PROCESS FOR APPLYING ROCK DUST TO A MINE WALL

Rock dust is applied to a coal mine wall for mine fire suppression in combination with a chemical foam containing a saturated fatty acid, preferably stearic acid, which imparts hydrophobic properties to the rock dust particles, avoiding agglomeration. The rock dust and foam containing a saturated fatty acid are combined by causing the rock dust and foam to flow through separate conduits to a combiner from which the resulting mixture is caused to flow through a nozzle for application to the mine wall.
Fig. 5
PROCESS FOR APPLYING ROCK DUST TO A MINE WALL

FIELD OF THE INVENTION

[0001] This invention relates generally to coal mining, and more particularly to a process for applying rock dust to a mine wall for the purpose of suppressing mine fires and preventing explosions.

BACKGROUND OF THE INVENTION

[0002] In coal mining, it has been common practice to apply limestone in the form of a dust to the walls of a mine, thereby causing the limestone to adhere to the walls. The process, known as “rock dusting,” has two effects. First, because the limestone dust covers exposed surfaces of unmined coal, it prevents mine fires from being propagated along those exposed surfaces. Second, if methane, coal dust, or a mixture of methane and coal dust ignite in a mine causing an explosion, the rock dust adhering to the mine walls will become airborne, and suppress the propagation of fire resulting from the explosion.

[0003] The United States Mine Safety and Health Administration has established standards for rock dusting, which include a requirement that all exposed surfaces of a mine be covered with rock dust at least 80% of the content of which is non-combustible. Existing methods for applying rock dust include application of rock dust to a mine wall. Recently, mines have begun using chemical foam to achieve improved adhesion of the rock dust to mine surfaces. One method of using foam in rock dust application is to apply a dry mixture of rock dust and a foaming agent to a mine wall. Another method is to apply a mixture of foam and rock dust to a mine wall. In the last-mentioned method, the foam is formed, mixed with rock dust in a mixing vessel, and pumped through a conduit to the point of application. A system for utilizing foam to enhance the adhesion of rock dust to a mine wall is described in U.S. Pat. No. 6,726,849, granted Apr. 27, 2004.

[0004] One of the difficulties encountered in rock dusting of mines is that when the rock dust comes into contact with water, it tends to agglomerate, and lose its ability to inhibit coal dust explosions and to suppress mine fires. The fineness of the limestone dust also contributes to cohesion of the dust particles.

[0005] The problem of agglomeration of limestone dust particles has been recognized, and has been addressed by measures to impart hydrophobic properties to the limestone dust. To this end, there is now available for use in mine dusting, as well as in various other applications such as in polymer fillers, a limestone powder treated to make it hydrophobic in order to reduce its agglomeration potential. One successful method of treatment is to coat the limestone particles with stearic acid. Coating with stearic acid can be carried out by immersing the limestone dust in a solution of stearic acid and then drying the material. Alternatively, the limestone particles can be coated by exposing them to a stearic acid vapor. Other approaches, including coating the limestone particles with a silicone preparation to impart hydrophobic properties to the particles, have been used to avoid agglomeration.

[0006] The commercially available treated limestone dust, which is typically composed of at least approximately 95% calcium carbonate (CaCO₃), a small amount (typically less than 2%) of silica (SiO₂), and from about 0.5% to 1% stearic acid, CH₃(CH₂)₄COOH. This commercially available treated limestone, and other treated limestone products, are relatively expensive, and there is a need for a less expensive and efficient way to avoid agglomeration of rock dust used in mining applications.

SUMMARY OF THE INVENTION

[0007] The invention is a method and apparatus, different from those previously used. One difference, which allows a number of advantages to be realized, is that in the method according to the invention, rock dust and foam are combined at the point of application to the mine wall.

[0008] In accordance with one aspect of the invention, an apparatus for applying rock dust to a mine wall comprises first and second conduits. Means are provided for entraining rock dust in air in the first conduit, and means are provided for mixing a foamy liquid and air to produce a flowable foam, and for delivering the flowable foam through the second conduit. Means are also provided for combining rock dust and air taken from the first conduit with flowable foam taken from the second conduit. A nozzle connected to the combining means is provided for applying a mixture of air, rock dust and foam from the combining means to a mine wall.

