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Applicability Condition of Surface Miner at Open Cast Mine - A Case Study

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Abstract - In open cast coal mining, various activities were done or being carried out only by conventional system of mining which includes drilling, blasting and crushing. All these operations resulting a lot of adversative impacts on the environment and the surrounding atmosphere. The adverse impacts that the conventional mining system results are ground vibration, noise pollution, air pollution, land degradation, ecological disturbances etc.

This generates necessity of additional machineries and manpower, eventually cost of mining coal rises. And also due to existence of villages adjacent the mines, blasting is limited as a result massive quantity of coal is blocked. And we all know that quality of coal has great concern in our country since most of the coal seams comprise low-grade quality of coal due to drift origin. Government legislation also forbids the dispatch of coal for more than 1000 KM, if coal comprises more than 36% ash.

In these circumstances, surface miner was being introduced which can proficient of solving the above declared problems. This allows the operator of the mine to ensure selective mining of coal so that quality of coal develops. The variety of thinner seams which are unworkable in conventional system of opencast mining, now converts workable and the whole reserve of non-renewable source of fossil fuel rises. It also decreases cost of production so that total profit of a mine growths.

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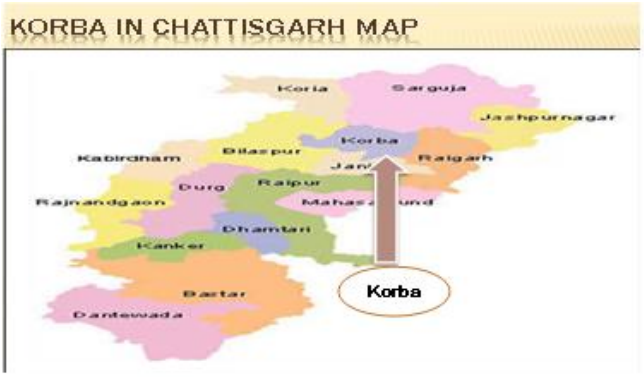
INTRODUCTION

The selection of mining method for Dipka Opencast Expansion Project (35MT) has been based on the following factors:-

Dipka Opencast Project is being worked by opencast methods deploying Surface Miner & Tipper combination.

Present depth of workings are about 100 m to 150m against an ultimate planned depth of 230 m(as per 35Mty PR). Dipka Expansion Opencast Project (30Mt) has been planned up to a maximum depth of 300m.

The coal deposit mainly constitutes of three thick coal seams occurring at shallow to moderate depth at favorable stripping ratio considering the grade. The existing system of coal by outsourcing and OB removal by departmental operation & outsourcing.



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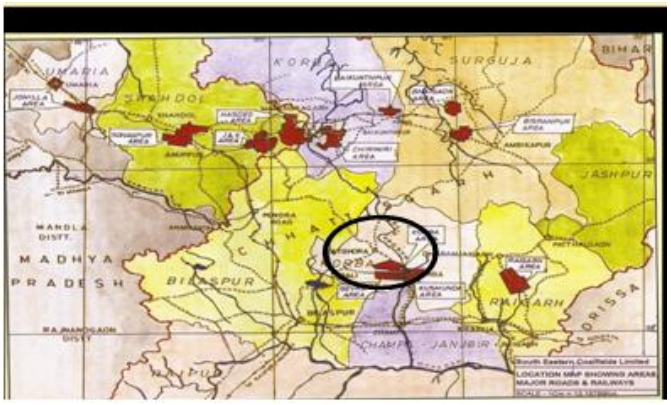

Map of Dipka OCP

LITERATURE REVIEW

As we know that, in the whole world, India is the third largest coal producing country and at about 88% of production of coal being extracted from these open pit mining. As usual the conventional system of mining coal by open cast mining method includes drilling, blasting, excavating and crushing. The HEMM which comprises in those various processes are Shovel, Drill machines, Grader, Dozer, Dumper, and Dragline. Earlier, as it is mentioned that mining operations are always associated with fatal effect of land degradation, environmental disorders, noise and air pollution and it results to overall environmental corrosion. Blasting process which is also carried out, give rise to blast-induced ground vibrations, disturbance to water regimes., air-blast, fly rock, blasting fumes, dust cloud, noise, and damage to nearby structures. Crushing and drilling operations also cause a lot of dangerous environmental complaint and harmful results such as air and noise pollution. And also the quality managing with the layers of grey shale/carbonaceous shale, stone bands, dirt bands etc in opencast coal mines has become a problematic work by the conventional method of mining.

The most important feature of the machine is the complete elimination of drilling, blasting, or ripping. The Continuous Surface Miner (CSM) is continuously operating mining equipment, where with the help of a rotating roll the rock crushed frasend. The roll comes in addition to the crushing often the function of the load on a conveyor.

Surface miners are specialized mining methods that are often used where drilling and blasting is not possible or when drill is to be mined matches the requirements. The machines do not require drill or blast or subsequent crushing as the cutting drums break and size rock. These machines can load into conveyor belts or directly load into trucks

METHODOLOGY

To do the objective of this project, the following methodologies are used.

