SPONTANEOUS COMBUSTION IN COAL

How Coal Self-Ignites?

The coal's temperature begins to climb above ambient. At about 150-300 degrees F, it begins to give off minute, but measurable, quantities of gas--aerosols, hydrogen, and CO (2)--precursors of combustion. As the temperature increases further--at about 600-700 degrees F--relatively, large, visible particulates are emitted. Soon, as the heating rate increases in intensity to about 750-800 degrees F, incipient combustion, and ultimately self-ignition and flame, will occur.

The risk from fire exists anywhere significant amounts of coal are in use or storage. Coal is a combustible material, making it susceptible to a variety of ignition scenarios. Preventing spontaneous combustion coal fires involves attention to many different factors. Among the most critical are the type, age, and composition of coal, how it is stored, and how it is used. Given the right kind of coal, oxygen, and a certain temperature and moisture content, coal will burn by itself.

Spontaneous combustion has long been recognized as a fire hazard in stored coal. Spontaneous combustion fires usually begin as "hot spots" deep within the reserve of coal. The hot spots appear when coal absorbs oxygen from the air. Heat generated by the oxidation then initiated the fire.

Such fires can be very stubborn to extinguish because of the amount of coal involved (often hundreds of tons) and the difficulty of getting to the seat of the problem. Moreover, coal in either the smoldering of flaming stage may produce copious amounts of methane and carbon monoxide gases. In addition to their toxicity, these gases are highly explosive in certain concentrations, and can further complicate efforts to fight this

Type of coal fire.

Even the most universal firefighting substance, water, cannot be used indiscriminately. Because of the remote possibility of a steam explosion, it is advisable that water be applied carefully and from a safe distance. Certain chemicals such as carbon dioxide or nitrogen may mitigate fire effects, but their use has had mixed success from a DOE perspective. The above information suggests that coal fires require awareness and prior planning to extinguish efficiently, completely, and safely.

Causes of Spontaneous Coal Fires

The following general factors have been mentioned as contributing causes:

1. Coal handling procedures allowed for long-time retention of coal, which increases the possibility of heating.

2. New coal added on top of old coal created segregation of particle sizes, which is a major cause of heating.

3. Too few temperature probes installed in the coal bunker resulted in an excessive period of time before the fire was detected.

4. Failure of equipment needed to fight the fire (drag chain conveyer).

5. Ineffective capability and use of carbon dioxide fire suppression system.

6. Delay in the application of water.

7. Inadequate policies, procedures, and training of personnel prevented proper decision making, including the required knowledge to immediately attack the fire.

Preventing Spontaneous Combustion in Stored Coal

Hugh quantities of coal are stored in bunkers, silos, hoppers and open air stockpiles. How susceptible such stocks of coal are to fire from spontaneous combustion depends on a number of factors, from how new the coal is to how it is piled.

Recommendations:

Know your coal. Anthracite (sometimes called eastern coal) has high carbon content and is much less combustible than low oxygen content bituminous (or western) coal. Freshly mined coal absorbs oxygen more quickly than coal mined at an earlier time, and is more likely to head spontaneously.

1. Storing coal with low sulphur content is helpful. Sulphur compounds in coal liberate considerable heat as they oxidize.

2. Air circulating within a coal pile should be restricted as it contributes to heating; compacting helps seal air out.

3. Moisture in coal contributes to spontaneous heating because it assists the oxidation process. Moisture content should be limited to 3 percent; sulphur content should be limited to 1 percent, "as mined." Coal having high moisture content should be segregated and used as quickly as possible. Efforts should be made to keep stored coal from being exposed to moisture.

4. Following the "first in, first out" rule of using stock reduces the chance for hot spots by helping preclude heat buildup for portions of stock which remain undisturbed for a long term. The design of coal storage bins is important in this regard.

5. A high ambient temperature aids the spontaneous heating process.

6. Use coal as quickly as practicable. The longer large coal piles are allowed to sit, the more time the spontaneous process has to work.

7. The shape and composition of open stockpiles can help prevent fires. Dumping coal into a big pile with a trestle or grab bucket can lead to problems. Rather, coal should be packed in horizontal layers (opinions range from 1 1/2' to 3' high) which are then leveled by scraping and compacted by rolling. This method helps distribute the coal evenly and thus avoids breakage and segregation

of fine coal. Segregation of coal particles by size should be strenuously avoided, as it may allow more air to enter the pile and subsequent heating of finer sizes.

8. The height of the coal pile is also important. Limit un-layered, un-compacted high grade coal to a height of 15' (10' for low grade coal); maximum height is 26' for layered and packed coal.

9. Properly inspect, test and maintain installed fire protection equipment.

10. Maintain an updated pre-fire plan and encourage regular visits to coal facilities by the site or local emergency response force.

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