[0009] In a preferred embodiment, the apparatus comprises the following interrelated elements. A vessel for temporarily containing rock dust is connected to receive rock dust from a supply thereof. A first source of compressed air is connected to the vessel, and a first conduit connected to the vessel is provided for carrying air, along with rock dust entrained therein, from the vessel. A first control means is provided for regulating the concentration of rock dust in the air carried by the first conduit. The apparatus also includes a mixing block for mixing a foamy liquid and air to produce a flowable foam. A pump, connected to a supply of foamy liquid and to the mixing block delivers the foamy liquid to the mixing block. A second source of compressed air is connected to the mixing block to supply air to the mixing block. A second control means is provided for independently controlling the rates at which foamy liquid and air are supplied to the mixing block. A second conduit is provided for carrying flowable foam from the mixing block to a Y-joint. The Y-joint has a first inlet connected to the first conduit for receiving rock dust and air, and a second inlet connected to the second conduit for receiving flowable foam. A mixture of air, rock dust and foam is delivered through an outlet of the Y-joint to a nozzle used to apply the mixture of air, rock dust and foam to a mine wall.

[0010] Various kinds of pumps can be used to deliver the foamy liquid to the mixing block. For example, the pump can be an air-driven pump connected to be driven by air from the second source of compressed air.

[0011] In another aspect, the invention is a method of applying rock dust to a mine wall. In accordance with the method rock dust is entrained in air in a first conduit. A foamy liquid and air are mixed to produce a flowable foam, which is delivered through a second conduit. The combination of rock dust and air from the first conduit and the flowable foam from said second conduit are combined in a Y-joint having an outlet. A mixture of rock dust, air and foam are thereby caused to flow through the outlet and applied through a nozzle to a mine wall.

[0012] The method and apparatus in accordance with the invention can utilize existing rock dust application equipment. The method and apparatus can also avoid the time-
consuming and difficult process of mixing of foam and rock dust in a mixing vessel and delivery of the mixture over long distances from the mixing tank to a mine wall. The method and apparatus are also superior to alternatives in which a dry composition of rock dust and foaming agent are applied to a wet mine.

Another aspect of the invention is a process for applying rock dust to a mine wall comprising mixing finely ground limestone powder with a foam containing a composition consisting of one or more saturated fatty acids to produce a resulting mixture of foam and limestone powder; and applying the resulting mixture to the wall of a coal mine. The concentration of the fatty acid composition in the foam, and the amount of foam mixed with the limestone powder, are preferably such that the ratio of grams of the composition consisting of one or more fatty acids to each kilogram of limestone powder in the mixture is in the range from approximately 1.74 to 3.48. This range is inclusive of the ratios 1.74 to 3.48.

Although the fatty acid composition can come into contact with the limestone at any stage of the process, preferably the limestone powder and foam containing the fatty acid composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which the resulting mixture is caused to flow through a nozzle for application to the wall of a coal mine.

Steatic acid is preferred as the fatty acid composition because it is inexpensive and readily available. However, good results can be achieved using related compositions such as palmitic acid or arachidic acid. Comparable results can also be achieved with other related saturated fatty acids, and of course combinations of two or more different saturated fatty acids can be utilized.

Further advantages of the invention will be apparent from the following description when read in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of an apparatus in accordance with the invention;

FIG. 2 is a more detailed schematic diagram of the dry rock dust entrainment apparatus which constitutes a component of the apparatus of FIG. 1;

FIG. 3 is a more detailed schematic diagram of the foam/air mixing device which constitutes a component of the apparatus of FIG. 1;

FIG. 4 is a detailed schematic diagram of the Y-joint nozzle structure for application of a foam and rock dust mixture to a mine surface; and

FIG. 5 is a graph depicting the results of flotation tests on limestone particles treated with varying quantities of foam containing stearic acid.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the apparatus shown in FIG. 1, compressed air is supplied through a first line 10 and through a second line 12. The compressed air can be supplied by a single compressor or by plural compressors. For the purpose of this description, line 10 and line 12 will be referred to respectively as "first and second" sources of compressed air even if they both derive air from the same compressor.

The first source is connected to a rock dust system 14, which is a known apparatus designed to draw rock dust from a supply, entrain the rock dust in air, and deliver the air-entrained rock dust through a long, flexible, conduit to an applicant site within a mine, where the rock dust is sprayed onto a mine wall.

