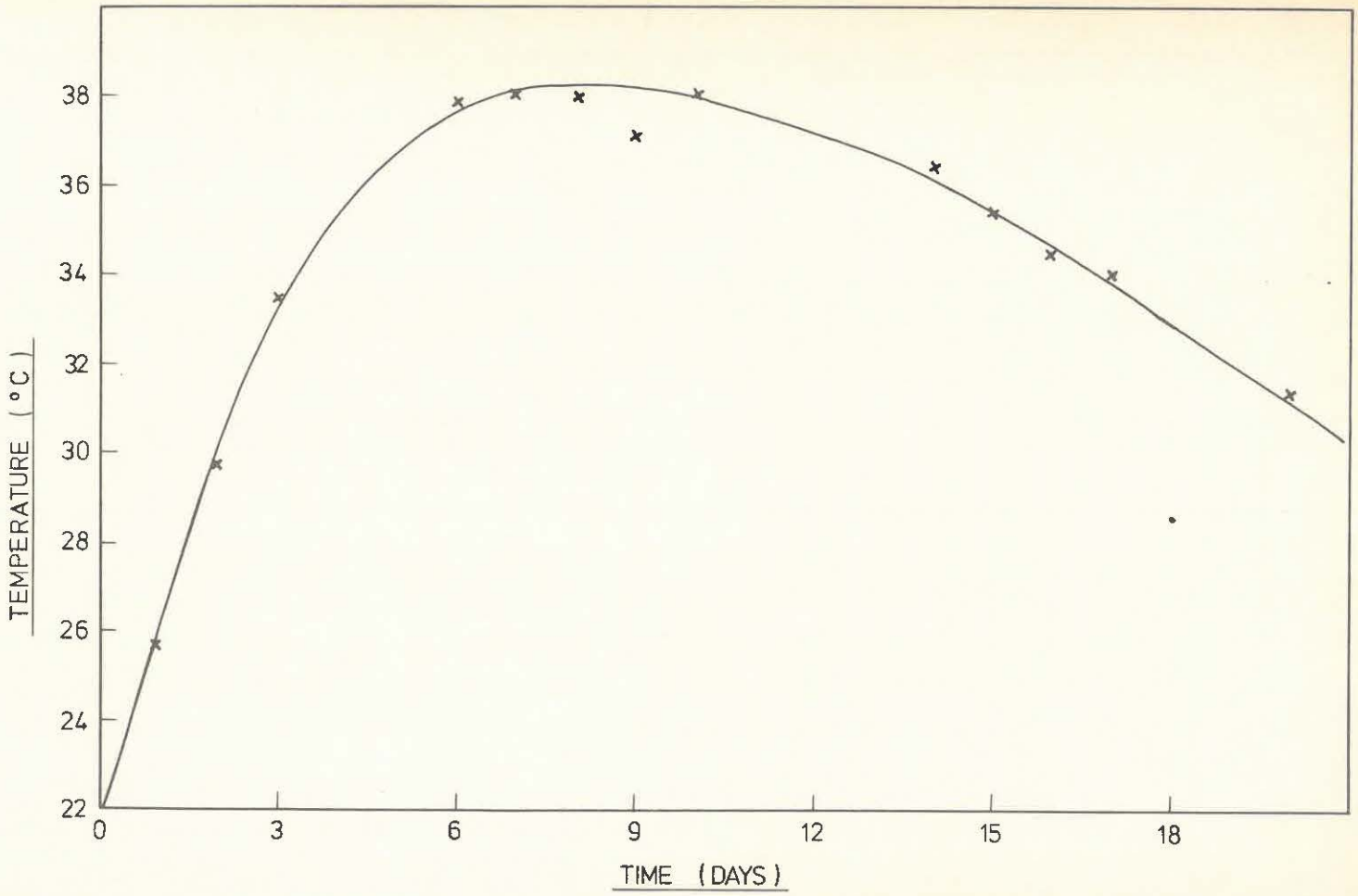

FIGURE 1. TEMPERATURE HISTORY CURVE.

ADDENDUM TO REPORT 18 OF 1974

The low reactivity index which resulted from the first bunker test is contrary to expectation. Subsequent discussions with a representative of Somerset Mining Co. revealed oxidation to be the most likely cause. It was, therefore, decided to re-examine a freshly mined sample of the coal at the earliest opportunity.

When a second consignment of roughly 120 tonnes of raw coal was subsequently submitted to the Institute for beneficiation at 1,58 relative density, a portion of the float material was once again subjected to spontaneous combustion tests.

During the loading of the washed coal into the test bunker, a sample was secured for size analysis, and the results are reproduced below.

