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Marine Newslink

August 2019

FEATURE ARTICLE
Spontaneous Combustion

PHOTO(S) OF THE MONTH
Fire in Coal Stockyard

BACK TO BASICS
Question of the Month

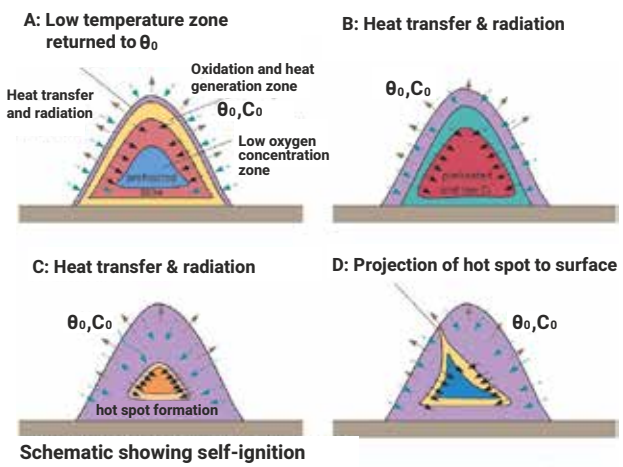
SPONTANEOUS COMBUSTION

Spontaneous combustion of coal is a major concern at every coal stockyard. As coal is the primary fuel for a thermal power plant, adequate precautions are required for its proper handling and storage. It becomes more important because of related safety and environmental implications of spontaneous combustion of coal. The problem is an inherent phenomenon that is aggravated by improper handling & storage of coal. The costs involved due to the energy and quantity loss of coal as an outcome of self-combustion can be considerable. Also accelerated weathering due to prolonged self-heating leads to loss of the gross calorific value of coal.

Spontaneous combustion of coal is the process of self-heating resulting eventually in its ignition without the application of any external source. Coal when exposed to air absorbs oxygen over the uncovered surface. Some fraction of the exposed coal substance absorbs oxygen at a faster rate than others and the oxidation results in the formation of gases; mainly CO, CO^2, water vapor along with the evolution of heat during the chemical reaction. If the rate of dissipation of heat is slower than the evolution of heat by oxidation there is a gradual build-up of heat and the temperature reaches the ignition point of coal thereby causing fire.

Major problems are usually associated with the stockpiling of coal or waste dumps containing rejected coal material, in unconsolidated heaps where oxygen can come in contact with the coal and heat cannot dissipate. The problem is compounded when rainfall causes erosion, thereby progressively exposing more coal to the oxygen in the atmosphere.

Favourable conditions for spontaneous heating are accumulation of heat caused by a rise in temperature and hence an increase in the reaction rate.



Schematic showing self-ignition of a coal stockpile

The most important parameters involved in the process of spontaneous combustion of coal are:

Factors inherent to coal:

- Size of the coal particles and surface area
- Moisture content
- Coal composition, quality and rank of coal
- Heat conductivity of the particles

Extrinsic conditions:

- Degree of compaction
- Temperature
- Barometric pressure
- Oxygen concentration

A three-stage approach is proposed using risk identification, sensing, spotting, monitoring, control and stockpile management. This methodology can ensure that coal in the stockyard is stored in a safe and efficient manner.

PREVENTION:

Mitigating the effects of factors responsible for the augmentation of spontaneous combustion of coal:

PROPER SELECTION OF PARTICLE SIZE DISTRIBUTION:

If the stockpile is of mainly medium to fine particle then making it finer or adding fines helps. If the stockpile consists of coarse particles of relatively low reactivity, then removing the finer material will help.

AVOIDING SEGREGATION:

Improper stacking might result in segregation of stockpiles and hence increased propensity to oxidation. Proper attention must be given to the preparation and maintenance of the stockpile. Pile maintenance might be crucial in avoiding channels where air can easily enter the dump. Proper compaction. Air circulating within the stockpile should be restricted by proper compacting and dozing off.
Moisture contributes heavily in spontaneous


Stockpile Segregation


Coal Compaction

combustion as it aids in the oxidation process. Moisture content should be limited to about 3% to avoid enhanced oxidation. Moisture must be checked regularly to keep stored coal from being exposed to it.