Details of the rock dust system 14 are shown in FIG. 2. The system comprises an enclosed vessel 16 in the form of a horizontally elongated, enclosed, cylindrical tank, which can be pressurized. A quantity of rock dust 18 is brought into the tank through a batcher (not shown) from a supply, usually above-ground. For compliance with U.S. Department of Labor regulation 30 C.F.R. §75.2, the rock dust used in the tank should consist of “pulverized limestone, dolomite, gypsum, anhydrite, shale, adobe or other inert material, preferably light colored, 100 percent of which will pass through a sieve having 20 meshes per linear inch, the particles of which when wetted and dried will not cohere to form a cake which will not be dispersed into separate particles by a light blast of air, and which does not contain more than 5 percent combustible matter or more than a total of 4 percent free and combined silica (SiO₂), or, where the Secretary finds that such silica concentrations are not available, which does not contain more than 5% percent of free and combined silica.”

The supply of rock dust 18 in tank 16 rests on a diffuser 20, typically a layer of cloth, below which an air chamber 22 is formed. The air chamber 22 receives air from air line 10. In an embodiment having two or more air chambers in side-by-side relationship, a diverting valve 24 can be used to divide the air flow so that each of the air chambers receives an adequate supply of air.

The air passes up through the diffuser (or through plural diffusers if more than one diffuser are provided), into the rock dust 18, causing the rock dust to take the form of a fluidized bed, from which rock dust can be drawn through a dip pipe 26, which extends into the fluidized bed to a location a short distance above the diffuser. The dip pipe leads to modulating valve 28 located outside the tank. Through a conduit 30, the modulating valve receives compressed air derived from the space 32 inside the tank above the fluidized bed. In the modulating valve 28, the rock dust flowing through the dip tube 26 is entrained from the air conduit 30, and the mixture of air and rock dust is carried away from the modulating valve through a first conduit 32, also shown in FIG. 1.

The modulating valve includes a flexible diaphragm 34, forming a part of the wall of a mixing chamber 36, through which air flows from conduit 30 past the outlet of dip pipe 26. A stem 38 that extends through and moves with diaphragm 34 has a poppet 40 at one end, arranged to regulate flow of air and rock dust from dip pipe 26 into the mixing chamber 36. The stem also extends through a wall 42 and is connected to an operating diaphragm 44 that separates the space between wall 42 and a cover 46 into two control chambers 48 and 50. A spring 52 urges the operating diaphragm in the direction to close the poppet 40.

A valve 54 in conduit 30 is controllable to restrict the flow of air through the conduit. On the upstream side of the valve 54, the conduit 30 is connected through a tube 56 to control chamber 50, and on the downstream side, the conduit is connected through a tube 58 to control chamber 48.

The restriction of air flow by valve 54 causes a pressure drop which in turn creates a pressure differential across the operating diaphragm 44 in the modulating valve, thereby allowing the amount of dust delivered through condu-
duit 32 to be controlled. When the aperture of valve 54 is reduced, the pressure differential across the operating dia-
phragm 44 cause the poppet 40 to move in the opening direc-
tion, increasing the rate of flow of dust and air from dip tube
26 into the mixing chamber 36. At the same time, the reduc-
tion of the aperture of valve 54 reduces the flow of air into the
mixing chamber through conduit 30. The result is that the rate
of flow of rock dust exiting through conduit 32 increases
while the air flows through conduit 32 at a relatively steady
rate. Thus, the valve 54 can be used to control the concentra-
tion of rock dust delivered through conduit 32.

[00030] Referring again to FIG. 1, the air in line 12 is split
into two flow paths, one passing through a ball valve 60 to
an air motor 62, which operates a high pressure hydraulic pump
68, arranged to deliver a foamy liquid from a supply line 70
to a line 72, which leads to a mixing block 74. Exhaust air
from the air motor 62 passes to the atmosphere through line
76. A pressure gauge 78 is provided for monitoring the pres-
ture of foamy liquid delivered to the mixing block through line
72. Valve 60 can be used to control the flow of foamy liquid
though line 72.

[00031] The other path into which air from line 12 is split
comprises line 80, another ball valve 82, and a check valve
84, the outlet of which is connected to deliver air to the mixing
block 74. Valve 82 can control the air to the mixing block. A
pressure gauge 86 is provided to monitor the air pressure in
the air path leading to the mixing block.

