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OF SOUTH AFRICA

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NOTES ON THE DISPERSIBILITY OF COAL DUSTS

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INTRODUCTION

The initial event in a coal dust explosion is the creation of a localized air blast, which is generally caused by a methane explosion.

The blast causes a pioneer dust cloud which is ignited by the initial explosion. The heat generated by these explosions generates an expansion wave, the motion of which picks up and disperses the layered coal dust into a dust cloud. If the requirements for further ignition are satisfied a flame will be propogated in the expansion cloud. From this it follows that dispersion of layered dust is of prime importance in the initiation and propogation of a coal dust explosion in mine workings.

Since the properties of South African coals are in many respects different to those of foreign coals, the question arises whether there are also significant differences in the ability of dusts of different coal types to disperse when subjected to air blasts.

A search of the literature reveals that little attention has been given to the determination of the relative dispersibilities of different coal types. More emphasis has been placed on studies of the dispersion characteristics of coal dust-stone dust mixtures.

However, from the published work some information may be gleaned from these factors and conditions that contribute to the dispersibility of coal dusts.

THE MODES OF DISPERSION OF DUST

Dusts can be dispersed in two modes, viz. erosion and denudation.

/When .....

When a dust erodes the dust is moved particle by particle; with denudation the whole dust deposit leaves the surface suddenly. The latter mode of dispersion occurs in a matter of 0.5 sec. and is, therefore, of prime importance in coal dust explosions.

The mode of dispersion which will be obtained depends on the physical properties of the dust deposit and on the conditions of the blast. Since this survey is concerned only with relative dispersibilities only, coal properties will be taken into consideration here.

The amount of dust removed from a deposit by a blast of air may be approximately represented by the following equation:

$$\text{Weight removed} = K\ A\ V^2\ \rho^2/CK$$

where

A is the time,
ρ is the bulk density of the dust,
C is the cohesion parameter,
V is the air velocity parameter,
A is the superficial area of the dust deposit,
K is a constant.

According to the results of extensive tests undertaken at the S.M.R.E. dust deposits for which the factor ρ^2/C is smaller than 6 will denude, whereas for dusts with ρ^2/C values greater than 6 only erosion will occur (for ρ in gm/cm^3 and C in gm/cm^2).

In the light of the low explosion susceptibility of South African coals (as tested by the U.S.B.M. test procedures), it seems that an investigation of the dispersibility of our coal dusts may lead to a better understanding of the factors that contribute to the singular explosion behaviour of our coals.

The principal factors, involving coal properties, which govern the dispersibility of dust are:

/i) .....

i) bulk density,
ii) cohesion between particles,
iii) particle size,
iv) moisture content,
v) weathered state of the coal.

It appears that the dust properties of most significance are the bulk density and the cohesion of the particles.

The high mineral matter content of South African coals suggests that they have relatively high bulk densities and that the dispersibility of the dust from them may be materially influenced thereby.

EXPERIMENTAL WORK

Experimental work has been started on measuring the bulk densities and cohesion between the particles of coal dust samples. Results of bulk density determinations of dusts from a few mines in Natal are shown in Table 1.

(The devices used for cohesion measurements are being constructed according to the design of the S.M.R.E. and no measurements have been made yet.)

From the table it is clear that the original coal dust samples are about twice as dense as the -200 mesh fractions.

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Pretoria.
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TABLE 1

BULK DENSITY VALUES g/cm^3 OF COAL DUST

(Mixed particle size)

Sample No.	Mine	Density of -200 mesh particles	Density of original sample
69D1	DNC	0.46	0.83
69D2	DNC	0.45	0.90
D3	DNC	0.44	0.85
D4	DNC	0.47	0.82
D5	DNC	0.47	0.89
D6	DNC	0.47	0.91
D7	DNC	0.47	0.80
D8	DNC	0.50	1.00
D9	DNC	0.48	0.83
D10	Northfield	0.45	0.88
D11	Northfield	0.46	1.00
D12	Northfield	0.47	0.87
D13	Northfield	0.46	0.93
D14	Northfield	0.42	0.95
D15	Northfield	0.45	0.97
D16	Northfield	0.46	0.97
D17	Northfield	0.44	0.93
D18	Northfield	0.46	0.87
D19	Indumeni	0.47	0.75
D20	Indumeni	0.47	0.77
D21	Indumeni	0.46	0.77
D22	Indumeni	0.45	0.88
D23	Indumeni	0.46	0.87
D24	Indumeni	0.46	0.77
D25	Indumeni	0.43	0.87
D26	Indumeni	0.44	0.87
D27	Indumeni	0.42	0.87