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FUEL RESEARCH INSTITUTE OF SOUTH AFRICA.

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THE EFFECT OF PREHEATING ON THE COKING
PROPENSITY OF COKING COALS.

by

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In the contribution to the 1962 Annual Report it was reported that the effect of preheating of a coking coal for various periods at a temperature just below its softening point had been studied.

The next phase was to study the effect of the preheating temperature, keeping the preheating period constant. It was decided to preheat the coal, Hlobane coking coal, for one hour at increasing temperatures until the coking properties had been destroyed.

Table I shows the effect of this treatment on the Roga Index, the B.S. Swelling Number, the Dilatation Amplitude and the Plastic Range of the coal. In addition, the Proximate Analyses of most of the treated samples are given.

TABLE I

COKING PROPERTIES OF HLOBANE (61/505B) PREHEATED FOR 1 HOUR

Temp. of pre-heating	Roga In-dex	B.S. Swelling No.	Dil. Ampl.* %	Plastic Range °C**	Min. Resist. cm Kg.**	Proximate Analyses				
						% H ₂ O	% Ash	% V.M.	% Fixed C	% D.A.F. V.M.
Un-treated coal	70	4-4½	67	67	28	1.2	10.5	22.9	65.4	25.9
260	66	-	46	-	-	-	-	-	-	-
300	67	4½	49	75	40	-	-	-	-	-
350	67	4	40	66	45	-	-	-	-	-
375	65	4	35	80	105	0.7	10.8	21.8	66.7	24.6
385	65	4½	38	90	125	0.7	10.7	21.7	66.9	24.5
400	57	4-4½	29	75	160	0.7	10.8	20.8	67.7	23.5
410	50	2½	18	76	two stages	0.7	10.8	19.4	69.1	21.9
435	16	1	0	17	200	0.8	11.1	16.5	71.6	18.7

* Audibert-Arnu Dilatometer

** Brabender Echterhoff Plastograph

Figure 1 gives a graphic representation of these results.

As can be seen, the Roga Index and the Swelling Number remain reasonably constant up to a preheating temperature of about 390°C, but then decrease rapidly. There is a gradual decrease in the Dilatation Amplitude, and this becomes rapid from about 390°C. The plastic range shows a gradual increase and then a rapid decrease from about 390°C.

The fact that the coking properties deteriorated rapidly when Hlobane coal was preheated to temperatures beyond 390°C (for 1 hour) gave rise to the question whether this temperature is significant for

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all coking coals or whether each coking coal possesses its own "specific temperature of preheating".

It was, therefore, decided to examine at least two other coking coals which, however, differ appreciably in their coking properties as determined in the laboratory. The two coals chosen were Tshoba and Indumeni. Tshoba has a B.S. Swelling Number of 5 and a Dilatation Amplitude of over 300%. Indumeni has a Swelling Number of $8\frac{1}{2}$ and a Dilatation Amplitude of 120%. One might assume that two coals with such divergent coking properties would show differing results on preheating.

Samples of these two coals were treated in a similar manner to the Hlobane, above, i.e. preheated for one hour to various temperatures. The coking properties determined are given in Tables II and III; the relative proximate analyses are also given. The graphic representation of these results is included in Figure 1.

TABLE II

COKING PROPERTIES OF TSHOBA (6/63) PREHEATED FOR ONE HOUR

Temp. of pre-heating	Roga Index	B.S. Swelling No.	Dil. Ampl. %	Plastic Range °C	Min. Resist. cm Kg.	Proximate Analyses				
						% H ₂ O	% Ash	% V.M.	% Fixed C	% D.A.F. V.M.
Un-treated coal	81	5	316	97	4	1.0	12.4	30.1	56.5	34.8
365	83	6	252	134	6	0.7	12.5	28.7	58.1	33.1
395	80	5	170	145	14	0.7	13.1	26.4	59.8	30.6
420	60	3	34	123	70	1.0	11.1	23.0	64.9	26.2
430	15	1	8, Contr.	0	-	1.4	12.9	18.9	65.8	21.8

