Stone Dust Barrier

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1. Introduction

The recommended method of use of both the distributed and concentrated stone dust barriers is discussed in the following pages. It is recommended that the distributed barrier be used in bord-and-pillar mines. Both barrier systems can be used as alternatives to the available barrier systems if well designed, installed and maintained.

2. Concentrated barrier layout

The concentrated barrier can be used as an alternative barrier system especially for areas where high-speed development takes place, for example in longwall sections.

2.1 Loading

The loading of the barrier is defined by Cybulski[1] as:

Q_A - the quantity of

stone dust on the whole barrier per square metre of the gallery's cross-section (kg/m^2).

It is recommended that the stone dust quantity, Q_A, of at least 100 kg/m^2 of roadway area be used.

2.2 Spacing

<u>Spacing of bags</u>

The spacing of the bags should conform to the following minimum standards:

<u>Distance between bags in a row</u>

- not closer than 0,4 m
- not further than 1,0 m

<u>Distance between rows</u>

- not closer than 1,5 m
- not further than 3,0 m

Distance to sidewall of outer bags

- not nearer than 0,5 m
- not further than 1,0 m

Distance to roof

- not nearer than 0,5 m for seam heights greater than 3,5 m.

Height restrictions

The following are minimum requirements, i.e. if the mine wishes to install more levels of bags within the other specified requirements, it may do so.

- for roads with a height range of less than 3,0 m: a single level of bags suspended below the roof.

- for roads in the height range 3,0 m to 3,5 m: a single level of bags suspended at approximately 3,0 m height.

- for roads in the height range 3,5 m to 4,5 m: a double level of bags suspended at approximately at 3,0 m and 4,0 m above floor level.

- for roads in the height range of more than 4,5 m but less than 6,0 m: a triple level of bags suspended at approximately 3,0 m, 4,0 m and 5,0 m.

Spacing of barriers

- the first row of bags not closer than 70 m from the last through road, and not further than 120 m.

- the first row of bags of the second barrier not further than 120 m from the last row of bags of the other barrier.

Barrier length

- minimum distance of 20 m
- maximum distance of 40 m

2.3 Means of suspension

The use of steel structures suspended from the roof bolts by any suitable means is recommended. A suggested example is the use of a chain-and-angle-iron configuration suspended from the roof bolts, allowing height adjustment as necessary. Any other possible suspension method can be investigated.

2.4 Other measures

It is important that the following control checks be carried out on a routine basis:

* ensuring that the structures are intact
* replacing of damaged bags
* ensuring proper closure of bags
* ensuring that the stone dust inside the bags is dry
* ensuring that the bags are filled to their design specification.

The use of the closing mechanism and plastic bag is controlled to the extent that no bag may be used unless tested and found to be of adequate quality, strength and thickness, and tested to ensure the correct operating characteristics (should work effectively for a dynamic pressure of 5 kPa).

Routine sample checks at the manufacturers by Kloppersbos personnel are recommended to ensure the quality of stone dust bags and closing mechanisms.

2.5 Worked example

An example of a typical calculation for the concentrated barrier is as follows:

a) Distance from face:
Assume 100 m

b) Cross-sectional area:
Bord width = 6,5 m
Height = 3,5 m
Area = 22,75 m^2

c) Amount of stone dust required:

Q_A =22,75 m^2 x 100 kg/m^2

= 2 275 kg

d) Number of bags required:

6 kg/bag = 2 275/6

= 379,2 bags

Say : 380 bags

e) If the outer bags are 0,6 m from the side, 14 bags can be suspended per row. It is suggested that for this concentrated barrier, a double level of bags be used. The number of rows will thus be: 380 / 14 / 2 = 14 double levels.

f) Assuming the bags are spaced 2,0 m apart and that the last through road is the zero position, the barrier will be located from 100 - 126 m.

2.6 Operation

It is required that at least one fully constructed barrier be in position at all times, implying leap-frogging from the second barrier.

3. Distributed barrier layout

The layout of the distributed stone dust barrier will be discussed in greater detail here. The basis of the design is such that a greater area is safeguarded so that greater protection should be afforded against coal dust explosion propagation in bord-and-pillar mines.

3.1 Loading

Cybulski[1] defined the concentration of stone-dust (Q_v) as follows:

Q_V - the concentration of stone dust in the zone in which the barrier is situated, i.e. the quantity of stone dust on the whole barrier in relation to the volume of the working area which it occupies (kg/m^3).

It is recommended that the following criteria be met in designing the distributed barrier:

Q_A - regulatory requirement of at least 100 kg/m^2 of roadway area
Q_V - not less than 1 kg/m^3.

where the greater of the quantities must be used.

3.2 Spacing

Spacing of bags

The spacing of the bags should conform to the above stated minimum standards (see Section 2.2).

Spacing of individual barriers

- the first sub-barrier, closest to the face, not closer than 60 m from the last through road and not further than 120 m.
- the fourth sub-barrier, furthest from the face area, to be installed not more than 120 m from the first row of bags in the first sub-barrier.
- the two intermediate sub-barriers in between.

3.3 Means of suspension

As described previously (see Section 2.3).

3.4 Other measures

As described previously (see Section 4.1.4).

3.5 Worked example

An example of a typical calculation for the distributed barrier is as follows:

a) Distance from face:

Assume 100 m

b) Protection distance chosen: 100 m

c) Cross-sectional area:

Bord width	=	6,5 m
Height	=	3,5 m
Area	=	22,75 m^2

d) Volume of protection area=22,75 x 100

= 2 275 m^3

5) Amount of stone dust required:

Q_A = 22,75 m^2 x 100 kg/m^2

= 2 275 kg

Q_v = 2 275 m^3 x 1 kg/m^3

= 2 275 kg

f) Number of bags required:

6 kg/bag	=	2 275/6
	=	379,2 bags
Say	:	380 bags

g) For four sub-barriers: 380/4 = 95 bags/barrier

h) If the outer bags are 0,6 m from the side, 14 bags can be suspended per row, requiring seven rows of bags per sub-barrier. Assuming the bags are spaced 2,0 m apart and that the last through road is the zero position, the sub-barriers will be located as shown in Table 1.

Table 1 - Distributed barrier positions

Distance from last through road (m)	Description
0	Begin
100 - 112	First sub-barrier
130 - 142	Second sub-barrier
160 - 172	Third sub-barrier
190 - 202	Fourth sub-barrier

CHECK: (102 m x 22,75) x 1 kg/m^3 = 2 320,5 kg
98 bags x 4 x 6 kg = 2 352 kg

3.6 Operation

It is required that at least three fully constructed sub-barriers be in position at all times, implying leap-frogging from the fourth sub-barrier.