PERFORMANCE AND ANALYSIS OF BUCKET WHEEL EXCAVATOR IN INDIAN COAL MINE

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Abstract - The investigation presented in this project is how the coal is excavated by using SME MACHINE BUCKET WHEEL EXCAVATOR in open cast mine present in NEYVELI Lignite mine the project work done in NLC India limited Tamil Nadu

The process done by BWE is to excavate the both over burden and lignite in mine the process doing is not easy there is an maintenance work ,lubricant process electric power consumptions is important the excavation capacity of lignite by BWE in one rotation of bucket wheel is 1400 litres, 14 bucket contain in the wheel of BWE ,in this process it observed how the bucket wheel is working what are work is carried out in BWE

In this theory, the performance of the BWEs at neyveli have been statistically analysed to determine the effects of physico-mechanical properties of overburden blasting and rainfall on machine productivity, availability, wear- and-tear of bucket teeth power consumption, production efficiency and cost of mining. An empirical relationship between the production efficiency, defined as the ratio of actual production rate to the theoretical one, and the bench height and width, height of slices, specific cutting resistance of the overburden material and its clay content, consumption of explosives, and conveyor length has been established.

This paper is concerned with the methodology for the calculation of risk or probability of slip along planar discontinuities within rock mass. A risk model is presented in which both geometrical and shear strength parameters may be regarded as random variables. However, the focus attention on the randomness of shear strength parameters. Adjacent discontinuities may be dissimilar in respect of shear strength parameters. However, individual shear strength parameter may be correlated and, therefore, the safety margins against slip along individual discontinuities are also correlated. Thus, it is not sufficient to calculate risk of failure along discontinuity as an independent event. It is also important to calculate the conditional probability of failure along a discontinuity given that an adjacent discontinuity has slipped. The relevant equations and calculation procedures are outlined and typical results presented.

The result of three case studies concerning the control of floor-heave problems are presented. Finite element modelling was employed to identify the causes of excessive floor heave, to propose remedial measures, and to evaluate the effectiveness of mine layout design in controlling floor heave. Five different chain pillar designs were modelled in this third study.

Key Words: Lignite, overburden SME (specialised mining equipment), BWE (bucket wheel excavator Excavation capacity, physic mechanical, machine productivity, power consumption, methodology, shear strength parameter, consumption of explosives, conveyor length, layout design.

1.INTRODUCTION

A Bucket wheel excavator (BWE) is a large heavy equipment machine used in surface mining. The primary function of BWEs is to act as a continuous digging machine in large-scale open pit mining operations, removing thousands of tons of overburden a day. What sets BWEs apart from other large-scale mining equipment, such as bucket chain excavators, is their use of a large wheel consisting of a continuous pattern of buckets used to scoop material as the wheel turns. They rank among the largest vehicles (land or sea) ever produced, and the largest of the bucket-wheel excavators (the 14,200 ton bagger 293) still holds the Guinness world record for heaviest land-based vehicle ever constructed.

It can move 240,000 cubic meters of earth per day, it's as heavy as more than 8,600 cars, and it's as tall as the statue of liberty these are just some of the outstanding features of bucket wheel excavator in the world, and it is still one of the biggest land vehicles today.

Machines used to mine large volumes of minerals over longer periods must above all be efficient and economical. And this is where Thyssenkrupp's continuous mining technology comes into play. Bucket wheel excavators are the ideal solution: they can move as much lignite and overburden in a day as 40,000 workers-240,000 cubic meters, equivalent to more than 10,000 dump truck loads. The material is picked up by the bucket wheel and transported on conveyors over three meters in width. The overburden is dumped by spreaders.