TABLE III

COKING PROPERTIES OF INDUMENI (63/238) PREHEATED FOR ONE HOUR

Temp. of pre-heating	Roga Index	B.S. Swelling No.	Dil. Ampl. %	Plastic Range °C	Min. Resist. cm Kg.	Proximate Analyses				
						% H ₂ O	% Ash	% V.M.	% Fixed C	% D.A.F. V.M.
Un-treated coal	70	$8\frac{1}{2}$ -9	121	40	50	1.1	11.7	24.8	62.4	28.4
380	61	8	77	43	75	1.0	12.6	23.1	63.3	26.7
400	55	$7\frac{1}{2}$ -8	34	35	180	1.0	12.4	22.2	64.4	25.6
415	40	4	30	21	190	1.1	12.4	21.2	65.3	24.5
430	0	$\frac{1}{2}$	2, Contr.	0	0	1.0	12.9	17.7	68.4	20.6

On examination of these results and the graphs, it is apparent that the coking properties deteriorate over the same temperature range when the coals are subjected to a preheating treatment. It, therefore, appears that coking coals do not possess a "specific tempera-

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ture" in this respect.

(Fig. II)

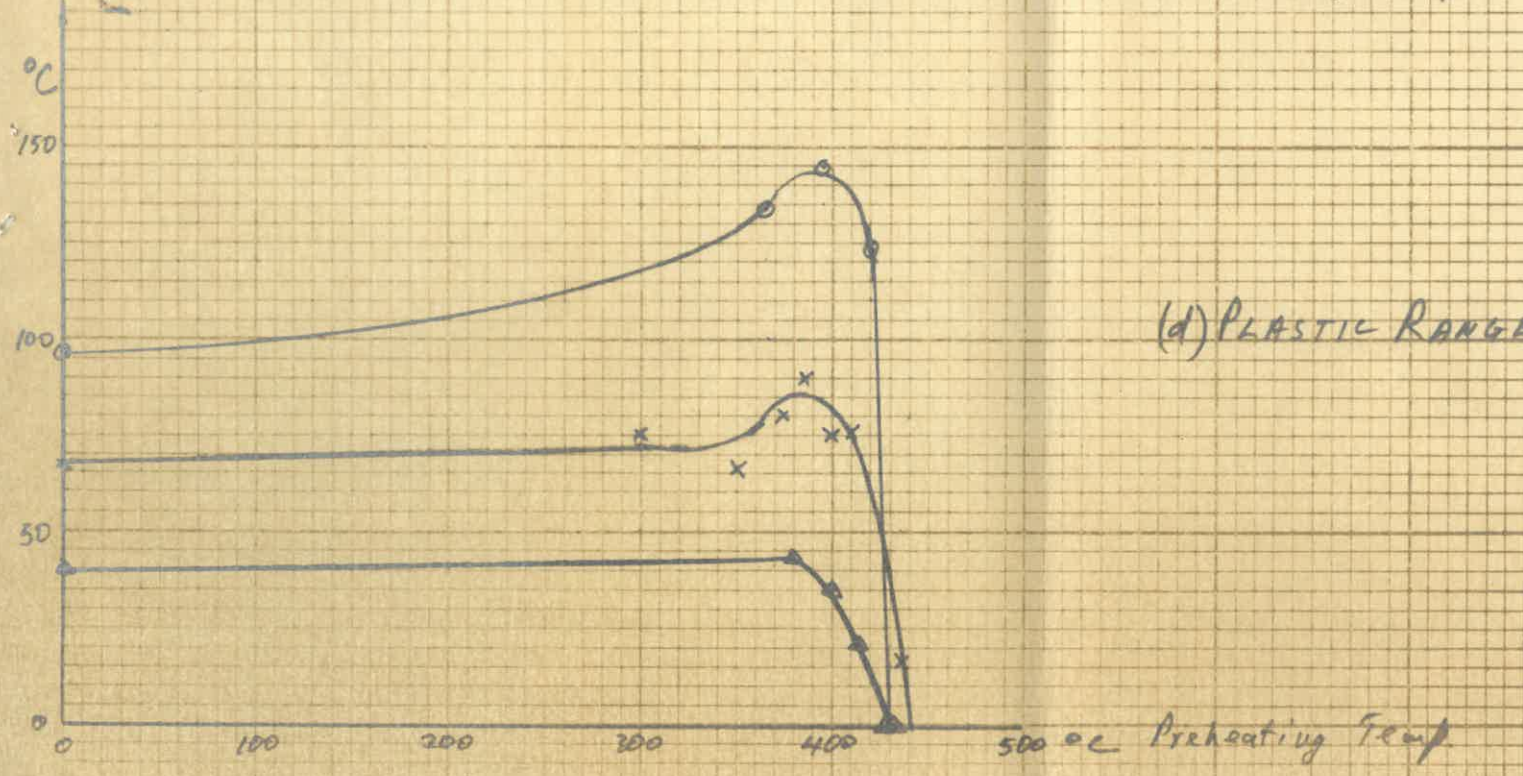
