

RESTRICTED

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ENCLOSURE (B) 15

STUDIES ON BRIQUETTING

by

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SUMMARY

A study was made of the suitability of pitchless briquettes for use as boiler fuels.

A briquette formed of the mixture of the caking coal and anthracite coal under proper conditions is suitable for this purpose. In this work it was found that the optimum conditions for briquetting were as follows:

Temperature, °C .....	about 400°C
Compression, kg/cm <sup>2</sup> .....	47.7
Time, min. ....	3
Mixing ratio of the Yubari coal to Phyeong- Yong coal .....	9:1

I. INTRODUCTION

These studies were undertaken in an attempt to find an optimum condition for briquetting in which process the caking property of coal would be used. A briquette having a strength of about 20kg/cm<sup>2</sup> and not absorbing water was designed.

Date of beginning of this project was in April 1941 and the date of finishing was in March 1944.

Key Personnel Working on Project:

Chem. Eng. Lt. Comm., M. KUMAMOTO

II. DETAILED DESCRIPTIONA. Description of Test Apparatus

1. The test apparatus for briquetting is shown in Figure I(B)15.
2. Lessing's apparatus was used for the determination of the decomposition temperature.

B. Test Procedure

Sample coals were ground and sized under 60 mesh screen. The determination of the caking index at different temperatures was carried out by Compton's method, and the decomposition temperature was determined by observing the evolved gas volume by Lessing's apparatus. The briquette was formed by keeping about 7gm of the coal powder at a definite temperature, pressure, and duration of time. After cooling the product was obtained.

The strength of the briquette was determined by measuring the hydraulic pressure in kg/cm<sup>2</sup> required to crush the briquette.

C. Experimental Results and Summary of Data

1. Nature of the Yubari and the Phyeong-Yong Coal. The Yubari coal possesses high caking power and the Phyeong-Yong coal is an anthracite.

The approximate percentage compositions of these coals are tabulated in Table I(B)15.

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The caking index at different temperatures and the decomposition temperature were investigated for the Yubari coal, and the results are shown in Table II(B)15 and in Figure 2(B)15.

The caking properties of this coal appear to start at 395°C and increase with increasing temperature, but increasing the temperature above 500°C did not appreciably increase the caking index. Decomposition, as observed by the evolved gas volume, began at 380°C and with further increase of temperature of the Yubari coal it decomposes. The results are plotted in Figure 2(B)15. Therefore, to obtain pitchless briquettes, caking coal must be kept at the temperature causing caking properties, or decomposition of coal will occur.

## 2. Experiment to Find Optimum Conditions for Manufacturing Pitchless Briquettes.

a. Effect of Temperature. The influence of temperature on the strength of briquettes formed under a definite condition (pressure=47.7kg/cm<sup>2</sup>, time = 3 min.) was investigated and the results are shown in Table III(B)15.

The effect of preparation temperature on the strength of the briquettes is especially apparent above 380°C at which temperature decomposition starts.

b. Effect of Compression Ratio and Time of Compression. The effect of compression and time of compression were investigated, and these data are tabulated in Table IV(B)15 and V(B)15.

The maximum briquette strength (kg/cm<sup>2</sup>) is obtained at a compression ratio of 56kg/cm<sup>2</sup>.

3. Preparation of Pitchless Briquettes from the Mixture of the Yubari Coal and the Phyang-Yong Coal. For the Yubari coal only, the optimum conditions for preparing pitchless briquettes were determined.

The strength of the briquette formed at different ratios of the Yubari and the Phyang-Yong coals was investigated and the results are given in Table VI(B)15.

Although the strength of the briquette increases with increasing mixing ratio of the Yubari coal, the briquettes formed at a ratio of 10% of the Yubari to the Phyang-Yong coal was compared with the briquette which was produced at 5th Naval Depot, and the results are shown in Table VII(B)15.

## III. CONCLUSIONS

Pitchless briquettes having suitable properties for boiler fuel were obtained by taking advantage of the caking power of the Yubari coal and the optimum conditions were as follows:

Temperature	400°
Compression (kg/cm <sup>2</sup> )	47.7
Time (min)	3
Mixing ratio of the Yubari coal and the Phyang-Yong coal	9:1

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Mechanical and technical problems still remain before this procedure can be applied in mass production.