2. METHODOLOGY

2.1. Introduction

Bucket wheel excavator is one of the specialised equipment SMW (specialised mining equipment). It is used in open cast mines, in India the BWE is used in **neyveli lignite corporation Tamil Nadu** .It is an continuous miner, heavy working machine the primary function of BWE is to act as a continuous digging machine in large–scale open –pit mining operation ,removing thousands of tons of overburden a day. What sets BWEs apart from other large-scale mining equipment , such as bucket chain excavator ,is their use of a large wheel consisting of a continuous pattern of buckets used to scoop material as the wheel turns . they rank among the largest vehicles (land or sea) ever produced, and the largest of the bucket –wheel excavators(14200 ton bagger still holds the Guinness world record for the heaviest land – based vechicle ever constructed.

2.2 Specification of BWE

DESCRIPTION	VALUE
1.Capacity(Theoretical)	3750 m^3/hr(solid)
2.Bucket Capacity	1400 litres
3.Maximum Cutting Height	30 m
4.Deep Cut Below Track Level	2 m
5.Block Width	40 m
6.Number Of Crawlers	6(all with drives)
7.Width Of Crawler	2000 mm
8.Ground Pressure	12 N/cm^2
9.Track Speed On Level	8 m/min
10.Maximum Gradient	
While Walking	1:10
B.)While Working	1:20
11.Minimum Turning Radius Of Excavator	40 m
12.Number of Buckets	14
13.Number of Discharges/Minute	70
14.Outreach of Bucket Wheel Boom From Centre Of Machine	34 m

15.Cutting Boom Slewing Range	360 degree
16.Belt Width	2000 mm
17.Idlers	
Carrying	3parts 40degree
Impact	5parts 60degree
Return	2parts 15degree
18.Belt Speed	4.2 m/sec
19.Type Of Belt	ST 2250
20.Cable Drum Length Of A Cable	1000 m
21.A)Supply Voltage	11000V
B)Operating Voltage	3.3/0.433 KV,110 V
22.Total Power Installed	4537 KW

Fig-1: BUCKET WHEEL EXCAVATOR

3. parts of BWE

3.1. Bucket wheel boom

The innovative wheel boom design future a combination of full web and framework structures. This design enhances the torsional stiffness of the structure and minimizes its susceptibility to oscillation.

The bucket wheel head with the powerful 900 KW bucket wheel gear box was developed especially for the mining of soft to medium hard materials. Equipping the bucket wheel drive with a 6 kV medium voltage motor and frequency converter has reduced transformer power loss and cable cross sections.

Fig no 7: Bucket wheel

3.2. Bucket

by use of FEM calculation the buckets are designed to withstand major digging forces. The bucket design also lends itself for use in sticky material. larger internal radii and a special cutting tool carrier height/width aspect ratio of the buckets reduce material adhesion inside the buckets.

An extended bucket body minimizes the contact of the excavated material with the annular space of the bucket wheel.

The chain buckets facilitate the material discharge.

3.3. Wheel boom hoisting gear

The wheel boom is supported by two hoisting cylinders which are hydraulically coupled using specially designed circuits. This ensures low-vibration of the SR(H)1050, even where continuously changing material hardness in the block occurs and eases the mining of thin material layers.

Each of the hoisting cylinder is equipped with mobile piston protection system to protect them against damage.

3.4. Crawler tracker

The optimized design of the crawlers with 6 track rollers enables more efficient production, maintenance and repair of all crawler track components and a more efficient rate of advance of the SRs(H) 1050 compact bucket wheel excavator.

The shorter and more compact crawlers facilitate extremely economically block excavator.

The latest generation of crawler girders and equalizers are integrated in an open crawler girder design which facilitates maintenances are repair of wear components(equalizers can be removed without lifting equipment). In addition to this, rockers and track rollers are constructed according to the reliable lifetime design.

3.5. Front steering track (FST)

Front steering track is placed at face of bucket wheel left side it has two crawler this track move forward of bench face

3.6. Reverse steering track (RST)

Reverse steering track is placed at the back of the (FST) discharge boom of BWE it move backward of front bench

3.7. Self alignment track (SAT)

Self alignment track is placed at right side of the bucket wheel which is help to move right and left side for BWE

Cable routing

Cables are routed between the undercarriage and superstructure via a unique cable saddle that is seated in two independent pivots in the enclosed machine room of the SRs(H)1050

There they are protected against dust and dirt.