SIZE DISTRIBUTION

Size Range	Percentage	
	Fractional	Cumulative
-3"+¾"	36,4	36,4
-¾"+½"	15,0	51,4
-½"+¼"	25,7	77,1
-¼"	22,9	100

The temperature history of the coal during the bunker test is reproduced in figure 2, and for convenience the relevant characteristics of the curve are tabulated hereunder.

/Reactivity .....

REACTIVITY DATA

Vo	Wo	Vm	t_m	M
°C	°C/day	°C	days	
25	5	28,1	17	0,79

The reactivity index, M, calculated according to equation 3 in the report, is given in the last column.

The value of the redetermined reactivity index is more realistic, and it follows that this coal can be stored safely only for a limited period, say 4 - 6 weeks. As a result of the delays which occurred during the road transport and the washing and drying of the sample, a period of 10 days, reckoned from the time of arrival of the first lorry-load of coal, had elapsed before the test proper could be commenced. As a result of this the reported reactivity index may be somewhat under-estimated.

PRETORIA.
6/12/1974.

TCE/KW.

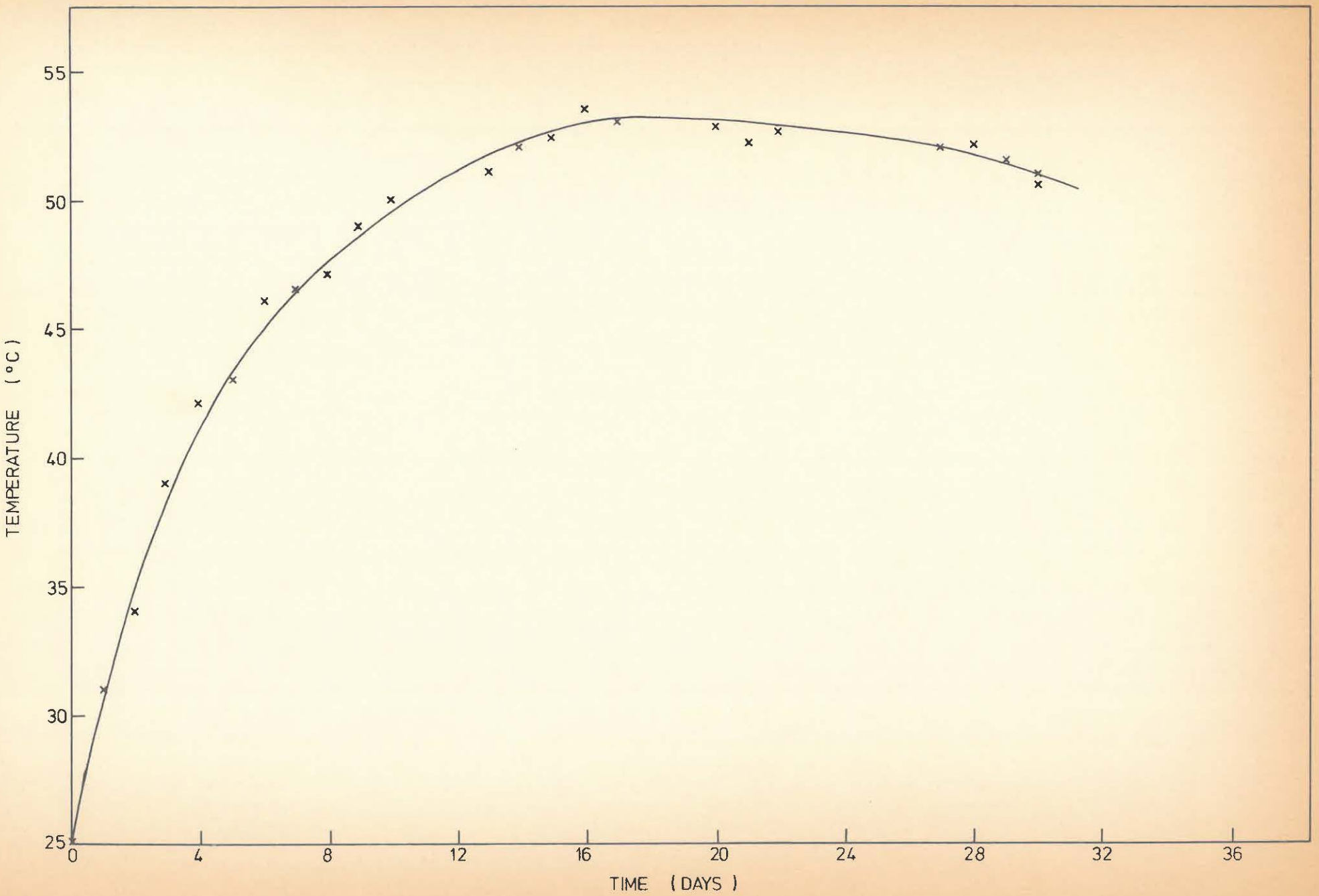

FIGURE 2. TEMPERATURE HISTORY CURVE.