DUST DISPERSION MODELING IN OPENCAST COAL MINES AND CONTROL OF DISPERSION IN MAHANADI COALFIELDS OF ORISSA

CONCLUSION & RECOMMENDATIONS
World energy demand is growing and coal is the only ingredient which will fulfill this demand to the extent of 70% for at least 50 years from now because it is available in abundance. The scenario in India is almost similar and the majority of coal comes from opencast mines. In Orissa and specially in Talcher Coalfield, where this study was undertaken, the share of coal production from opencast mines constitute more than 99.2%. At present average coal production and dispatch from Talcher Coalfield of MCL ranges from 1.5 lakh te-2 lakh te/day and considering the huge demand of coal for energy starved nation this production will increase rapidly and may touch the figure of 2.5 lakh te/day very soon. Handling of such huge production results in formation of dust which is the major source of deteriorating the ambient air quality in Talcher Coalfield of MCL.

Major source of dust generation, during the opencast mining operation, crushing of coal to the required size (-100 mm) and transportation of crushed coal to the railway siding for dispatch to the Power Plants, are identified as coal transportation roads, CHPs and Railway Sidings.

Fugitive Dust Model or FDM, a conclusively more preferred model over its next competitor ISCT Model, is a powerful tool to determine the impact of various dust generation activities on the ambient air environment. This model was used to assess the impact of coal mining, crushing, transportation etc. undertaken by Mahanadi Coalfields Limited on the ambient air quality of different receptor locations and the impact was also measured by direct method of air quality sampling. The results obtained through the model were compared with the
measured results to validate the model and it was found that accuracy of the model is approximately 90%.

It was also concluded that bigger size dust (more than 30 micro meter to 100 micro meter) settles within 10 m from the dust generation source like coal transportation roads, intermediate size dust (10 to 30 micro meter) are likely to settle within 100 m and smaller size dust (less than 10 micro meter size), which constitute a lesser fraction in the total generated dust, remain suspended in the ambient atmosphere for a longer period and the back ground concentration reaches only after 300 to 500 m from the source of dust generation.

Coal Transportation Road along with Haul Road was identified as major polluter contributing 75% dust followed by CHP which contributes 15% of dust and Railway Siding and other sources contributes 10%.

It was also observed that dust dilution potential of the prevailing atmosphere is very less during night time and thus the dust level remains high during the night time. Speed of vehicles was also found to be contributing highly towards dust generation.

**Recommendations**

**Haul Road Dust Control (Unpaved)**

Haul Road and coal transportation road contribute maximum towards dust generation and its dissemination in opencast mines. Conventional method of dust suppression on the unpaved haul road include water sprinkling through mobile water tanker (28,000 ltrs capacity) and grading of the road surface to take care of the un-even surface due to spillage material as well as due to movement of tyres of the vehicles with heavy loads. Pot holes and rut holes on the haul road are filled up with gravel chips (commonly called metals) and then a layer of morrum is
spread on it and finally compacted by Road Roller. Chain dozers are also applied for construction and maintenance of haul roads.

Proper care/attention is required for design and maintenance of haul road as dust generation directly depends on it.

The amount of dust that will be emitted is a function of two basic factors;

- **The erodibility** of the material involved
- **The erosivity** of the actions to which the material is subjected

In broad terms, the effectiveness of any dust suppression system is dependant on **changing** material erodibility or erosivity. The nature and particle size distribution of a mine haul road **wearing course** material has a fundamental influence on the tendency to form fugitive dust. Particles that become suspended for a noticeable length of time are **generally <30μm** in diameter. The amount of material in this range is therefore approximately proportional to a material's erodibility. In general, the silt and fine sand content of a material (i.e. 2-75 μm) is a good indication of its erodibility.

In most circumstances **regular watering**, the application of **chemical dust palliatives** and/or the **optimal selection of wearing course materials** are the only viable alternatives in controlling mine haul road dust emissions.

Several products are available for controlling dust from unpaved roads. These products work by **attracting moisture**, **binding dust particles together**, **sealing the surface**, or some combination of these effects.