This method of cables routing achieves an operational superstructure slewing range of 360° relative to the undercarriage via a simple, trouble free design.

3.8. Conveyor

Conveyor is used in BWE us B1 belt and B2 belt the belt B1 is fitted with hoper near the bucket wheel it receive the OB and lignite from bucket wheel passed to the receiving boom and the boom is deliver to the belt B2 which is fitted with receiving boom the belt is then passed to delivery boom end of the bucket wheel.

3.9. Operator cabin

Operator cabin is for operating bucket wheel the cabin is only for the operator the cabin is carrying with one A/C and fan then monitor which is connected with cameras ,all data monitors display for overall BWE to check the problems of BWE one landline phone etc…

Operator cabin is one for bucket wheel and another one wheel for discharge boom.

3.10. Electrical controls

The electrical control is placed at the top of the BWE near the counter weight it has three transformer the electrical cables are fitted at bottom of BWE cable drum all the electrical cables wires are plugged with electrical room all the current, power source are noted at the room with meter circuit.

3.11. Receiving boom and discharge boom

The receiving boom is receive the OB and lignite from the B1 belt one conveyor the receiving boom is fitted at centre of the BWE it carry heavy amount of OB and lignite and deliver to the B2 belt to the discharge boom the discharge boom is end of the bucket wheel it discharge the OB and lignite to direct main conveyor or to the MTC

3.12. hoisting rope

Hoisting rope is to hoist the bucket wheel and discharge boom in vertical direction the rope are totally 22 which is winded with 16 wire rope are well grease to be strong.

3.13. rotary plate

The rotary plate is fitted with near the bucket wheel it receive the OB and lignite it will direct to the hoper the rotary plate has 8 plate.

3.14. Application of BWE's

Bucket wheel excavators and bucket chain excavators take jobs that were previously accomplished by rope shovels and draglines. They have been replaced in most applications by hydraulic excavators, but still remain in use for very large-scale operations, where they can be used for the transfer of loose materials or the excavation of soft to semi-hard overburden.

3.15. Size of Bucket Wheel Excavator

The scale of BWEs varies significantly and is dependent on the intended application. Compact BWEs designed by ThyssenKrupp may have boom lengths as small as six metres (20 ft), weigh 50 tons, and move 100 m^3 (3,500 cu ft) of earth per hour. Their larger models reach boom lengths of 80 m (260 ft), weigh 13,000 tons, and move 12,500 m^3 (440,000 cu ft) per hour. The largest BWE ever constructed is TAKRAF's Bagger 293, which weighs 14,200 tonnes and is capable of moving 240,000 m^3 (8,500,000 cu ft) of overburden every day. Excavations of 380,000 m^3 (13,000,000 cu ft) per day have been recorded. The BWEs used in the United States tend to be smaller than those constructed in Germany.

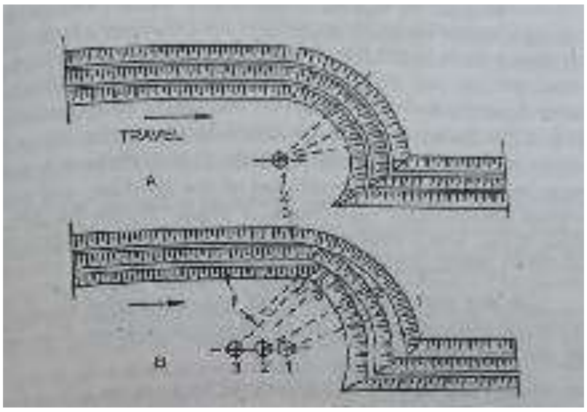
conveyor

4. WORKING OF BUCKET WHEEL EXCAVATOR:

4.1. Full block method

This is commonly adopted and is the position of the excavator by numerals 1, 2, 3, of the full block method is practised with a bucket wheel excavator having a boom that can be pushed out and pulled back i.e., capable of thrust forward the full block method as practised with an excavator having a bucket wheel boom that can be lifted and lowered but has no thrust movement,

