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CHINESE-CANADIAN METALLURGICAL COAL BLENDS: PREDICTION OF COKE CHARACTERISTICS

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by

J.T. Price*, J. Gransden,* and T.D. Brown**

Introduction

Calculations have been carried out to predict some coke characteristics that can be expected from simple blends of Chinese and Canadian metallurgical coals. The objectives of the calculation were to define the approximate coke stability factor and ash content that could be produced from these blends during carbonization in slot-type ovens.

The Predictive Methods

Three predictive methods have been used:

1. The Inerts/Reflectance Method

   This uses the maceral composition analysis and the mean reflectance of the vitrinite in the coal to define a coke stability. See Figure 1. Reference 1, 2, 3.

2. The Composition Balance/Strength Method

   This uses the reflectance distribution of the vitrinite maceral (V-step distribution) and a calculated petrographic strength index to define a coke stability. See Figure 2. Reference 4.

3. The Fluidity/Reflectance Method

   This version of the M.O.F. diagram uses Gieseler fluidity and mean reflectance of the vitrinite maceral to predict coke stability. It has been developed from C.R.P.L. carbonization data specifically for use with Western Canadian coals. See Figure 3. Reference 1.

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Three Chinese coals were considered as one component of a binary blend with six Canadian coals. The Canadian coals were considered in two groups:

(a) Producing mine operations; and

(b) Mines under development.

Information on the Chinese coals was supplied by DREE; information on the Canadian coals came from CRPL file data.

A summary of the coal analyses, on which the predictions were based, is presented in Table 1, and the results of the coke blend predictions are presented in Table 2.

In considering the coke stability predictions from the various processes it must be remembered that:

(1) the predictions are based on limited data on the Chinese coal component of the blend(s) and that

(2) only Predictive method 3 has been exhaustively examined for use with western Canadian coals. It is considered the most reliable predictor.

(3) Current Canadian blast furnace practice requires an ASTM stability greater than 55, an ash content below 8%, and a sulphur content below 0.7%.

Conclusions

The predictive data developed in this study indicates that many of the Chinese-Canadian coal blends considered can meet the stability and sulphur standards required by current Canadian blast-furnace practice. The ash content of the coke may be marginally above optimum levels.

The analytical and predictive data should be confirmed by an experimental program conducted in the technical scale coke ovens at the Coal Resource and Processing Laboratory.

References

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2. Pearson, D.E., "The quality of Western Canadian coking coal", Can. Min. Met. Bull., vol 73, p 70-84, 1980.

3. DeMarchis, J., "Quick Reference Stability Graph".

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TABLE 1. Analysis of Individual Blend Components

	Proximate Analysis, %				Coking Characteristics				
	A (db)	FC (db)	S (db)	VM (db)	F.S.I.	Gieseler Fluidity ddpm	R_o	Contraction/ Expansion	Total Dilatation
Chinese Coking Coals									
Zao - Zhuang	8.2	57.87	0.69	38.9	$5\frac{1}{2}/7$	6-13,000	0.92	$\frac{25-30}{42-77}$	72-102
Kai - Luan	11.7	63.77	0.70	24.6	$6\frac{1}{2}/8$	4,450	1.30	$\frac{26-31}{100-170}$	130-196
Yan - Zhou	7.2	58.27	0.45	34.5	$2\frac{1}{2}$	35	0.76	-	-
Canadian Coking Coals									
A.	8.0	73.4	0.44	18.6	4	2.5	1.58	14/11	25
B.	8.4	68.1	0.39	23.5	$7\frac{1}{2}$	79	1.27	24/16	40
C.	9.5	65.0	0.3	25.5	5	435	1.06	23/49	72
D.	9.8	68.4	0.32	21.8	7	20	1.38	16/23	39
E. (Developing Mine)	7.0	72.5	0.36	20.0	$2\frac{1}{2}$	1	1.60	-	0
F. "	5.6	69.7	0.49	24.7	$7\frac{1}{2}$	138	1.38	18/30	48