[00032] As shown in FIG. 3, the mixing block 74 comprises
a metal block having internal passages. Compressed air deliv-
ered through check valve 84 (FIG. 1) enters the block though
an opening 88 and diluted foam concentrate, delivered as a
liquid by pump 68 through line 72, enters the block through
opening 90. The diluted foam concentrate flows through pas-
sage 92 and restriction 94 into a mixing chamber 96 having an
outlet 98. Compressed air flows through passage 100 and into
the mixing chamber 96 through a restricted passage 102,
which meets the side of mixing chamber 96 so that the flow of
compressed air into mixing chamber 96 is perpendicular to
the direction of flow of the liquid foam concentrate. Turbu-
ulence in the mixing chamber produces the foam that is deliv-
ered through outlet 98. The mixing block regulates the flow of
diluted foam concentrate and compressed air to maintain proper
proportions.

[00033] Referring again to FIG. 1, the outlet of the mixing
block is connected through a conduit 104 to a Y-joint 106, in
which foam in conduit 104 and rock dust entrained in air in
conduit 32 are mixed.

[00034] As shown in FIG. 4, the Y-joint 106 comprises a
coupling 108 for connection to rock dust conduit 32, and a
side inlet 110 for connection to the foam conduit 104. The
side inlet 110 delivers the foam into an elongated interior
chamber 112 aligned with the coupling 108. The foam and
rock dust are mixed in chamber 112, and the mixture is
delivered through a discharge nozzle 114 at the end of cham-
ber 112 remote from coupling 108.

[00035] All or parts of the rock dust conduit 32 and the foam
conduit 104 can be flexible, allowing an operator to aim the
nozzle for application of a foam and rock dust mixture to a
mine surface.

[00036] The foamy liquid delivered to pump 68 through
line 70 (FIG. 1) can be prepared by dilution of a foam con-
centrate with water. A suitable foam concentrate is composed
of an anionic surfactant and a carboxylic acid salt, described
in U.S. Pat. No. 4,874,641, granted Oct. 17, 1989, the discl-
 sure of which is here incorporated by reference. The foam
exhibits a high degree of stiffness and longevity, making it
especially suitable for application along with rock dust to a
mine surface. Optionally, a quantity of a thickener such as
hydroxypropylmethylcellulose to the foam concentrate can
be added to increase foam stability and increase foam vol-
ume.

[00037] An example of a suitable foam concentrate
described in U.S. Pat. No. 4,874,641 is one composed of 4% by weight sodium olein sulfonate (100% active basis),
3.6% by weight stearic acid (100% active basis), 0.71% by
weight potassium hydroxide, and 91.69% by weight, water.
Any of the compositions described in U.S. Pat. No. 4,874,
641, as well as many other known foaming compositions, can
be used. The foam concentrate can be diluted with water to a
ratio as high as approximately 10:1.

[00038] Another foam concentrate that can be used is one
composed of 4% by weight sodium olein sulfonate (100% active
basis), 5% by weight stearic acid (100% active basis),
0.71% by weight potassium hydroxide, and 90.29% by
weight, water. This concentrate can be utilized effectively at
dilution ratios (water to concentrate) up to about 10:1. Signi-
ificantly lower dilution ratios can be used, but reducing the
dilution ratio below 7:1 has little if any beneficial effect, and
can increase operating costs unnecessarily.

[00039] As mentioned above, the function of the mixing
block is to maintain proper proportions of the diluted foam
concentrate and compressed air. In the case of a diluted foam
concentrate having the composition described above, a desir-
able proportion is from 2.75 to 3 cubic feet of compressed air
(at approximately 100 psi) for each gallon of liquid. The
apertures of the restrictions in the mixing block are chosen
accordingly. The sizes of the apertures, of course, also affect
the rate of foam delivery.

[00040] In the operation of the apparatus of FIG. 1, foam
generated in the mixing block is carried to the point of appli-
cation to a mine surface by conduit 104 while rock dust
entrained in air is carried to the point of application by conduit
32. The foam, rock dust, and air are combined in the Y-joint
106, and sprayed onto the mine surface by nozzle 114. The
Y-joint/nozzle assembly can be hand-held, or moved by
robotic machinery.

[00041] The concentration of rock dust in air in conduit 32
is controlled by valve 54 (FIG. 2) and regulated by the opere-
tion of the modulating valve 28.

[00042] The proportion of foam to rock dust can vary con-
siderably, and will depend to a large extent on the personal
preference of the individual who carries the nozzle and
applies the foam/rock dust mixture to a mine wall. In general,
if the mixture contains too much rock dust, excessive amounts
of fugitive rock dust can become airborne. On the other hand,
if excessive amounts of foam are used, there is not only waste
of foam producing chemical, but the amount of rock dust may
be insufficient to achieve the desired fire-suppressing effect.