- Literature gathering
- Collection of details from Dipka open cast mine of SECL

OBJECTIVE

- Why surface miner is suitable, not the conventional mining system.
- Effect of utilization of surface miner on economics of mine.
- Effect of disposition of surface miner on the quality of coal.
- Suitability for overview of surface miner in Indian geo-mining circumstances.

REASONING FOR THE STUDY

As, I have already mentioned that the earlier used conventional system of opencast coal mining yields lots of adversative effect on environment. And this also needs large number of HEMM for drilling, blasting, excavating and crushing so that requirement of machineries and manpower rises. These increase cost of mining of coal. Also in Indian geo-mining situations huge numbers of stone/dirt bands are existing in coal seams. Throughout blasting, these bands mix with coal so that quality is further worsened. The thinner coal seams are not minable with the help of conventional system of coal mining so that non-renewable source of energy is misused. Starting of surface miner in these conditions resolves all the above stated problems. Here surface miner cuts coal, size and loads in one single pass which excludes the necessity of HEMM for drilling, blasting, excavating and crushing etc. also when we do selective mining of thinner coal seams the quality of coal improves.

In India population is very high and most of the coal mines are bounded by some villages which limits blasting operation in the mine so that massive quantity of coal is blocked. Meanwhile demand of coal for creating electricity and other industrial resolution is very high which need substitute method to remove coal securely without affecting the villagers. The surface miner is one of the best substitute method of mining coal since it advances quality, decrease cost of production and also environmentally friendly.

PREDICTABLE INPUT FROM THE STUDY

1. To comprise the changes in the production of the mine after utilization of surface miner with the conventional system of mining of coal.

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2. To evaluate the decrease of adversative effect on environment after the introduction of surface miner in the mine.

3. To estimate the possibility of working of non-workable seems after introduction of surface miner.

4. To measure the development in principles of safety after the introduction of surface miner.

5. For making the mine operator conscious of several advantages of mining by surface miner in comparison to the conventional system of mining.

6. For assessing the development in quality of extracted coal by surface miner as compared to the conventional system of mining.

LIMITATIONS

This particular study contains the following limitations

- This study is restricted to specific geo-mining conditions of particular mines.

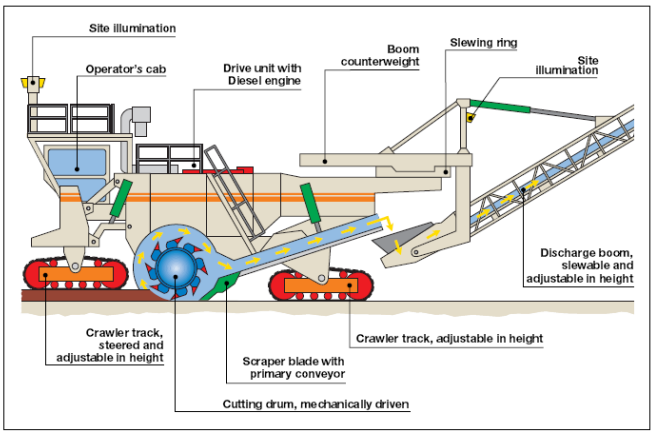
- This Study is partial to surface miners of 2100 SM, 2200 SM, 2500 SM, 4200 SM model of Wirtgen surface miner and also KSM 303 and KSM 304 of L & T surface miner. The cost and production will differ with different model of surface miner.

General description of surface miners

Mainly there are three kinds of surface miners available on market today:

- Machine with middle drum configuration
- Machine with front cutting boom
- Machine with front cutting wheel
- Machine with middle drum configuration

Its cutting width varies from 250-4200mm, weight 40-90tonn, and installed power 450-1250KW. Their manufacturing companies are Wirtgen, Bitelli, Huron. Now all over India and the world, only the “machine with middle drum type configuration” is used because the cutting drum is situated under the Centre of the machine and in between the length of crawler track. Four crawler tracks are situated, two at the front and two at the rear so that the big machine can resist its balance.



Machine with middle drum configuration

From application point of view this machine is as important as other two. Its cutting width is 5250mm, cutting depth 1000 to 5500mm; weight 135tonn, installed power is 750 KW. Its manufacturing company is voestalpin. Earlier these type surface miners were used but not it has been stopped because the big cutting drum is situated at the front side of the machine and the machine has also a very big cutting boom attached for loading the material and this machine has only two crawler tracks. So the machine can’t maintain the balance properly

The application of this type surface miner offers advantages whenever the following conditions have to meet:

- Mining of huge masses
- Selective mining of changing rock layers with thickness exceeding 0.5 m
- Selective with a high separation accuracy
- Manufacture of the lump masses appropriate for belt conveying with less fines
- Use of cost beneficial belt conveyor

This type surface miner was also used earlier but now it has been stopped because this machine contains a giant like cutting wheel which is situated on the front side of the machine and this machine consists of only three crawler tracks, two at the front and one at the rear. As a result the machine cannot resist its balance or stability throughout the operation.

