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FUEL RESEARCH INSTITUTE

OF SOUTH AFRICA

TEGNIESE MEMORANDUM
TECHNICAL

NO. 6 OF 1973

SPONTANEOUS HEATING OF LANDAU COAL

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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA

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1. A sample of Landau low-ash coal was submitted by the T.C.O.A. and was tested in the Institute's experimental bunkers to assess the liability of this coal towards spontaneous combustion.

   During the loading of the coal a sample was obtained for analysis and the analytical data of the coal are presented in tables 1 and 2. Part of this sample, as well as a sample which was secured at the termination of the test, was used in a study of the effect of oxidation on the properties of a coal. The results of this study are reported in Technical Memorandum No. 7 of 1973. The swelling number of the coal was again determined on completion of the bunker test and was found to have decreased to 3, the original value being 4.

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

   The value of M can be evaluated with the aid of the equations:

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$$MN\varepsilon = W_o A$$

and $$N\varepsilon t_m = AV_m + \ln (MN/AV_m)$$

In these equations, the meanings of 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 at which the maximum coal temperature occurs, reckoned from the start of the experiment (days).

The data for V_o, W_o, V_m and t_m and the results of the computation are given in table 3. As the initial temperature was somewhat uncertain a value of 33°C, as determined by extrapolation, was adopted. In order to investigate the effect of an error thus introduced, the reactivity index was calculated at two additional initial temperatures, viz. 28 and 38°C. This range will certainly include the true initial temperature.

3. 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 without trouble for a limited period (approximately 4 to 6 weeks.) When $M > 1$, special precautions are required.

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In practice, the initial temperature of the coal may at times be appreciably higher than that prevailing during the experiment. The magnitude of M then increases in proportion to exp (A (V_a - V_o)), where V_a is the actual initial temperature. Using the relationship, it can be shown that M increases from 0,511 at 28°C to 0,63 at 35°C and to 1 at 51°C.

4. In conclusion, it is anticipated that the coal will not heat unduly during storage provided the initial storage temperature does not exceed 35°C. If the initial temperature ranges from 35 to 51°C, then the coal can be stored safely only for relatively short periods.

(SIGNED) T.C. Erasmus
CHIEF RESEARCH OFFICER

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TABLE 1

ANALYSIS OF AIR-DRIED COAL

Moisture	:	2,1%
Ash	:	6,7%
Volatile Matter	:	32,4%
Fixed Carbon	:	58,8%
Total Sulphur	:	0,66%

TABLE 2

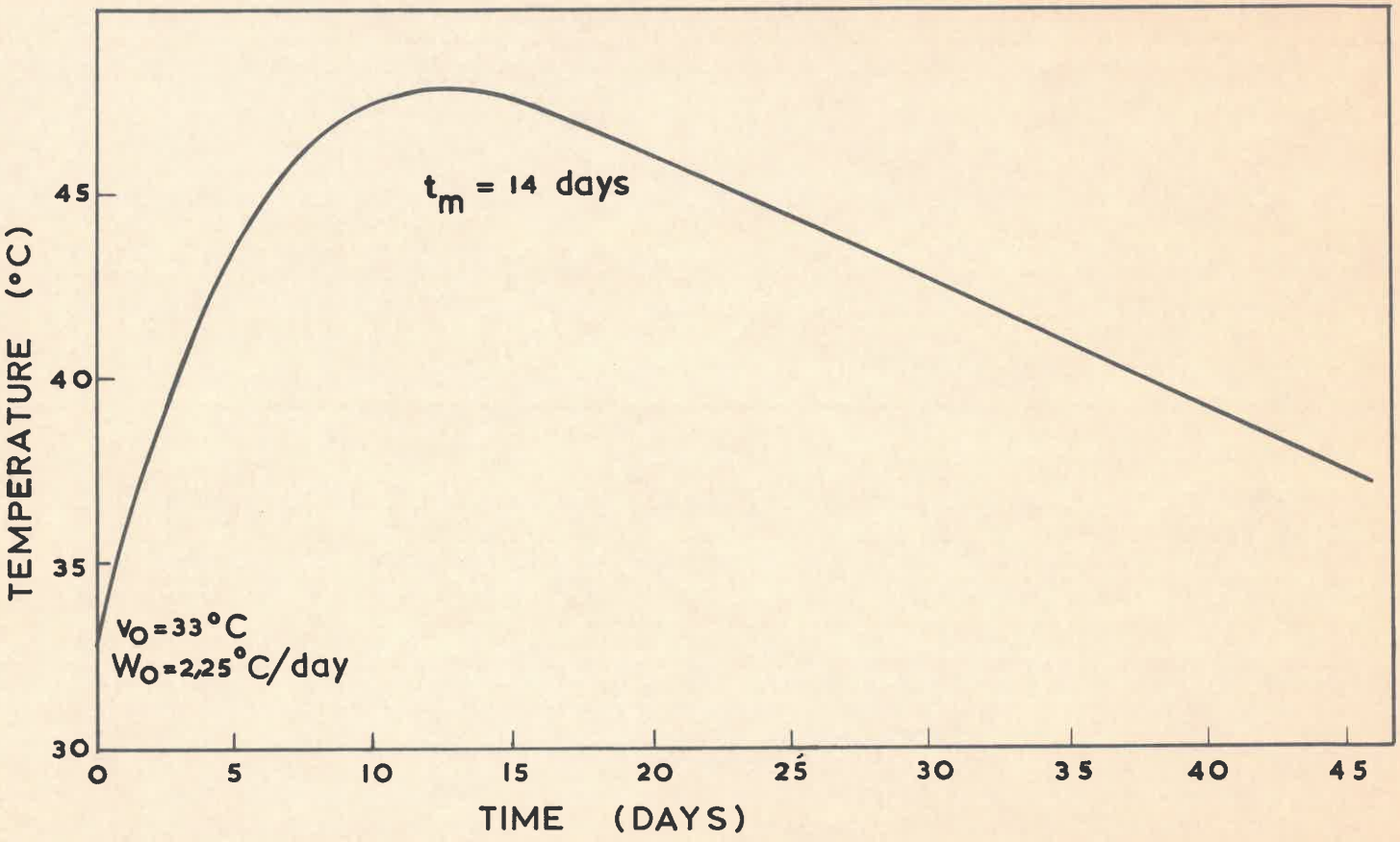
SIZE GRADING

+ ¾"	:	26,6%
- ¾" + ½"	:	14,4%
- ½" + ¼"	:	22,4%
- ¼" + ⅛"	:	14,0%
- ⅛" + 30 #	:	20,8%
- 30 #	:	1,8%

TABLE 3

REACTIVITY DATA

V_o	W_o	V_m	t_m	N	M
°C	°C/day	°C	days		
33	2,25	48	14	10,6	0,382
28	3,5	48	14	12,5	0,504
38	1,0	48	14	7,1	0,252



TEMPERATURE HISTORY OF LANDAU LOW ASH COAL.