TABLE 2. Predicted Coke Quality Characteristics: Binary Blends

Blend Composition	Predicted ASTM Stability			Predicted Coke	
	Method 1	Method 2	Method 3	Ash Content, %	Sulphur Content, %
100% Zao Zhuang	41	48	40	12.0	0.70
70% Zao Zhuang:30% A	60	52-56	56	11.1	0.60
70% Zao Zhuang:30% B	56	48-52	46	11.5	0.60
50% Zao Zhuang:50% B	49	50-55	52	11.3	0.55
70% Zao Zhuang:30% C	45	28-32	43	12.1	0.58
50% Zao Zhuang:50% D	55	52-54	54	12.1	0.50
100% Kai Luan	60	62	55	15.2	0.70
70% Kai Luan:30% A	64	58-60	60	13.4	0.60
70% Kai Luan:30% B	60	60	57	13.8	0.60
70% Kai Luan:30% C	57	55-57	55	14.4	0.58
50% Kai Luan:50% C	55	52-56	55	13.8	0.50
50% Kai Luan:50% D	60	57-59	59	13.7	0.51
70% Kai Luan:30% Yan Zho	56	53-58	54	14.0	0.60
100% Yan Zhou	5	5	30	10.5	0.36
70% Yan Zhou:30% A	50	47-52	42	10.2	0.38
50% Yan Zhou:50% D	50	43-47	48	11.5	0.34
70% Zao Zhuang:30% E	56	52-56	53	10.8	0.60
70% Kai Luan:30% E	60	53-57	59	13.1	0.60
70% Yan Zhou:30% E	47	45	43	9.8	0.36
50% Zao Zhuang:50% F	59	61	53	9.5	0.60
50% Kai Luan:50% F	64	59	59	11.2	0.60
50% Yan Zhou:50% F	53	50	49	8.7	0.43