**Chloride salts** are the first category of dust suppressant. These chemicals are **moisture attractants**, which work by drawing moisture out of the air during periods of high humidity, particularly at night. They also **reduce the evaporation**
rate of water during hot dry periods. This tends to hold the dust on the road surface, although there is no physical bonding.

Calcium chloride should be mixed into a solution and sprayed on the surface at a rate of 400 to 500 gram per square meter. At this rate, it would require about 4,000 kg of dry flake to treat 1 linear km of road of 10 meter wide. A follow-up treatment at half to 2/3 of the initial rate is usually needed.

**Dust Suppression Strategy for Black topped Road or Paved Roads**

Huge volume of coal transportation takes place on blacktopped roads for transportation of coal to the local consumers, which takes place through trucks. Approximately 35,000 te to 40,000 te coal is transported daily and if a conservative estimate is made 2,000 to 2,500 trucks ply every day for the transportation of coal. Although, there is stricture for covering of the trucks before start of the journey, still the huge traffic of trucks on the road generates a lot of fugitive dust. Three pronged approach is required to control the dust due to this huge volume of traffic:

(A) Properly surfaced and graded roads, free of rut holes & pot holes and ramblers with proper drainage and regular maintenance of the road.

(B) Evacuation of the road side accumulated dust either through mechanical sweeper or loading and transportation for proper disposal.

(C) Water spray at required interval with sufficient pressure and efficient nozzles to create fog like mass. This will reduce water consumption as well as improve the efficacy of suppressing the air borne dust.

Currently one such Mechanical Road Sweeper, manufactured by M/s TPS Infrastructure Ltd., is being used for first time in India on coal transportation roads at Talcher coalfields which are highly dusty however its movement and
operation are required to be monitored very meticulously for actually reducing the dust level.

**Control of dust at CHPs**

Coal Handling Plants also require three pronged approach to effectively control the dust.

(A) Proper Enclosure of the dust generating operations: Receiving Hoppers along with the chain conveyor feeding the Run of Mine Coal (ROM) to the Primary crusher should be covered with corrugated sheets and flexible material from all the three sides, this is very effective in containing the dust. Primary crusher should be fully covered. Secondary crusher and the belt conveyor should also be covered properly.

Mist Spray arrangement at the unloading hopper, discharge chute and along the belt conveyor: Normally the nozzles of the misters get choked with the dust particles in the water supply line. This must be avoided and if not possible pressure filters should be used prior to the water supply. Mist spray effectively contain the air borne dust. Dry fog system should also be considered for this purpose.

(B) Regular evacuation of the spillage coal from the CHP Circuits and the CHP Complex: There is number of leakage points for coal dust spillage in the CHP Circuits and there should be arrangement for manually feeding these spillage coal by Belcha in the belt conveyor. Spillage coal at the discharge end should be lifted by pay loaders and sent to siding at regular interval. A good housekeeping is the key to reducing dust generation from the CHP Complex.
(C) Reduce the requirement of crushing by producing more coal through surface miner, because surface miner produced coal is less than 100 mm in size and does not require crushing.

Control of dust at Railway Siding

Crushed Coal from CHP or directly from surface miner face is transported through tippers which unload the coal on the platform. Then pay loaders load the coal in the wagon. Due to the unloading, loading and movement of number of tippers and at least 10 nos of payloaders in the entire 700 m long platform, Railway Sidings becomes a major source of fugitive dust emission. Water sprinkling through mobile and fixed sprinklers and good house keeping through plying of wheel dozers are the key to control of dust at Sidings.

Silo loading arrangement is recommended for all sidings which will totally eliminate tipper and payloader movement and consequent loading and unloading operations and thereby will drastically reduce the dust generation from the sidings.

More number of Surface Miner in reducing fugitive dust emission

The conventional mining requires basically three unit operations namely Drilling, Blasting and Crushing at CHP to make the coal dispatchable for use at Power Plants. Surface Miner is a machine, first time introduced in India at MCL for cutting of coal directly and the size of cuttings are less than 100 mm, thus all the basic unit operations involved in conventional mining i.e. drilling, blasting and crushing are altogether eliminated due to use of Surface Miner and thus dust generation reduces significantly. The current share of surface miner production of approximately 45% should be gradually increased to 75% for better dust control.