CASE STUDY ON DRAGLINE

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Abstract - *Draglines have been explicitly used in coal mining for a no.of decades, either as stripper or stripper and coal extractor. As this equipment retains certain intrinsic benefits, which their rivals do not have, they should essentially be operated in round-the-clock fashion for high productivity and low expenditures. In India, the advancement of giant surface mining projects like Bina and Jayanth with setting up of high coal production targets (up to 10MT/year) demands for systems to remove huge volume of overburden in minimum possible time. This has led to major changes in overburden excavation technology in surface coal mining from shovel mining to dragline mining. Coal India Limited (CIL), now has standardized the draglines in two sizes, namely 10/70 and 24/96 for their mines. Most mines depend on the dragline 24 hours/day, 7 days/week. In many of coal mines, it's the only primary stripping tool and the mine's yield is totally dependent on the dragline's performance. For these reasons, only dragline design requires a greater attention placed on developing components with higher levels of reliability and predictability so that repairs and replacement of components can be programmed at times that will minimum affect the overall mining operation. Prior to installing draglines in mines, various aspects have to be taken into consideration for selecting suitable size. The dragline is a Heavy Earth Moving Machine (HEMM), working and operating procedures have been discussed*

KeyWords: **DRAGLINE, MINIMUM, MINES, INSTALLATION, MACHINARY.**

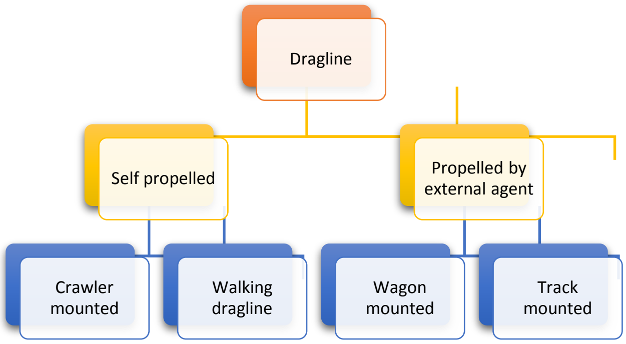
1.INTRODUCTION

Dragline used in surface mining is heavy equipment. They are mostly built on-site for strip mining operations to remove overburden and coal and they are largest mobile land machine ever built. It consists of large bucket which is suspended from a boom with wire ropes. The bucket is maneuvered by means of ropes and chains. The hoist rope is powered by electric motors and drag rope is used to draw bucket assembly horizontally.

Maximum speed is only few meters per minute. For larger distances disassembly is generally required. Mining draglines are not moved frequently as their reach can work a large area from one position. A dragline is most efficient for excavating material below the level of their base. It can dig above itself also but inefficiently. It is not suitable to load piled up material as a shovel. Draglines are popular with many mines due to their reliability and extreme low waste removal cost.

However, they have very limited application due to their boom height, boom length and dig-depth. Nowadays keeping in view of the demand of increasing productivity draglines having longer booms and large bucket capacity are being selected. However to obtain low cost per cubic meter it is imperative to operate the dragline in a scientific manner for which constant supervision, good overburden preparation, and preventive maintenance of dragline and selective proper bench height of overburden is very much required. In order to achieve higher coal production targets, it is necessary to remove large volumes of overburden in shortest possible time and therefore it has been found that Draglines are the best suited equipment to perform this type of work.

1.1 CLASSIFICATION OF DRAGLINE:-



1.2 CONSTRUCTION OF WALKING DRAGLINE

Walking dragline is also an intermittent discharge-type excavator. The machine is well known for having longest boom among excavators. The boom length varies from 9 to 96m. unlike other excavators, the bucket is not rigidly held by the frame structure. Filling of the bucket is done by pulling or dragging it against the material towards the machine because of which the machine is named a Dragline. Thus greater skill is required to control the bucket.

Intensive operation of these excavators under favorable geomining conditions results in the cheapest means of overburden removal. Such machines are made by a no. of manufacturers in many sizes and capacities enabling correct matching between the planned requirements and the equipment selected. This machine is also capable of digging below the working level. Below Fig shows the view of such machines

Draglines are made up of attic construction by structural steel which is lowered down or raised up by the cable of boom hoist. For dragging the bucket towards the machine, one end of drag cable is attached with the bucket and the other end is connected to the dread which is at the foot of the boom.