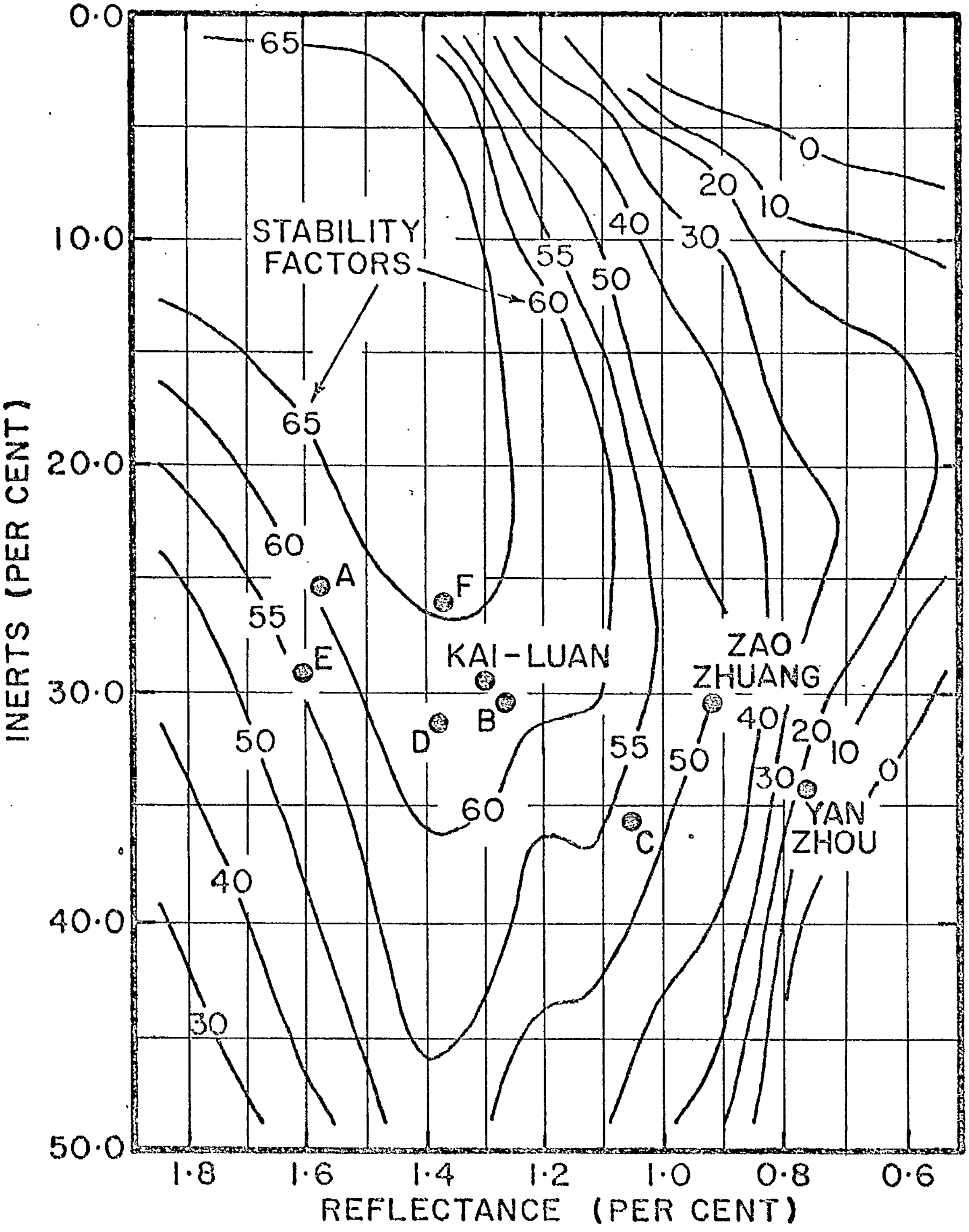

Figure 1. Relationship Between Coke Stability Factor with Coal Reflectance and Petrographic Inerts

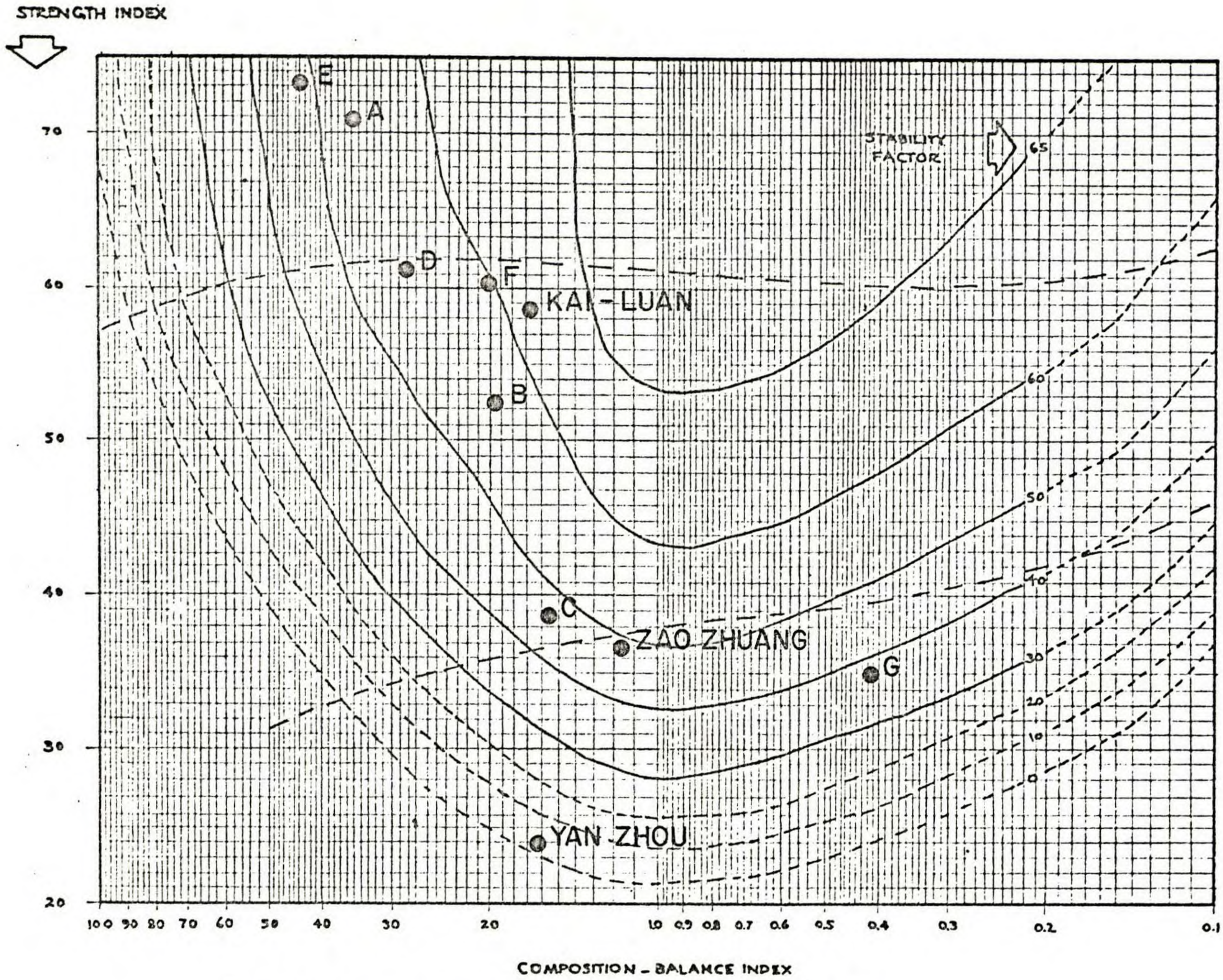

Figure 2. Petrographic method of predicting coke strength. Positions of Chinese coals are estimates.