DIMENSIONS OF STOCKPILE:

Dumping coal in one big pile will lead to problems. Size and area of stockpile should be based not only on estimated tonnage but also on design principles of stockpile management. Proper spreading & measuring of stockpiles helps negate weathering of coal. Rather coal should be packed in horizontal layers of about 1.3 to 3 feet high followed by levelling and compaction by dozers. It helps in evenly distribution of coal thus avoiding segregation of fine coal. Pile unlayered, uncompacted high-grade coal should be limited to about 15 feet and while layered and packed coal pile height should be limited to about 26 feet.

USE OF PROTECTIVE COVERING:

Inert covering material such as tarpaulin sheets with sufficient heat resistivity can be

used to cover the openly kept stockpile to reduce the loss of calorific value and further oxidation of coal. It helps in cutting off oxygen to come in contact with coal.


Stockpile Covering


Stockpile Covering


Stockpile Covering

MONITORING:

An early warning system to prevent the onset of fire remains the best and most reliable solution. Stockpiles are monitored initially to check temperature, presence of gases and sufficient compaction.


Stockpile Covering

TEMPERATURE:

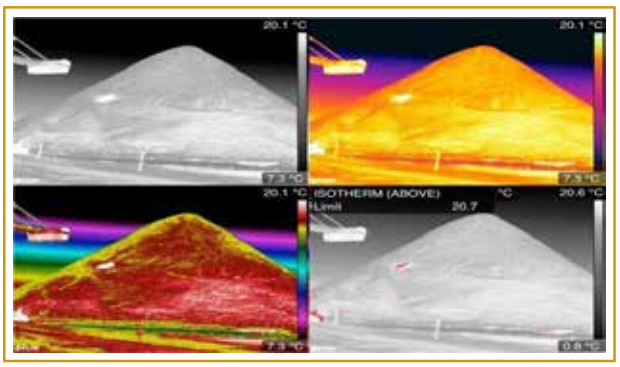
Calibrated thermocouples are preferred over fixed probe thermometers as these can malfunction due to continued stockpiling activities. Temperature below 50°C should be assumed safe but as the range gets to 70°C or more, stockpile should be closely monitored, and control measures deployed.

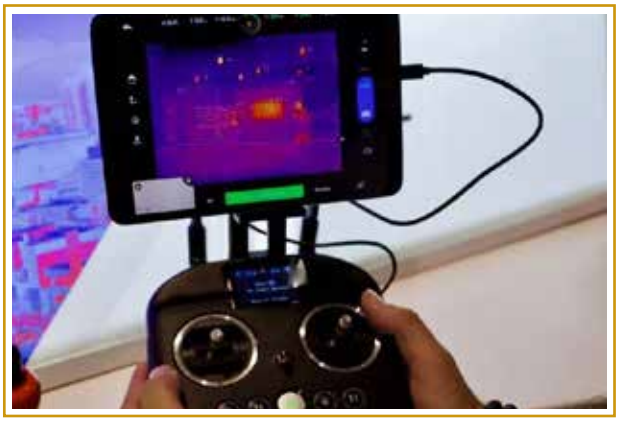
CONTINUOUS THERMOGRAPHIC MONITORING.

Where a storage facility is large and difficult to access, a continuous and fully automatic monitoring device can be employed. A fixed thermal imaging system located at a suitable viewing point can successfully monitor over a large area and importantly detect hot spots.

Power plants, Ports, Coal Stockyards can also invest in a deployable vehicle or drone with radiometric thermal camera inspection system. By performing daily site inspections from a vehicle or drone remote, potential problem areas can be identified days before spontaneous combustion may occur. Having this system will enable early detection and prevention of spontaneous combustion. It provides a means of detecting hotspots in stockpiles before they become problematic and cause downtime.

The problem areas become easy to identify during hours when the sun has set as the reflected heat from solar radiation is removed and the coal starts to cool as the ambient temperature drops. Early morning is typically an excellent time to perform an





inspection as the stockpile will be cool except for areas that have developing problems.

