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THE CONSOLIDATION OF FOOTWALL DUST IN INTAKE AIRWAYS AND ROADWAYS USING CALCIUM CHLORIDE

by

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INTRODUCTION

Vehicular and pedestrian traffic in dry airways and roadways underground raises considerable dust from the footwall. This dust is picked up by ventilating air and is carried into the mine workings.

As the use of water for allaying dust is not entirely satisfactory because of the frequency with which water must be applied, waste engine oil¹ has been used for this purpose with advantage. This is, however no longer freely available. A suitable water soluble substitute, MULREX 925, has been developed and its dust suppression qualities have been demonstrated².

Calcium chloride has also been found to be excellent for the consolidation of footwall dust³ because of its deliquescent and hygroscopic properties. (Deliquescence is the process

of dissolving and becoming liquid by attracting and absorbing moisture from the air while hygroscopicity is the process of readily absorbing and retaining moisture). The hygroscopic property greatly reduces the evaporation of moisture from the surface of the footwall thus resulting in the consolidation of dust for a longer period of time. Through deliquescence moisture may be extracted from humid mine air which will aid in the consolidation of dust which may settle even after treatment with calcium chloride.

In Germany a Permanent Committee on Explosive Dusts has in 1976 recommended that hygroscopic salts such as calcium and magnesium chloride may be used to eliminate dust explosions in Coal Mines. Its use has subsequently been accepted by the Head Mining Office of North-Rhine-Westphalia⁴ as well as by the Head Mining Office of the Saar Territory and the Rhineland-Palatinate⁵. Because of the corrosive property of calcium chloride stone dusting is, however, still to be applied where a corrosion risk exists, such as at electric installations and switchgear. The recommendation also is not applicable to areas such as working faces, which by virtue of a mining activity in which water is used, are kept wet constantly. The calcium chloride may be applied as a liquid solution, paste, flakes or powder, not only to the footwall but also to side and hanging walls.

As calcium chloride is now locally available as a 32 per cent solution in water (Klipfontein Organic Products), its potential to consolidate footwall dust in a colliery was investigated.

TEST METHOD

A roadway of suitable length, which had not previously been treated with anything except water, was selected and its dimensions were recorded.

In order to simulate a relatively constant vehicular or pedestrian traffic three mine workers swept the footwall with brooms. Some intermittent pedestrian and vehicular traffic was encountered, though.

Two modified thermal precipitator dust sampling instruments were placed at the intake to, and three at the return air side from the test section and the difference in photoelectric readings (P.E.R.) was calculated to give a measure of the dust production over the test site. An average of 4 samples, each taken over a period of 10 minutes were taken of the intake and 6 of the return air.

The calcium chloride (concentrate or aqueous dilution thereof) was applied by means of a water cart fitted with sprays and hauled up and down the test site by a tractor. No mixing of the calcium chloride with the footwall dust was undertaken.

Dust conditions were assessed before treatment and at various times after treatment with solutions applied at an average rate of 228, 105 and 29 g/m².

RESULTS AND DISCUSSION

The results of the three tests performed, one on each of the different concentrations, are listed in Table 1.

Before application of calcium chloride

Extremely high dust concentrations were produced by the three mine workers sweeping, together with intermittent pedestrians and trackless vehicular traffic, as evidenced by the difference between the intake to and return air from the test site this being 192 and 195 for the first two tests.

After application of calcium chloride

The application of calcium chloride resulted in a very marked reduction of the dust produced by sweeping and by traffic. None, if any, dust was created as evidenced by an insignificant difference in dust concentration between the intake to and return air from the test site. The negative figures obtained may even suggest that some of the dust entering the test site settled and was also consolidated.

For the application rate of 228 g/m² the dust was still consolidated well, firm and damp even 162 days after the application of calcium chloride. However it required light watering down (fortnightly).

The medium rate of application (105 g/m²) still resulted in an acceptable consolidation of the footwall dust up to at least 99 days after treatment. However, the consolidated layer was breaking up at a number of places after this period.

Treatment of footwall dust at a rate of 29 g/m² was unsuccessful. An inspection after 28 days revealed that hardly any consolidation had occurred. The roadway was still dry and dusty. No dust measurements were therefore made.

These results clearly indicate that the effectiveness of the application of calcium chloride depends on the concentration used. Those given here may serve as guidelines only for mine personnel wishing to apply calcium chloride. Appropriate tests should be conducted first.

The results are in conformity with those reported by the German Permanent Committee on Explosive Dusts who maintain that areas with a low dust load will remain protected for months while areas with a high dust load may require monthly applications. Dust settling on the conglomerate is considered also to be quickly moistened and incorporated, thus reducing the chances of a dry dust layer of 0,1 mm to be formed, this being considered to suffice in the transmission of a coal dust explosion.

Rate of application (g/m ²)	Dust Concentration (P.E.R.)		Dust production by difference (P.E.R.)	Cost of treatment (c/m ²)	Remarks
	Intake	Return			
228	9	201	192	11,4	Before application of calcium chloride
	5	6	1		33 days after treatment.
	2	3	1		57 days after treatment. Roadway firmly consolidated, damp and in good condition.
	56	40	-16		162 days after treatment. Roadway still solid but required light watering down (fortnightly).
105	9	204	195	5,2	Before application of CaCl ₂
	3	5	2		44 days after treatment. Roadway firmly consolidated, damp and in good condition.
	42	27	-15		99 days after treatment. Roadway still well consolidated but surface breaking up at a few places.
29	—	—	—	1,5	Hardly any consolidation. After 28 days the roadway was still dry and dusty despite frequent watering (weekly).

TABLE 1

Concentrations (P.E.R. units) of airborne coal dust found before and at various times after the consolidation of footwall dust* using calcium chloride solutions in water.

*The thickness of the footwall dust layer varied between 5 and 10 mm.

The corrosive property of calcium chloride

It would be expected that the hygroscopic nature of calcium chloride and its acid reaction with water will cause accelerated corrosion of underground steel structures, tracks and haulage ropes. During tests conducted on gold mines in 1954 no evidence of corrosion had been found, though³. Furthermore, it has been considered unlikely that corrosion would be so severe as to affect significantly the service lives of underground machines or their components. Calcium chloride has been used for some years for melting ice on streets in winter and the corrosion problems encountered on the less robust underbodies of ordinary motor vehicles was overcome by the use of suitable paint systems and periodic washing down⁶.

CONCLUSIONS

The effectiveness of calcium chloride to consolidate footwall dust in a colliery has been demonstrated. Its effectiveness depended on the rate of application. Rates of 228 and even 105 g/m² were very successful, at the higher level even up to 162 days after application. An application rate of 29 g/m² proved to be unsuccessful. The cost of application (11.4 and 5.2 cents per square metre) compares favourably with that of "MULREX 925".

The conducting of appropriate tests in order to optimise the application rate of calcium chloride should lead to an effective system of consolidating footwall dust in colliery intake airways and roadways.

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VISIT TO PULLEN'S ENGINEERING WORKS

INTRODUCTION

On 24th March 1981, 30 members of the society visited Pullen's Engineering Works to observe fan repairs and motor rewinding. Mr. Gordon Pullen, Managing Director wel-