[00043] A number of foam/rock dust compositions were
produced using a foam concentrate containing 5% stearic
acid, diluted with 8 parts of water to 1 part concentrate. The
wet weight of the foam/rock dust composition varied from
21.78 to 69.5 L/bf³. The water content (by weight) and the air
tcontent (by volume) of the several compositions are shown in
the following table. The increasing weight of the samples
corresponds to increased rock dust content, the rock dust by
itself having a density of 90 L/bf³.
Samples 2-10 yielded satisfactory results, and sample 5, having a wet weight of 35.29 Lb/ft³ was considered to produce the best results. Sample 1 contained too much water and samples 11-13 had too high a rock dust to water ratio. It was observed that a higher air content produced a lighter, and more readily dispersed, mixture. For that reason, an air content of at least approximately 40% by volume is preferred. The apparatus and method of the invention produce results in common with prior methods that utilize foams in combination with rock dust. For example, fugitive dust is significantly reduced, and the foamed rock dust encapsulates coal dust particles. The invention, however, has additional advantages. As mentioned above, conventional rock dust application equipment, e.g., the apparatus shown in FIG. 2, can be utilized in the practice of the invention, so that high volumes of rock dust/foam mixture can be applied to mine surfaces easily, rapidly, and efficiently. Since mixing of the rock dust and foam takes place immediately upstream of the application nozzle, it is unnecessary to carry out the mixing of foam and rock dust as a batch process utilizing a mixing vessel. The method and apparatus can provide for delivery of the rock dust and foam to the vicinity of the application nozzle through flexible hoses over relatively long distances, so that movement of the foam generating and rock dust entrainment equipment can be minimized. Still another advantage of the invention lies in its ability to allow the operator to make adjustments of the foam/rock dust composition and density rapidly, and while at the application site in a mine, in order to meet existing conditions.

Further experiments were carried out to determine the effectiveness of the stearic acid component of the foam in imparting hydrophobic properties to limestone particles. In these experiments, limestone dust samples were prepared by obtaining commercially available pre-screened limestone, sized specifically for mine wall application. The dust particles were then mixed with a diluted foam concentrate corresponding closely to one of the foam concentrates described above, namely, the one composed of approximately 4% by weight sodium α-olefin sulfonate (100% active basis), approximately 5% by weight stearic acid (100% active basis), approximately 0.71% by weight potassium hydroxide, and the remainder water. The coated dust particles were then dried in an oven at 200°F and then screened to yield dust particles in a size range from 200 to 100 US mesh.

Weighed samples of the dried and screened coated dust particles were then subjected to a flotation test by sprinkling the material onto the surface of a quantity of water, and the amount that fell to the bottom was dried and weighed.

In an exemplary experiment, the foam concentrate was diluted 7:1 with water and mixed with a quantity of limestone particles as set forth in the following table:

<table>
<thead>
<tr>
<th>Sample</th>
<th>Lb/ft³ (wet)</th>
<th>% water</th>
<th>% air</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21.78</td>
<td>37.35</td>
<td>84.74</td>
</tr>
<tr>
<td>2</td>
<td>31.18</td>
<td>22.88</td>
<td>73.28</td>
</tr>
<tr>
<td>3</td>
<td>33.29</td>
<td>15.8</td>
<td>84.86</td>
</tr>
<tr>
<td>4</td>
<td>35.07</td>
<td>25.27</td>
<td>70.88</td>
</tr>
<tr>
<td>5</td>
<td>35.29</td>
<td>21.7</td>
<td>69.3</td>
</tr>
<tr>
<td>6</td>
<td>40.84</td>
<td>19.48</td>
<td>63.46</td>
</tr>
<tr>
<td>7</td>
<td>42.9</td>
<td>18.69</td>
<td>61.21</td>
</tr>
<tr>
<td>8</td>
<td>54.28</td>
<td>13.38</td>
<td>67.72</td>
</tr>
<tr>
<td>9</td>
<td>54.39</td>
<td>11.99</td>
<td>61.82</td>
</tr>
<tr>
<td>10</td>
<td>55.72</td>
<td>11.98</td>
<td>58.51</td>
</tr>
<tr>
<td>11</td>
<td>57.15</td>
<td>12.13</td>
<td>44.2</td>
</tr>
<tr>
<td>12</td>
<td>61.05</td>
<td>11.19</td>
<td>29.76</td>
</tr>
<tr>
<td>13</td>
<td>69.3</td>
<td>9.58</td>
<td>30.18</td>
</tr>
</tbody>
</table>

The graph in FIG. 5 shows the percentage of each sample that remained on the surface of the water on a dry weight basis. From the graph it can be seen that four of the samples exhibited a flotation ratio of 93% or higher, and were evaluated as having satisfactory hydrophobic properties.