Table I(B)15  
APPROXIMATE PERCENTAGE COMPOSITION OF COALS

Coal Origin	Yubari	Phyong-Yong
Moist. (%)	1.99	2.80
Vol. M. (%)	41.20	7.66
Fix. C. (%)	47.50	76.34
Ash (%)	9.31	13.20

Table II(B)15  
CAKING INDEX OF THE YUBARI COAL

Temp. °C	Caking Index
350	0
395	1
450	2
490	3
525	4
900	5

Table III(B)15  
EFFECT OF TEMPERATURE ON STRENGTH OF BRIQUETTE

Temp. °C	Strength of Briquette kg/cm <sup>2</sup>
280	6.5
300	10.0
320	12.5
340	15.5
360	17.5
380	20.0
400	31.0
420	47.5

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Table IV(B)15  
EFFECT OF COMPRESSION RATIO ON THE STRENGTH OF BRIQUETTE

Briquetting Condition	Press kg/cm <sup>2</sup>	Strength kg/cm <sup>2</sup>
Temp. = 400°C	16	17.5
	24	23.5
	32	27.5
	40	41.5
Time 3 min.	56	75.0
	63	64.0
	72	57.0
	78	47.0

Table V(B)15  
EFFECT OF TIME OF COMPRESSION STRENGTH OF BRIQUETTES

Briquetting Condition	Time of Compression Min.	Strength of Briquet kg/cm <sup>2</sup>
Temp. = 400°C	3	35
	6	37
	10	caking
Compression = 47.7kg/cm <sup>2</sup>	15	caking
	20	caking

Table VI(B)15  
STRENGTH OF BRIQUETTE

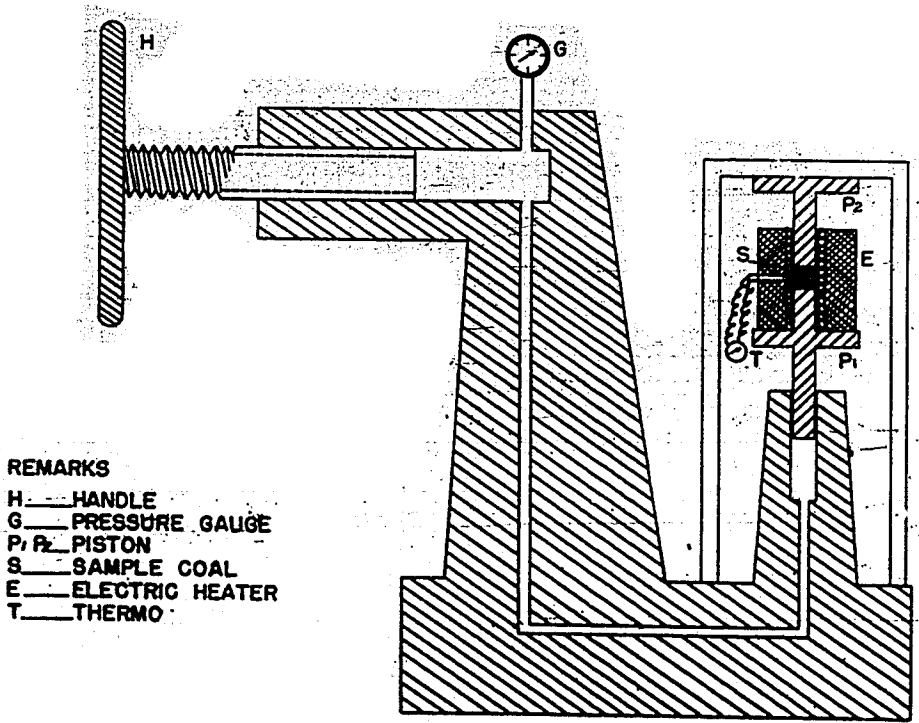
Briquetting Condition	Mixing Ratio of the Yubari (%)	Strength of Briquette kg/cm <sup>2</sup>
Temp. = 400°C	10	20.5
	20	24.5
Time = 3 min.	40	31.0
	60	34.0
Compression 47.7kg/cm <sup>2</sup>	80	38.0

