COOEE PRODUCTS

WIND TUNNEL TESTS FOR THE EVALUATION OF SELECTED SOLUTION STRENGTHS OF COOEE DUSTBLOC VENEER TO REDUCE DUST LIFT-OFF FROM THE SURFACE OF COAL STOCKPILES

CONDUCTED AT TUNRA BULK SOLIDS HANDLING RESEARCH ASSOCIATES, UNIVERSITY OF NEWCASTLE

INTROSPEC CONSULTING
A DIVISION OF INTROSPEC MARKETING SERVICES PTY. LTD ABN 54003420157

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Date: 7 June 2008

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DATE ISSUED: **7 June 2008**

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1. INTRODUCTION

This Report provides details of a series of laboratory wind tunnel tests conducted to determine the effectiveness of Cooee Dustbloc veneer treatment to reduce dust emission from the surface of coal stockpiles and the surface of coal transported by rail transport.

A typical coal type, regarded as being prone to dust lift-off under operational conditions, was selected for the test program. Although the performance may vary on other coal types, it is considered that the test program results can provide an indication of the potential performance of the product under Coal Industry operational conditions.

The tests were conducted in the laboratory of Tunra Bulk Solids Handling Research Associates (Tunra), University of Newcastle, and involve the use of a wind tunnel, shown in Figure 1, specifically designed for Introspec Consulting to simulate, as close as possible, typical stockpile and rail transport conditions.

To simulate typical stockpile adverse wind conditions the sample trays were exposed to a wind speed of 10 metres per second (36 km per hour).

To simulate typical rail transport adverse wind conditions the sample trays were exposed to a wind speed of 20 metres per second (72 km per hour).

Figure 1: Wind tunnel with two sample trays

2. TEST PROCEDURE

2.1 Coal Sample

A series of laboratory tests were previously conducted on the coal sample to determine the relationship between dustiness and moisture content and the dust extinction moisture level (DEM). The tests were conducted following the procedure detailed in Australian Standard AS 4156.6-2000, Coal Preparation Part 6: Determination of dust/moisture relationship for coal.

The coal sample was screened to remove any product greater than 6.3mm to represent the sizing most vulnerable to dust lift-off and to increase consistency in the relatively small sample trays.

2.2 Wind Tunnel Test Procedure for Stockpile Simulation

Two test trays 225mm x 150mm x 25mm deep, each containing the coal sample with different solution strength or application rate, were placed in the wind tunnel at an angle of 35 degrees, simulating the typical angle of repose of coal stockpiles at port terminals.

To simulate the typical stockpile moisture level an allowance was made in the pre-test sample moisture level for loss of moisture due to evaporation which is likely to occur during handling operations between arrival at the port and construction of the completed stockpile. It was assumed that a loss of moisture may occur from the average arrival moisture level giving a pre-test moisture level of 75% the DEM value previously determined.

To allow for loss of moisture by evaporation from the surface of the completed stockpile before application of surface treatment, each sample was oven pre-dried for a period of 60 minutes at 30-35ºC.

The surface of the samples was treated with Cooee Dustbloc dust suppressant at alternative solution strengths of 1:60, 1:50, 1:40 and 1:30, at an application rate of 1litre/m^2. The tests at all solution strengths were repeated as shown in Table 1.

The sample trays containing each product were placed in the wind tunnel for a period of 8 hours exposed to a wind speed of 10 metres/sec.

2.3 Wind Tunnel Test Procedure for Rail Transport Simulation

Two test trays 225mm x 150mm x 25mm deep, each containing the coal sample with different solution strength or application rate, were placed in the wind tunnel at an angle of 35 degrees, simulating typical angle of repose of coal in rail wagons.

To simulate the coal load moisture level an allowance was made in the pre-test sample moisture level for loss of moisture due to evaporation which is likely to occur during stockpiling operations at the mine prior to train loading. It was assumed that a loss of moisture may occur from the average pre-train loading moisture level giving a pre-test moisture level of 75% the DEM value previously determined.

To allow for loss of moisture by evaporation from the surface of the loaded coal, after application of surface treatment and during transport, each sample was oven pre-dried for a period of 60 minutes at 30-35ºC.

The surface of the samples was treated with Cooee Dustbloc dust suppressant at alternative dosage rates of 1:40 at an application rate of 0.5 litres per square metre, and 1:40, 1:30 and 1:20, at an application rate of 1 litre/m^2 as shown in Table 2.

There was some variation in prevailing weather conditions during the test period.

The sample trays containing the surface treated sample were placed in the wind tunnel for a period of 8 hours exposed to a wind speed of 20m/sec.