The satisfactory samples were derived from a mixture in which the calculated weight % of stearic acid in the diluted foam concentrate was in the range from approximately 0.17 to 0.34. Outside this range, the percentage of particles that remained afloat after a short time fell off rapidly. Accordingly, based on the exemplary test described above and similar tests, it was determined that the useful range for the ratio of grams of stearic acid to a kilogram of limestone particles in the mixture of foam and limestone particles was in the range of approximately 1.74 to 3.48.

Similar results can be achieved using saturated fatty acids closely related to stearic acid, such as palmitic acid, CH₁₇(CH₂)₁₆COOH, and arachidic acid CH₂₀(CH₂)₁₇COOH in a foam composition. Moreover, hydrophobic properties can be imparted to limestone dust by treating them with other saturated fatty acids in the same family, such as caprylic acid CH₁₀(CH₂)₄COOH, capric acid CH₁₀(CH₂)₈COOH, lauric acid CH₁₂(CH₂)₁₀COOH, myristic acid CH₁₄(CH₂)₉COOH, behenic acid CH₂₀(CH₂)₁₂COOH, lignoceric acid CH₁₇(CH₂)₂₀COOH, and serotic acid CH₁₇(CH₂)₂₂COOH. Stearic acid is preferred, however, primarily because it is inexpensive and readily available.

What is claimed is:

1. A process for applying rock dust to a mine wall comprising:
   - mixing finely ground limestone powder with a foam containing a composition consisting of one or more saturated fatty acids to produce a resulting mixture of foam and limestone powder; and
   - applying the resulting mixture to the wall of a coal mine.
2. The process according to claim 1, wherein the concentration of said composition in the foam and the amount of
foam mixed with the limestone powder are such that the ratio of grams of said composition per kilogram of limestone powder in said mixture is in the range of approximately 1.74 to 3.48.

3. The process according to claim 1, wherein the limestone powder and foam containing said composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which said resulting mixture is caused to flow through a nozzle for application to said wall of a coal mine.

4. The process according to claim 1, wherein the concentration of said composition in the foam and the amount of foam mixed with the limestone powder are such that the ratio of grams of said composition per kilogram of limestone powder in said mixture is in the range of approximately 1.74 to 3.48, and wherein the limestone powder and foam containing said composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which said resulting mixture is caused to flow through a nozzle for application to said wall of a coal mine.

5. The process according to claim 1, wherein said one or more saturated fatty acids are from the group consisting of palmitic acid, stearic acid, and arachidic acid.

6. The process according to claim 5, wherein the concentration of said composition in the foam and the amount of foam mixed with the limestone powder are such that the ratio of grams of said composition per kilogram of limestone powder in said mixture is in the range of approximately 1.74 to 3.48.

7. The process according to claim 5, wherein the limestone powder and foam containing said composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which said resulting mixture is caused to flow through a nozzle for application to said wall of a coal mine.

8. The process according to claim 5, wherein the concentration of said composition in the foam and the amount of foam mixed with the limestone powder are such that the ratio of grams of said composition per kilogram of limestone powder in said mixture is in the range of approximately 1.74 to 3.48, and wherein the limestone powder and foam containing said composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which said resulting mixture is caused to flow through a nozzle for application to said wall of a coal mine.

9. The process according to claim 1, wherein said composition is stearic acid.

10. The process according to claim 9, wherein the concentration of said composition in the foam and the amount of foam mixed with the limestone powder are such that the ratio of grams of said composition per kilogram of limestone powder in said mixture is in the range of approximately 1.74 to 3.48.

11. The process according to claim 9, wherein the limestone powder and foam containing said composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which said resulting mixture is caused to flow through a nozzle for application to said wall of a coal mine.

12. The process according to claim 9, wherein the concentration of said composition in the foam and the amount of foam mixed with the limestone powder are such that the ratio of grams of said composition per kilogram of limestone powder in said mixture is in the range of approximately 1.74 to 3.48, and wherein the limestone powder and foam containing said composition are combined by causing the limestone powder and foam to flow through separate conduits to a combiner from which said resulting mixture is caused to flow through a nozzle for application to said wall of a coal mine.

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