sublimation of molybdenite, which in this work occurred around 1,050° C. If molybdenum disulphide obeys the Tammann rule, that is, if it begins to sinter noticeably at a temperature about one-half of its absolute melting point[4], then it would be expected to have a melting point around 2,375° C.

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PETER CANNON

General Electric Research Laboratory,
Schenectady, New York. March 20.

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Alicyclicity and Smoke Emission of Coal

MUCH work has been done in the past on the smokiness or the smoke nuisance of coal during combustion, but mainly on its abatement. The fundamental causes of smoke emission have been little studied, though its obvious link with volatile matter and/or tar[1] has been known. Recent dehydrogenation studies[2,3] made by us leading to the determination of alicyclic carbon in coal have resulted in certain findings on the pyrolysis and combustion behaviour of dehydrogenated coals which obviously suggest that alicyclic bodies in coal are the main smoke-forming constituents.

It has been shown elsewhere[3] that dehydrogenated coals (for example, by Vesterberg's technique—dehydrogenation carried out with sulphur below the decomposition point of coal) do not yield any tar and that the char yield increases proportionately to the alicyclic carbon content of coal at the expense of tar-forming bodies. It has been shown[4] that alicyclic bodies in coal are primarily responsible for the formation of tar.

These findings naturally prompted us to study the combustion behaviour of the dehydrogenated coals. As the devolatilization of alicyclic bodies, that is, the tar-forming bodies, is completely inhibited on dehydrogenation, it was anticipated that pyrolysis of such bodies would also be avoided during combustion, resulting possibly in the smokeless burning of such coals. This was found to be so in the case of all dehydrogenated coals prepared from different ranks.

Table 1. ALICYCLICITY AND SMOKINESS OF COAL

Coal	On unit coal (per cent)			
	Carbon	Hydrogen	Alicyclic carbon*	'Smokiness'†
Assam	80·3	5·9	16·1	2·44
Jambad Bhowlah	80·6	5·4	13·7	2·25
Poniati	83·5	5·5	15·5	2·25
Laikdih‡	87·3	5·3	10·1	1·50
Pootki‡	88·0	5·3	11·2	1·40
Jharia, IX	90·7	4·7	5·5	0·87
Jharia, IX	90·4	4·6	3·6	0·75
Anthracite (South Wales)	93·2	3·5	nil	nil

* Data taken from earlier papers (refs. 2, 3 and 4).
† By 'smokiness' is meant here the soot and free carbon in the flue gas which was trapped and filtered off quantitatively in glass-wool and weighed. The experiments were carried out in a small muffle furnace under identical conditions of air-supply, that is, the ratio of air to the amount of volatiles was kept the same in all cases by adjusting the weight of coal.
‡ Vitrains.

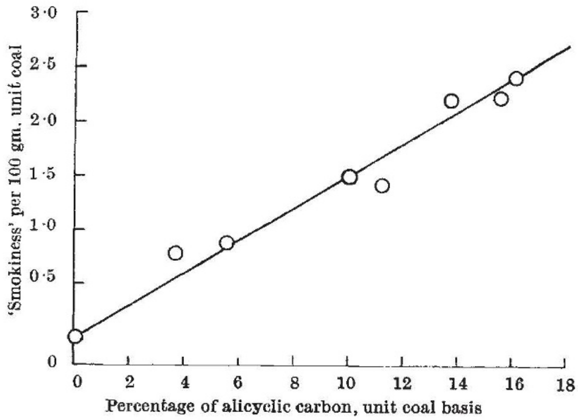

Fig. 1. Relation between alicyclicity and smoke emission of coal

Halogenation also has been found[5] to bring about the same type of dehydrogenation and stabilization of alicyclic carbon during subsequent pyrolysis. Such dehydrogenated coals are also smokeless during combustion. Prior treatment of coal with acids like sulphuric and phosphoric and certain other dehydrating agents like phosphorus pentoxide and potassium hydrogen sulphate also renders a coal smokeless without having to carbonize it. It has been found that during such treatment no tangible loss of carbon or hydrogen takes place, but apparently a reorganization (possibly condensation) of the alicyclic part in relation to the basic aromatic nucleus occurs whereby devolatilization of alicyclic bodies is completely inhibited[6].

Controlled oxidation[7] of any coal will also bring about a similar change.

It would appear, therefore, that smoke emission is primarily due to the alicyclic structures in coal and any process which can help stabilize such structure would make a coal smokeless.

Relative smokiness of different ranks of coal has been measured (Table 1) and is found to bear a linear relationship with alicyclic carbon content of the coals (Fig. 1). Anthracites and semi-anthracites contain very little or no alicyclic carbon, and hence they are smokeless. Semi-coke or char are smokeless fuel as these carbonized products do not contain any alicyclic structure. Thus it is possible to make a smokeless fuel from any coal without having to carbonize it. The inhibition of tar formation on oxidation of coals has been known for a long time; but the fundamental causes have become evident from our studies on dehydrogenation of coals.

B. K. MAZUMDAR
S. S. CHOUDHURY
A. LAHIRI

Central Fuel Research Institute,
Jealgora, Bihar, India.
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