COMPACTION TESTING:

Dynamic cone penetrometer can be checked for consistent compaction. Also, one of the better ways to measure the compaction of piles is to employ densiometric tests on to find below surface voids on air-dry basis. Voids below 15% are considered ideal and voids from 15% to 20% are generally considered as acceptable.

GAS TESTS:

To find the inertness of the surroundings and extent of depletion of oxygen subsurface gas tests are useful. About 50ppm of Carbon monoxide above the residual carbon monoxide level indicates that internal temperature is more than 70°C.

CONTROLLING:

Control measures need to be employed when the temperature of the stockpile reaches to the level of 60°C - 70°C:

At the first indication of presence of hotspot, dumpers/excavators can be used to excavate the hot material. The excavated material should then be allowed to cool and re-compacted accordingly.

To sustain combustion; oxygen, fuel and heat must all be present. The absence of any one of these elements will result in at least the temporary cessation of burning. Spontaneous combustion in stockpiles and dumps can usually best be controlled by handling high risk material in a way that limits its contact with oxygen, e.g. by compaction to minimise airflow by cladding with inert material to prevent the ingress of air, by limiting the height of the dump and by orientation of the stockpile or dump with respect to the prevailing wind.

USE OF SEALANT:

The sealant combines an inhibitor of coal oxidation, (CaCl), with a binding agent and

filler, (bentonite). Most of the known oxidation inhibitors have poor stability when applied as either a coating on coal surfaces or filler in cleavages and fissures. Therefore, bentonite and CaCl are homogenized to form a mixture having long-term stability.

WATER SPRINKLERS:

Though use of water should be carried out sensibly as there is always risk of production of water gas by the mixture of carbon monoxide and hydrogen. Water should NEVER be used in thick jet but in sprinkler form.

Taken together, these actions can and will help in saving coal as a commodity. Prevention methodology provides safe approach to control spontaneous combustion of coal. Coal costs represent a large percentage of operating budgets of power plants. Therefore, coal savings in power plants provide a real opportunity to improve the financial performance of the overall organization.

PHOTO OF THE MONTH:
FIRE IN COAL STOCKYARD

BACK TO BASICS

QUESTION OF THE MONTH: (Please submit your replies by 25th of each month)
India is major importer of various grades of Coal. How many different grades are imported in India?

LAST MONTH'S QUESTION:

Cargo of fruit was exported from India to Jebel Ali, UAE. The coverage under the policy was as per Institute Cargo Clauses (B). Unfortunately the ship had a collision with another ship & had to be taken to refuge port for repairs. In order to carryout repairs, all the containers were offloaded & then reloaded. When the ship arrived at destination, it was found that the cargo of fruit was considerably damaged. It was found that the damage was due to natural decay. Is this claim admissible under the policy?

LAST MONTH'S ANSWER:

No, the claim is not admissible as per ICC (B) exclusion no. 4.5.

CORRECT ANSWERS SENT BY: (In order of replies received)

Shruti Chaubey - Zoom Insurance Brokers Pvt. Ltd., Gurugram
V. Ganesan - Marsh India Insurance Brokers Pvt. Ltd., Chennai
Mitul Shah - Probitas Insurance Brokers pvt Ltd, Vadodara
Ruchika Majumdar - First Policy Insurance Brokers Pvt. Ltd., Pune
V. P. Mohankumar - Link-K Insurance Broker Co. Pvt. Ltd., Coimbatore
Kritika Singh - Ideal Insurance Brokers Pvt. Ltd., Gurgaon
Binita Chowkhani - Epoch Insurance Brokers Pvt. Ltd., New Delhi
Bharat Bhushan - Optima Insurance Brokers Pvt Ltd., New Delhi

PLEASE SEND YOUR REPLIES/ANSWERS TO ADDRESSES GIVEN ON LAST PAGE OF THE MARINE NEWSLINK.

IF YOU HAVE ANY COMMENTS / FEEDBACK PLEASE SEND IT TO

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