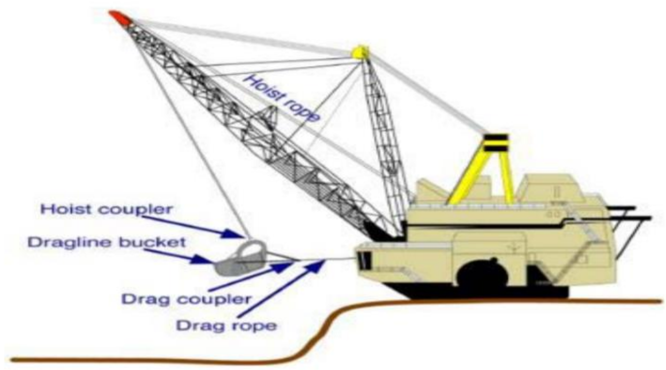


FIG-1: WALKING DRAGLINE

The bucket is filled up by pulling or dragging the bucket against the loose material by the drag cable and then it is hoisted up by the hoist cable. Finally it dumps the material directly over the spoil dump or over the trucks or railway wagons.

Generally the draglines are used for direct handling and rehandling of overburden material during overcastting since it is the cheapest means of overburden removal.

2. DRAGLINE STRIPPING METHODS

1)Simple Sidecasting Method:-

- This is the simplest form of strip mining, which involves excavation of the overburden in a series of parallel strips.
- The strips are worked in a series of blocks.

- The 0/B from each strip is dumped into the void left by the previous strip after the coal mineral has been mined.
- It is customary to start the excavation of each block by digging a wedge shaped key cut with the dragline standing in line with the new high wall.
- From this position, the machine can most easily dig a neat and competent high wall.
- The nearest high wall is affected by starting the out with the dragline in line 18 with the crest and moving it as the out gets deeper, ending with the machine in line with the toe of the new high wall.
- By this means, the slope angle of the new high wall can be closely con rolled.
- The width of each strip is usually designed so that the material from the key cut can be thrown into the previous cut without the need for rehandle.
- When the key cut has been completed, the dragline is moved close to the old high wall edge from where it can excavated the reminder of the blocks.
- With a suitable selection of bench height and block width, as well as, proper reach, casting can be done dear off the coal bench.
- However, more often than not, the spoil pile touches the crest of the coal seam for obvious advantages mentioned early.
- Associated demerits are also present. Rehandling is no intended as it jeopardizes the economy of operations.
- Advance benching with this method is also practiced due o reasons already mentioned.
- The manner in which a dragline must be applied to dispose of the material is of greater significance in affecting dragline productivity.
- In the simple case shown in the Fig. the dragline sets on the top of the material to be excavated and swings through an arc of between 45 to 90 degrees to dump the material.
- A typical average cycle time for the operation is 45 seconds.

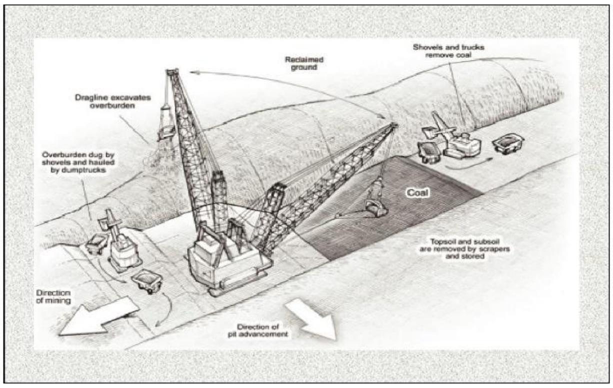


FIG-2: SIMPLE SIDE CASTING METHOD

2)Dragline Extended bench method:-

- Where overburden depth or the panel width exceeds the limit at which the dragline can sidecast the burden from the coal, a bridge of burden can be formed between the bank and the spoil which effectively extends the reach of the dragline.
- The bridge extends the bench on which the dragline is operating.