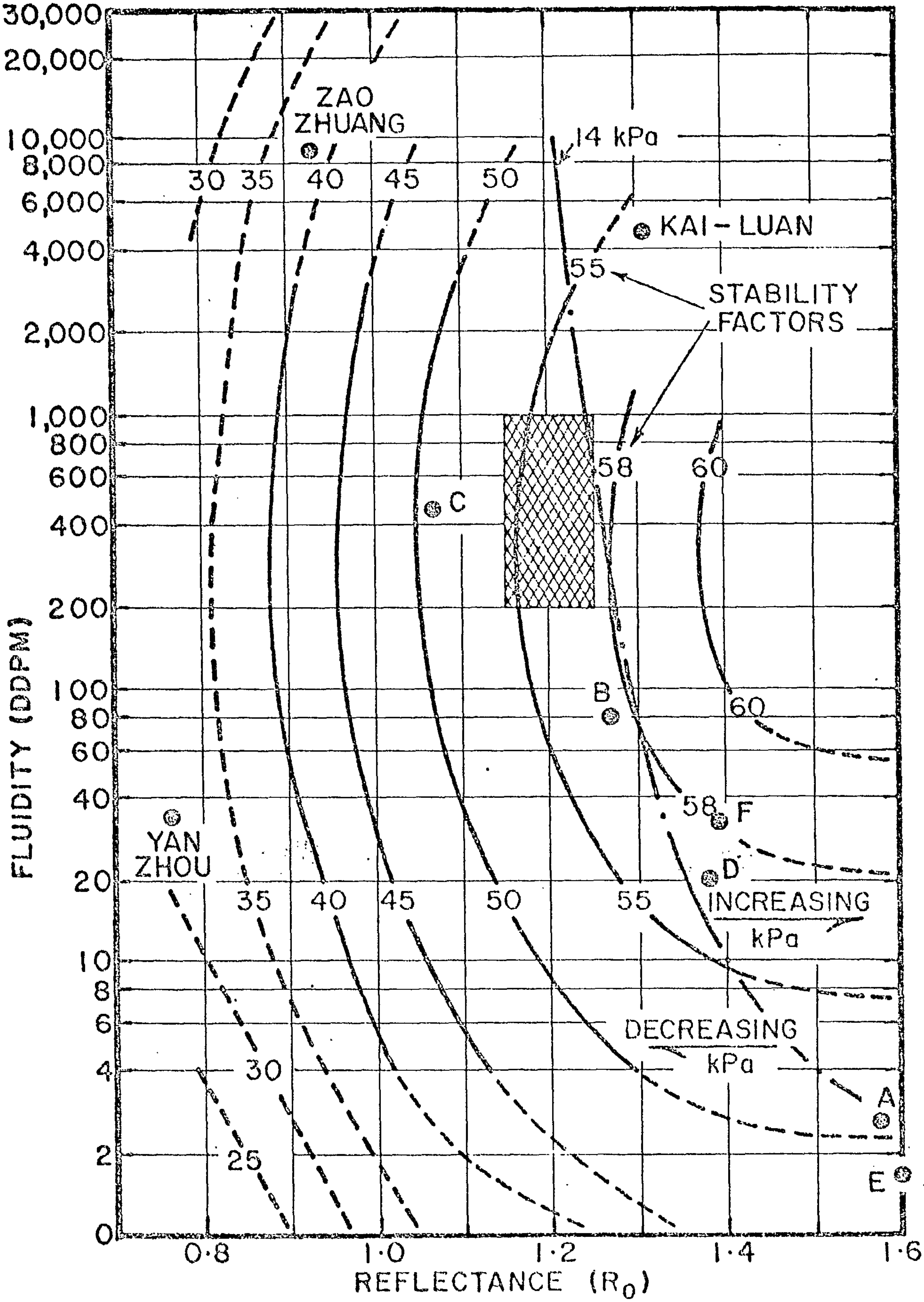

Figure 3. Method of predicting coke strength from coal fluidity and mean maximum reflectance - based on CANMET regression analyses for Western Canadian coals.