Table VII(B)15  
STRENGTH AND APPROXIMATE PERCENTAGE COMPOSITION OF BRIQUETTES

Properties	A	B
Moisture	1.95	1.87
Vol. M. (%)	16.03	20.63
Fixed C. (%)	67.47	66.37
Ash (%)	14.55	11.13
Strength kg/cm <sup>2</sup>	35.0	24
Composition	10% Yubari Coal 90% Phyang-Yong Coal	10% Saits Coal 80% Phyang-Yong Coal 10% Pitch

- A Briquet prepared and in our laboratory (10% Yubari Coal.)  
B Briquet produced in Fifth Fuel Depot.

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REMARKS

- H --- HANDLE
- G --- PRESSURE GAUGE
- P<sub>1</sub> P<sub>2</sub> --- PISTON
- S --- SAMPLE COAL
- E --- ELECTRIC HEATER
- T --- THERMO

Figure 1 (B)15  
TESTING APPARATUS FOR BRIQUETTING

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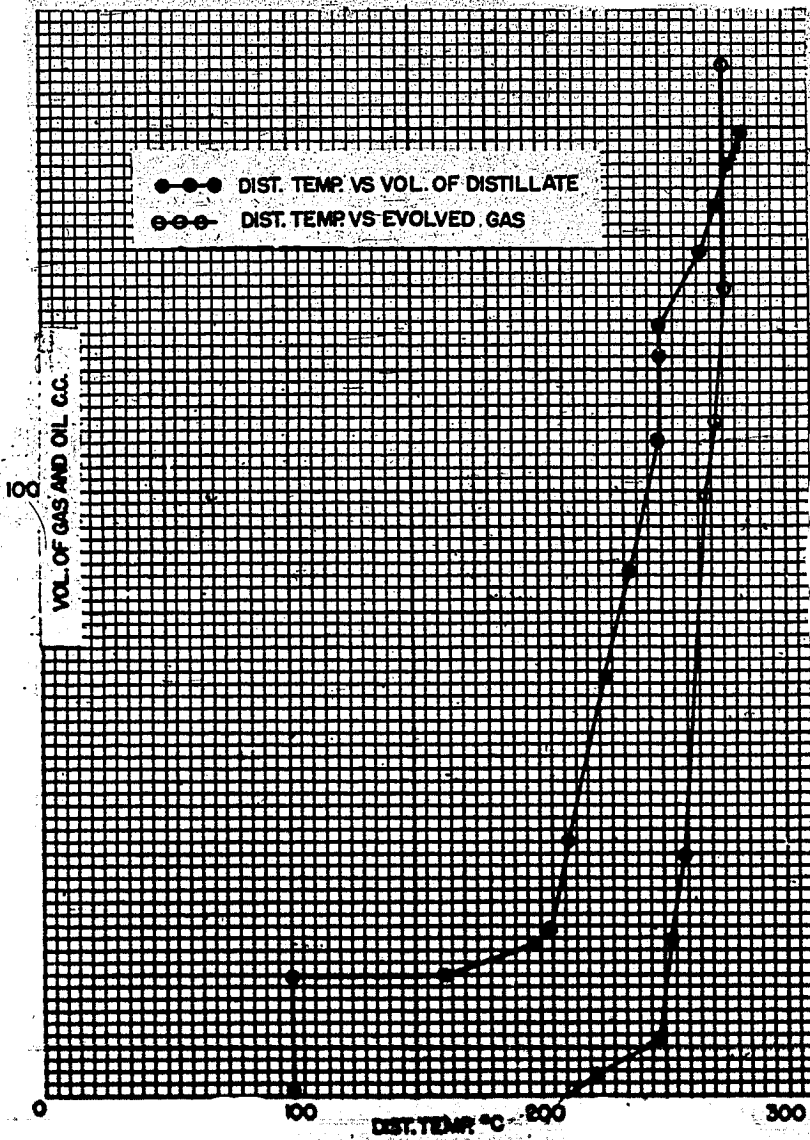


Figure 2-(B)15  
RELATIONSHIP BETWEEN DISTILLATION TEMPERATURE  
AND VOLUMES OF DISTILLATE AND EVOLVED GAS