- The bridge is formed by material falling down the spoil bank or by direct placement with the dragline.
- To remove the bridge material from the top of coal, it must be rehandled. Extended bench systems are adaptable to many configurations of pit geometry.
- In this method the dragline forms its working bench by chopping material from above the bench and forming the bridge, then moving onto the bridge to remove it from top of coal.
- The primary dragline strips overburden and spoils it into the previously excavated panel.
- This material is leveled, either by tractor-dozers or the secondary dragline, to form the bench for the secondary dragline.

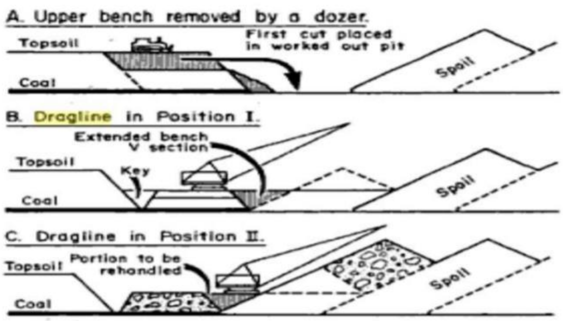


FIG-3: Dragline Extended bench method

- The secondary dragline first strips material near the highwall, then moves on to the bridge to move the rehandle material.
- In a two-dragline system, one machine must operate at the pace set by the other.
- Therefore, mine design must consider their respective capacities when assigning respective digging depths.
- The primary dragline strips overburden to the top of the first seam. Coal is removed, then a small parting dozed into the pit and the second coal seam removed.
- The secondary dragline strips the large interburden to the third and final seam.
- Extended bench systems must be designed carefully in order to maximize the dragline(s) productivity and to minimize the amount of rehandle.

3)Dragline Pull-Back Method:-

- Occasionally, overburden to be stripped will be beyond the capacity of the dragline to spoil off the coal by any of the previous methods described.
- In this case, a secondary dragline can be placed on the spoil bank to pull back sufficient spoil to make room for complete removal of overburden.
- Generally, rehandle volume is greater for the pull-back than an extended bench method of operation.
- However, it may also serve to level spoil piles in addition to providing more spoil area for the primary dragline.
- If the overburden/interburden is generally beyond the capability of draglines working on the highwall, the pullback method would seem to be a solution.
- However, great care must be given to the design of this method because of the inherent hazards of operations.
- Spoil slopes can be unstable, more so during periods of severe rainfall.

- Draglines frequently are utilized to strip overburden from deeper coal seams than originally intended.
- Occasionally, spoil slopes cannot be maintained at designed angles.
- Various methods have evolved to stack more material into the spoil bank to alleviate these problems.

DRAGLINE BALANCING DIAGRAM:-

Balancing diagram can be defined as the graphical representation of the scheme to be adopted for determining the suitable seating position of the dragline in order to get maximum overburden accommodation in de-coaled area with least rehandling for achieving high rate of coal exposure and ensuring slope stability (Rai, 1997).

The balancing diagram assists in determining the coal exposed by a dragline, the percentage of overburden, rehandling and the volume of overburden to be accommodated in the de-coaled area (Singh and Rai, 1998).

Besides these, balancing diagram shows the dragline cuts and spoil geometry (in two dimensions) cross-section, height of dragline bench and cut width taken by the dragline. The cuts sequence by dragline, key cut (box cut), first cut (next to key cut), and first-dig can be estimated through the cross-sections drawn in diagram (Pundari, 1981).

3.4.1 Purpose of drawing balancing diagram:-

a) It shows the dragline cut sections i.e. key cut, first cut (next to key cut), first dig (next to first cut) and rehandled section (as per mode of operation).

b) It shows the dragline bench height, cut width taken by draglines, thickness of coal seam and gradient and various slope angles.

c) Determination of rate of coal exposure (daily/monthly or annually).

d) Calculation of workload distribution on each dragline in respect of their annual productivity (i.e. cross-section area taken by each dragline should be in the same ratio as their annual productivity).

e) Calculating the percentage of rehandling.

f) Calculating the overburden to be accommodated in the de-coaled area.

3.4.2 Preparation of Dragline balancing diagram:-

Let BCDE be the cross-sectional area to be removed to expose coal seam A B C O. for convenience, this area be called First-dig.

