MSHA Docket Number MSHA-2014-0029
Request for Information to Improve the Health and Safety of
Miners and To Prevent Accidents in Underground Coal Mines

Section C. Rock Dust

17. What specific tests should be performed to monitor the quality of rock dust to assure that the rock dust will effectively suppress an explosion in the mine environment?

C.17.
Test 1) Particle size analysis via air-jet sieve
ASTM C110-10 or equivalent - Standard Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone, *Section 18. Dry Screening of Hydrated Lime, Pulverized Quicklime, and Limestone by Air Jet Sieving.*

Test 2) *Gravimetric Method for Determining Incombustible Content for Dust Samples*, Method Number MH-102, Dated 03/24/2003, method attached.

18. What materials produce the most effective rock dust?

C.18.
Limestone is the most common and cost-effective material used as rock dust

19. What are the advantages, disadvantages, impact on miner health and safety, and costs of limiting rock dust to light-colored inert materials, such as limestone and dolomite?

C.19.
Advantages: Improve illumination in the mine; MSHA inspectors will be able to visible see where rock dust has been applied and where more rock dust needs to be applied.
Disadvantages: Costs 2x more than darker-colored rock dust
Impact: No impact on miner health; miner safety should be improved as miners may have increased visibility down hole.
Costs: Example only - Dark-colored rock dust: $15/ton Light-color rock dust: $30/ton
Light-color will increase cost of rock dust by a factor of 2x

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20. Please provide information on the types of impurities that could degrade rock dust performance. What tests or methods can be used to detect the presence of impurities?

C.20.
Tests: Combustible matter greater than 1% (w/w) using test method MH-102, method attached. Limestone rock dust contains < 1% combustible matter (unless the material is contaminated or blended with other materials)

ASTM D7348-13, Standard Test Method for Loss on Ignition (LOI) of Solid Combustible Residues

21. **What particle size distribution for rock dust would most effectively inert coal dust?**
What should be the maximum particle size?
What should be the minimum particle size?
Please explain and provide the rationale for your answer.

C.21.
Recommend maintaining the existing rock dust sizes, as listed in 30 CFR § 75.2:
Minimum 100% passing a No. 20 mesh sieve
Minimum 70% passing a No. 200 mesh sieve

Suggest MSHA discuss this topic with NIOSH Office of Mine Safety and Health Research (OMSHR)... Current rock dust definition 30 CFR § 75.2 allows for all sorts of particle size distributions and no definition of amount of fines (i.e., respirable dust < 10 microns). Coarse material is easy to remove from the rock dust (via sieving/screening). Fine material is not easy to remove and will require extra processing, adding significant increased costs. The level of fines in rock dust are a function of the grinding (or other processing methods) plus the softness of the limestone and/or whether excess fines (such as from de-dusting operations) have been added to the product. All extra processing will add cost to the rock dust and may affect product availability in some regions.

22. Determination of fine particle size of rock dust by sieving may be complicated by static agglomeration. What test methods should be used to measure the size distribution of rock dust to ensure consistent quality?
What are the advantages, disadvantages, and costs of these test methods?

C.22.
Use an air jet sieve
ASTM C110-10 Standard Test Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone, *Section 18. Dry Screening of Hydrated Lime, Pulverized Quicklime, and Limestone by Air Jet Sieving*
Advantages: consistent, reliable, and accurate
Disadvantages: Expensive, one-time cost for equipment

Costs: $8000/each... *http://www.hmicronpowder.com/products/other-lab-equipment/micron-air-jet-sieve*

23. How can the potential of rock dust to cake be minimized? Are objective and practical tests available to determine the caking potential of rock dust? If so, please explain and provide documentation.

C.23.
By rending the rock dust hydrophobic via a surface treatment.
Test Methods available include:

1) 24-hr water wicking test (NIOSH OMSHR method attached)
2) Dispersion chamber test (NIOSH OMSHR test)
3) Brookfield Powder Flow Tester (*http://www.brookfieldengineering.com/products/pft/powder-flow-tester.asp*)
4) Dust View Tester (*http://www.palas.de/file/xn828/application/pdf/product+brochure+DustView+II+-+dust+measurement+device.pdf*)

24. Please provide information on how fine particles (less than 10 micron) may increase the likelihood of caking in rock dust.

C.24.
The finer particles in rock dust, by virtue of enhanced particle-particle interactions, have a tendency to agglomerate. Polar particles, such as limestone, have dipole-dipole attractive forces as well as Van der Waals forces. As the limestone particles get finer, these attractive forces increase. When moisture is present and the limestone is wetted, the fine particles stick together. If the limestone is then dried, the fine particles form a cake. Treating the surface of the particles can prevent this potential to cake.

25. Can rock dust be treated with additives that would reduce caking?
Would the additive enhance or diminish the ability of the rock dust particles to quench a coal dust explosion and, therefore, impact the effectiveness of the rock dust to inert coal dust?
Please provide information on the chemical composition of any suggested additives, the quantities needed, costs, and potential impact on miner health and safety.
If available, what areas of an underground coal mine would need to be treated with non-caking rock dust?
Please explain and provide the rationale for your answer.

C.25.
Yes, rock dust can be treated with specific additives to render the rock dust hydrophobic.
Once the rock dust is hydrophobic, it will not cake in the presence of water, therefore, making it more readily available to quench an explosion. Hydrophobic rock dust improves the effectiveness of rock dust

to inert an explosion. Suggest MSHA discuss this topic with NIOSH Office of Mine Safety and Health Research (OMSHR).

Chemical composition of additives: Chain compounds with a combination of surface reactive and non-polar, hydrophobic sites. May include carboxylic acids with a long, aliphatic tail or organic compounds containing carbon-silicon bonds.
Quantities needed: less than 2% by weight
Costs: up to 2x current cost of conventional, untreated rock dust
Impact on miner health: no impact at additive levels used
Impact on miner safety: increases safety of miners as treated rock dust performs better at inerting an explosion

26. Applied rock dust must be dispersible to inert an explosion. What in-mine tests can be used to determine the caking resistance (i.e., dispersibility) of applied rock dust?

C.26.
24-hr water wicking test (NIOSH OMSHR method attached)

27. How does combustible material degrade the performance of rock dust?
How should MSHA modify the existing specification in the definition of rock dust?
Please explain and provide documentation.

C.27.
One wants to minimize the level of combustible material, in general, in a coal mine. If your rock dust is bringing more combustible material into the mine, this is not a good thing.

MSHA should modify the existing spec as follows: Limit the level of combustible material in rock dust to 1% maximum.

28. How should MSHA modify the existing requirement for free and combined silica in the definition of rock dust? Please explain and provide documentation.

C.28.
The current requirement of max. 4% (w/w) silica is sufficient.

29. How can the respirable particle size fraction of rock dust, i.e., less than 10 micron be limited while maintaining the effectiveness of the dust to suppress the propagation of a coal dust explosion? Please explain.

C.29.

It can't. NIOSH OMSHR has shown that rock dust needs a minimum amount of <10 micron particles to effectively inert an explosion. If you remove this so-called "respirable dust" fraction from the rock dust, the rock dust will not effectively inert an explosion.

A hydrophobic rock dust, when applied as a slurry, may reduce airborne coal dust without reducing the effectiveness of the rock dust.