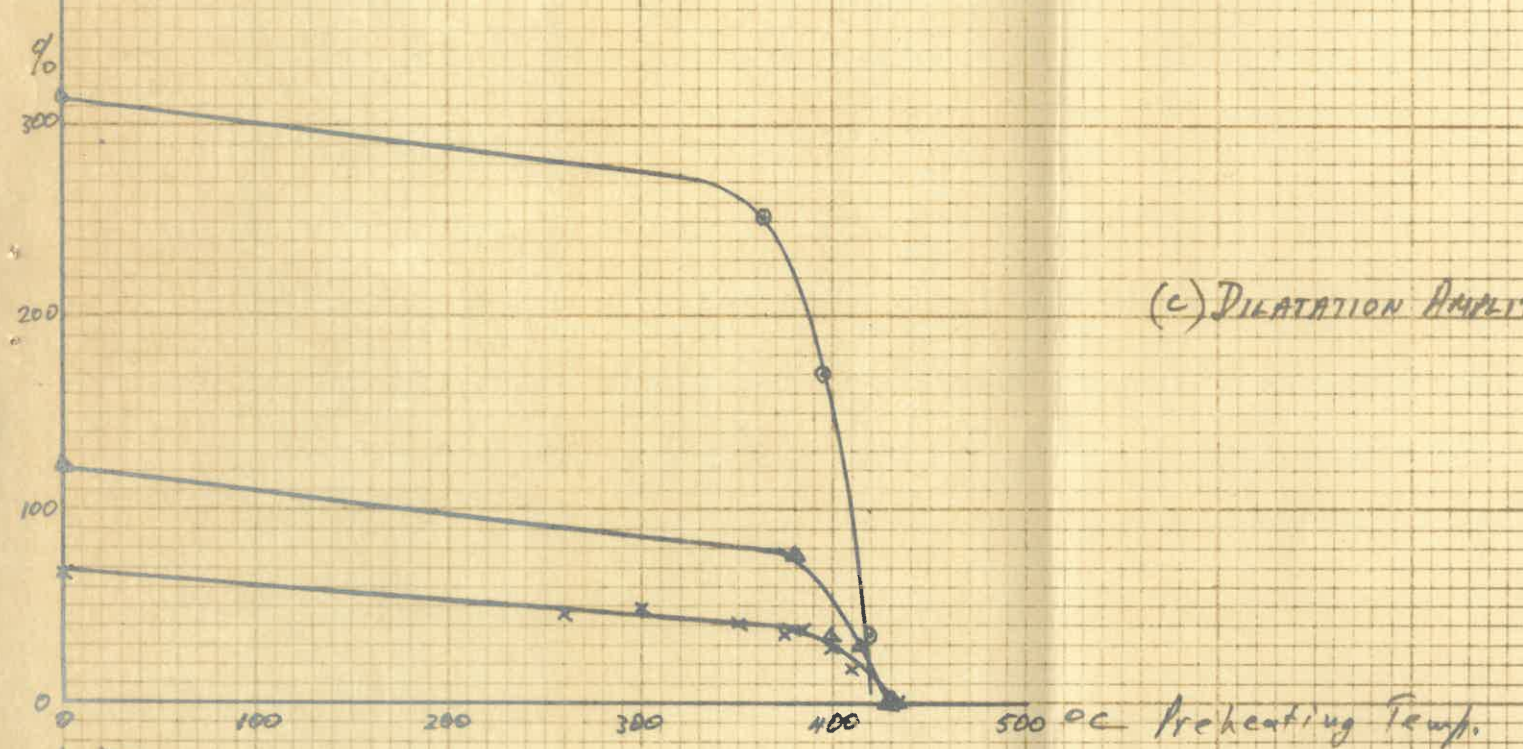
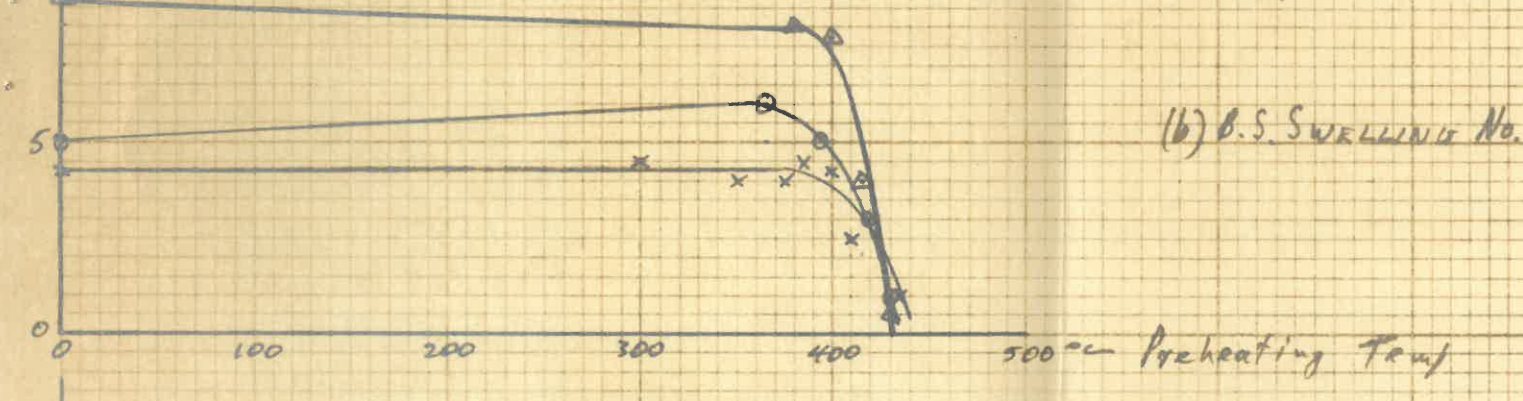
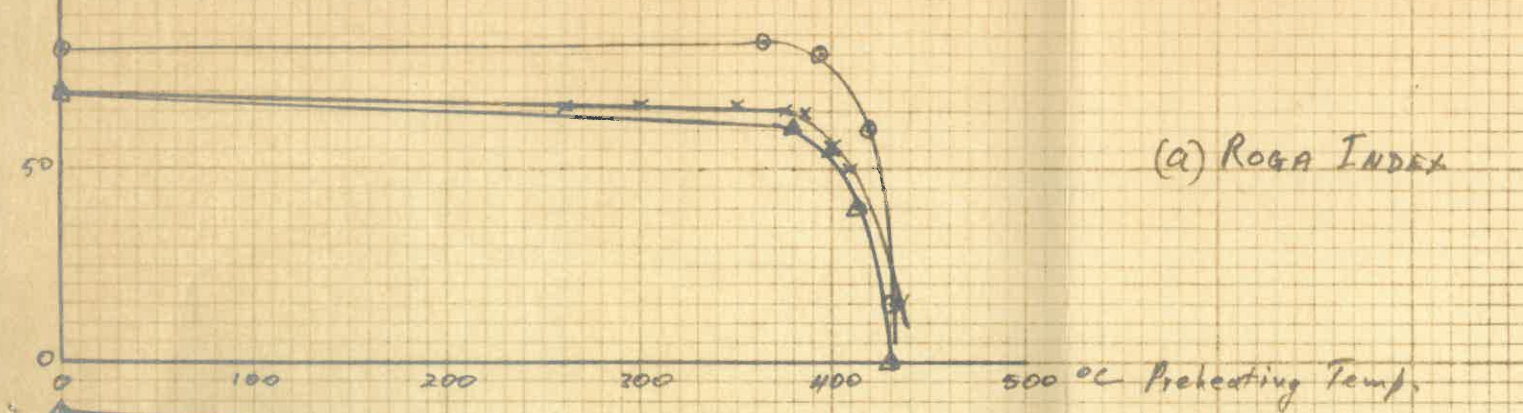
An examination of the graphs of the volatile matter and fixed carbon contents of the preheated coals reveals a change over the same temperature range as the deterioration of coking properties. Hence, for the three coals in question, and preheating for one hour, it can be stated that the coking properties deteriorate as the volatile matter is driven off.