Machine with front cutting wheel

Parameters	**Type of Surface Miner**		
	Middle Drum	**Front Cutting Boom**	**Front Cutting Wheel**
Cutting Width (mm)	250-4200	5250	7100
Cutting Depth/height (mm)	0-80	1000-5500	0-2900
Capacity	For all machines output is related to material characteristics		
Weight (Tonne)	40-190	135	540
Installed Power (KW)	450-1200	750	Upto 3340
Manufacturers	Wirtgen, Bitelli, L & T and Huron	Ermeer, Tesmec, Voest Alpine	Krupp Fordertechnik and Tenoa TAKRAF

Here, I can conclude by over viewing the above three type surface miners, that the first one i.e. “the machine with middle drum configuration” is more suitable in comparison with the other two because it is more efficient and sophisticated and also very safe.

Uses and Application of Surface miner

This shows, for what other purposes the surface miner is suitable or applicable and its use in different operations. This shows versatility in suitability of surface miner.

Desired materials:

We all know that the most common finish product is a selected material which is cut, crushed, loaded and hauled in a single method. Using the surface mining process, we can attain greater output also with fewer budgets and fewer apparatus. Also under this concept, we can mine the coal securely without any environmental problems.

Clean usable surfaces:

Clean and steady surfaces are extra advantage of surface mining technology. A number of clients have used surface miners for entries to their mining or construction processes. This modest facility permits safe hauling and also avoids harm to other apparatus used in daily mining condition as well as construction conditions.

Ramps:

Ramps which are desired for road and highway construction are other examples of complete yields of surface mining since the machineries operation can be programmed and GPS navigation can be added, optionally laser guided and the surface miner can make accurate fixed cuts or variable cuts to come across custom engineering requirements.

Highwalls

The surface miner is also capable of producing compact highwalls. The conventional mining approaches like drilling and blasting can loosen material on highwalls. But highwalls created by surface miners are steady, accurate and clean. There is no danger of falling substantial into the roadway. A safe working environment next to highwalls can be occupied by the surface miner.

Trenching:

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One major example of complete products is trenching. Trenching roads and under- passes are very time taking and costly. But the surface miner gives a clean, flat and steady surface on time and also within the budget, which a conventional mining method cannot achieve.

Trenching by surface miner

Application of surface miner

- Mining of harder minerals (ex: limestone, dolomite, gypsum, etc)
- Mining of thin seam deposits.
- Selective mining of materials with varying mineral content.
- Creating channels.
- Digging exploratory channel.
- Removal of partings
- Mining of residual minerals.
- Removal of consolidated overburden layer.
- Digging drainage ditches.

Comparison of surface miner with conventional mining method:

Why surface miner is suitable:

Here I have compared the surface miner with the conventional mining method to find out why surface miner is more suitable.

Mining by surface miner	Conventional system of mining
1.Cost of production is much lesser than conventional system.	Cost of production is comparatively higher.
2. Requirement of drilling, blasting and crushing is not here.	Requirement of drilling, blasting and crushing.
3. Mining is possible in close proximity of village, road and other permanent structure.	Mining is not possible due to restriction in blasting.
4. No chance of spontaneous heating and fire.	Blasting produces crack in the coal bench which leads to spontaneous heating and fire.
5. Stability of bench and high wall is comparatively much better.	Stability of be1nches and high wall is comparatively poor due to induced stress caused by blasting.
6. It is an environmentally friendly method of mining.	Drilling, blasting and crushing produces adverse effect on environment.
7. Selective mining is possible as a result quality of mined out coal is better.	Selective mining is not possible.
8. Thin seam mining is possible as a result non-workable seam becomes workable.	Thin seam mining is not possible.
9. Less capital investment and infrastructure is required.	High capital investment and infrastructure is required.
10. Top of bench and high wall is smooth	Top of bench and high wall is uneven.

CONCLUSION

The surface miner is multipurpose and beneficial apparatus which is capable of extracting the quality coal in extremely inter-banded seams. Collecting satisfactory material and data about the seam features, seam behavior and seam characteristics and by making careful planning of every cut of the

surface miner joint with good supervision, we can reach upto the achievement of grade enhancement and grade control.

Disposition of a surface miner in a mine has a incredible possibility of savings of man power necessity. The surface miner also enables superior and intense area of regulation, since the apparatus population is decreased, consecutively guaranteeing greater production, increase efficiency of dump trucks due to greater fill factor on account of identical size.

The revolutionary trials have strengthened the confidence of the coal industry and also inspire the industry to go for greater capacity apparatus which is suitable for cutting the stiffer coal or harder coal as well as the dirt bands in other fields of India. By means of the state of art technology of surface miners attached with heavy ash investigation, opens up extensive views of additional potentials in surface mining particularly for quality improvement without falling back to coal beneficiation.

Now the new cuttability index can able to deliver a convenient tool for decision making on the matter of applicability of surface miners. This is a very good method for comparing different production materials of different mines.

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