3 COOEE DUSTBLOC TEST RESULTS

3.1 Wind Tunnel Test Results from Stockpile Simulation

Table 1 provides results from the tests to show the mass of dust lift-off for different application scenarios and prevailing weather conditions.

Table 1 - Dust lift-off (grams) when Cooee Dustbloc solution was applied at various water : Cooee Dustbloc dosage ratios and various dosage rates, and exposed to a wind speed of 10 metres/second for eight hours

Treatment Dosage Ratio	Dosage Rate (litre/sq m)	Dust Lift Off (g)	Temperature (^{0}C)	Humidity (%)
40:1	0.5	0.0	18	52
40:1	1.0	0.0	18	52
60:1	0.5	0.0	24	66
80:1	0.5	2.8	24	66
80:1	1.0	0.0	24	66
100:1	1.0	1.9	24	66

3.2 Wind Tunnel Test Results from Rail Transport Simulation

Table 2 provides results from the tests to show the mass of dust lift-off for different application scenarios and prevailing weather conditions.

Table 2 - Dust lift-off (grams) when Cooee Dustbloc solution was applied at various water : Cooee Dustbloc dosage ratios and various dosage rates, and exposed to a wind speed of 20 metres/second for eight hours

Treatment Dosage Ratio	Dosage Rate (litre/sq m)	Dust Lift Off (g)	Temperature (^{0}C)	Humidity (%)
40:1	0.5	515.0	18	52
40:1	1.0	5.5	18	52
30:1	1.0	35.4	24	66
20:1	1.0	0.0	24	66

4 OBSERVATIONS

4.1 Test Program Weather Conditions

The wind tunnel test program was conducted under typical Newcastle autumn weather conditions, with relatively low temperatures and relatively high humidity as indicated in the tabulated test results.

The test procedure was adapted to more closely simulate typical summer conditions by pre-drying each sample for 60 minutes at a temperature of 30-35 degrees C. The pre-drying will to some extent offset the effect of the prevailing weather conditions.

4.2 Performance of Cooee Dustbloc under simulated coal stockpile test conditions

The coal type selected for the study has been observed to have a high dust emission tendency.

The tests indicated a consistent trend with increasing dust lift-off related to decreasing solution strength. Consistent results were observed when tests were conducted by repeating solution strengths of 1:60, 1:50, 1:40 and 1:30.

At a dosage rate of 1.0 litre per square metre dust lift-off was completely reduced to zero when the Cooee Dustbloc solution strength was 60:1.

At a dosage rate of 1.0 litre per square metre dust lift-off was completely reduced to zero when the Cooee Dustbloc solution strength was 80:1.

In an operational situation it is likely that a dosage rate of 1.0 litre per square metre dosage rate will achieve more effective surface penetration than a dosage rate of 0.5 litres per square metre.

Further laboratory tests and field trials could be conducted to explore the effectiveness of veneering for a broader range of coal types, for the effect of prevailing temperature conditions, and to investigate the potential impact of slip failures in the coal surface on the overall effectiveness in terms of dust control.

4.3 Performance of Cooee Dustbloc applied to typical coal surface under simulated rail transport test conditions

The coal type selected for the study has been observed to have a high dust emission tendency.

The tests indicated a generally consistent trend with reducing dust lift-off related to increasing solution strength. A high level of dust lift-off (515 grams) was recorded using a dosage ratio of 40:1 at a dosage rate of 0.5 litres per square metre. However the recorded dust lift-off using a dosage ratio of 40:1 decreased to 5.5 grams when the dosage rate was increased to 1.0 litre per square metre.

A third test, using a dosage rate of 1.0 litre per square metre at 30:1 dosage ratio recorded a dust lift-off of 35.4 grams. However the prevailing temperature was recorded as 24 degrees C compared with a temperature of 18 degrees C for the previous test.

The higher recorded dust lift-off (35.4 grams) at 30:1 dosage ratio compared with the lower recorded dust lift-off (5.5 grams) at 40:1 dosage ratio may be due to the temperature variation. These tests could be repeated to verify the assumption if required.

Dust lift-off was completely reduced to zero when the Cooee Dustbloc solution strength was increased to 20:1.

When the wind tunnel is operated at a wind speed of 20 m/s (72 k/h) a minor level of vibration is induced in the structure and the vibration is transferred to the test trays. This will to some extent simulate the effect of vibration transferred to the coal load in QR wagons during transport. This level of vibration was not observed to cause any slip failure in the contents of the sample trays at the typical coal angle of repose so the surface sealant remained intact for the test duration.

Further laboratory tests and field trials could be conducted to explore the effectiveness of veneering for a broader range of coal types, for the effect of prevailing temperature conditions, and to investigate the potential impact of slip failures in the coal surface on the overall effectiveness in terms of dust control.