Let, A1= First-dig ……………… (1)

Now the dragline sitting on the highwall side removes the blasted overburden which lies in the cross-sectional area of first-dig. Maximum amount of overburden which can be accommodated in the dump FGKH is limited by the reach of the dragline and designed dump-slope.

Let A2= Dump Area …………. (2)

Assuming S to be the swell factor of the overburden material, actual area of overburden required to be accommodated in dump would be A1S.

Let, A3= A1S-A2 …………….. (3)

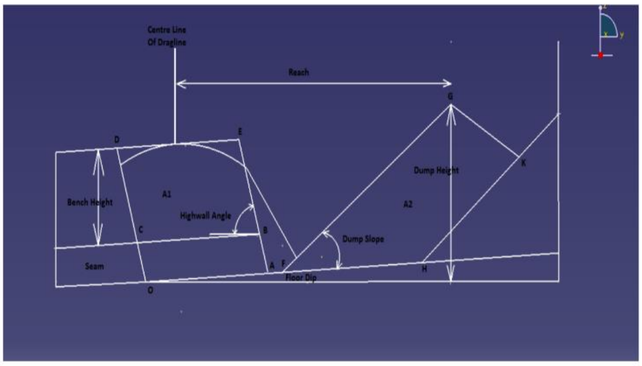


FIG-4: Balancing diagram for Total Side casting

Case-1. When A3<0

In this case the dump area is incapable of accommodating overburden more than the available first-dig quantities. This implies that height of the dragline bench or cut width may be increased such that the first-dig quantity is increased. This process is repeated till the dump area is equal to the losses first dig quantity.

Case-2. When A3=0

This indicates an optimum solution for the simple side-casting method of dragline deployment. In simple sidecasting operation there is no rehandling of material and thereby it is the most economical operation. Any increase in the height of dragline bench or cut width would give rise to an increase in first-dig and this increase is not possible to be accommodated in the dump.

Case-3. When A3>0

This implies that the dump is incapable of taking the loose first-dig completely and A3 amount of overburden would be left as residual. This residual can be handled in two ways, either by transporting and dumping elsewhere or by generating extra dump capacity can be increased by increasing reach. Reach can be increased by selecting different equipment with higher reach. But the choice of availability is limited. Alternatively the reach can be increased by shifting the dragline towards the dump side. Extended bench method of dragline deployment is employed for this purpose.

APPLICABLE CONDITIONS FOR DRAGLINE:-

1. Gradients should be flatter than 1 in 6

2. Seams should be free of faults & other geological disturbances

3. Adequate Strike length of the quarry, should not be less than 1 km

4. Thick seams with more than 25m thick are not suitable

5. A hilly property is not suitable

6. Overburden can easily be excavated after blasting

MAINTENANCE OF DRAGLINE:-

Maintenance is responsible for the smooth and efficient working of an industry and helps in improving the productivity. It also helps in keeping the machines in a state of maximum efficiency with economy.

1 Breakdown Maintenance

2 Preventive Maintenance

3 Predictive Maintenance

4 Scheduled maintenance

5 Component-wise maintenance

3. CONCLUSIONS

With the advancement that has taken place in recent past in the field of productive or diagnostic maintenance system, it is possible to predict a failure of the machine much before they occur, so that maintenance staff can prepare themselves and arrange necessary parts required and skilled manpower for repairs to put the machinery back on line.

With the increase in size complexity and fleet strength of HEMM it is imperative to follow a planned preventive maintenance to keep the machines fit for long periods and improves the machine availability. The plan need not be elaborate initially and a humble beginning has to be made somewhere. Whatever simple may be the plan, it should be followed strictly.

Dragline usage & implementation should be increased since it one of the successful method used for removal of over burden, which is known through case study and has a scope for advancement and betterment through ages.

REFERENCES

[1] **Mishra G.B:** Surface Mining, Geominetech Publications, 2007, PP. 439-452.
[2] **Seymour C.A:** Dragline stripping extended bench method.
[3] **Satyamurthy M:** Dragline deployment in opencast mines, Minetech Volume10 No.1, pp 13-15.
[4] **Satyamurthy M:** Dragline deployment in opencast mines", Minetech Volume10 No.1, pp 13-15.

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