To obtain a clearer picture of the rate of devolatilization, degasification curves for these three coals are necessary. In previous work on Hlobane coal such a degasification curve was obtained. However, the temperature had been raised quickly to 320°C and only from that temperature at a rate of 3°C per minute. Under these circumstances the devolatilization commenced at about 390°C, with a maximum rate at 450°C. It is advisable to have the temperature rate of 3°C over the whole heating range, i.e. from room temperature. This work is now being carried out.

(signed) E.F.E. Müller.

Senior Technical Officer.

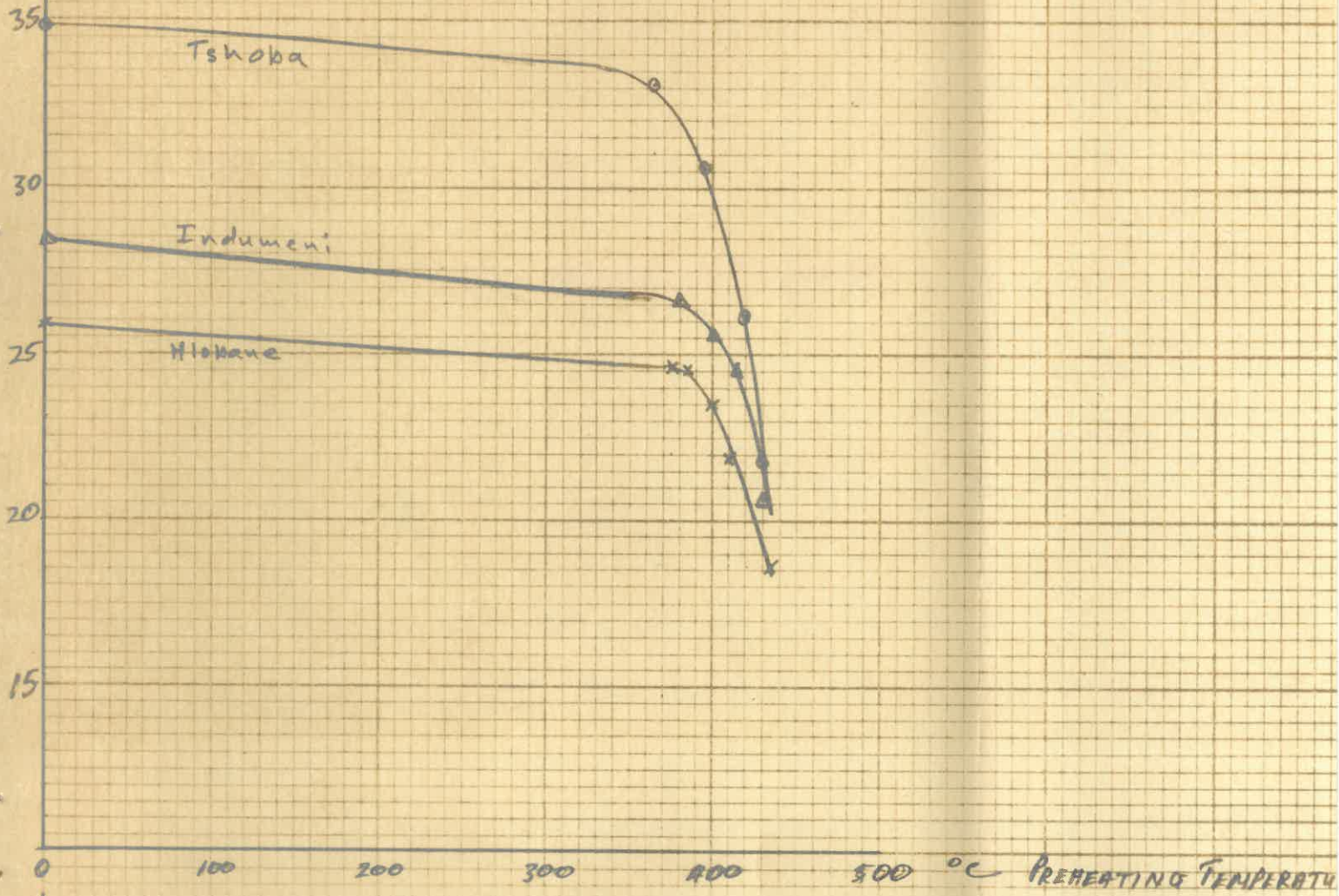
FIGURE I: COKING PROPERTIES ON PREHEATING FOR 1 HOUR.



Ulohana Tshoba Endau

FIGURE 11

% VOLATILE MATTER (D.A.F.)
in SAMPLE



% FIXED CARBON (D.A.F.)