Where selective wining of minerals is not necessary, full block method is employed so that the bucket wheel cuts in full blocks and parallel operation with cuts which are made as wide as possible .the blocks removed by giant bucket wheel excavators have a width 45 m to 100 m. this large width of cut which can be maintained along the whole face, not only reduces the travel way for the crawlers, and consequently, the time required for this displacement, but also that shifting work required for the transport system used to dispose of the mineral. The method is therefore simple and 1:20 into the new block and finally excavators the ramp also

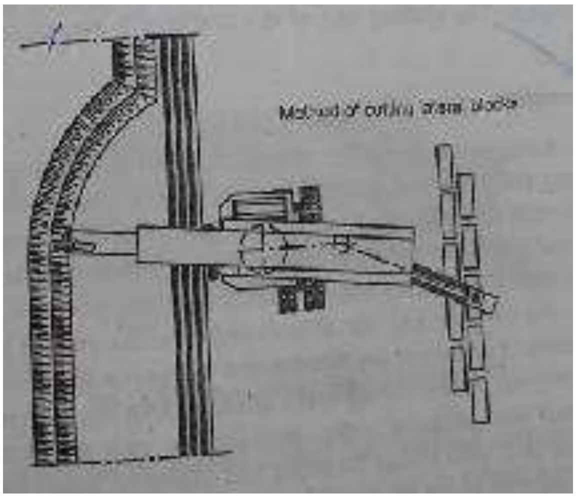


4.2. Lateral block method

In order to remove continuously waste partings or mineral seams of minor thickness selectively the excavators adopts the method of cutting lateral blocks. Both bucket wheel excavators with thrust or without thrust-can dig the necessary lateral slopes. The width of the block depends, however, always on the length of bucket wheel boom. bucket wheel excavators with a short bucket-wheel boom are not suitable for cutting lateral blocks. Should the level of the selected seam lie high above the travel-way of the machine, and taking into account the necessary slope angle, a "super" bucket wheel would be required, i.e., with a diameter large than that which would actually be needed for the output required.

In any case, the amount of crawler travel increase with decreasing width of blocks. the travel-way is reduced if an excavator with thrust is employed.

The excavated rock is transported by a system of belt conveyor mounted on the machine to hopper cars and then to belt conveyors or rail wagons. The loading belt of the machine is also mounted on boom.



5. EXCAVATING OF OB AND LIGNITE

5.1. Wheel and Digging

The "sector" for the ability of the machine to dig through semi-hard rock lies in its wheel and in its digging technique.

Common bucket wheels are designed with a bucket wheel body on which the individual buckets and precutter are mounted separately.

With the new wheel the buckets and teeth are an integral part of the wheel body and the flow of the circumferential forces goes undisturbed from the teeth directlu into the main wheel plate.

The teeth itself are designed in a long and pointed form. This profile assures that the teeth attack the material with the tip only and the full power of the strong wheel is directed at a s small area into the material.

The high specific force which is gained by this makes it possible to cut even very hard material.

5.2. Material handling

Bucket wheel technology is used extensively in bulk materials handling. bucket wheel reclaimers are used to pick up material that has been positioned by a stacker for transport to a processing plant.

Stacker reclaimers, which combine tasks to reduce the number of required machines, also use bucket wheels to carry out their tasks.

In shipyards, bucket wheel are used for the continuous loading and unloading of ships, where they pick up material from the yard for transfer to the delivery system

6. CONCLUSION

Bucket-wheel excavators have been in use at the neyveli lignite mine in the state of Tamil Nadu, India, since the early nineteen-sixties. The mining environment has been particularly harsh for BWE application. The adverse influencing factors are the hardness of the over-burden formation, high abrasivity of rock and artesian ground water conditions.in this paper, the performances of the BWEs at Neyveli have been statistically analysed to determine the effects of physic-mechanical properties of overburden, blasting and rainfall on machine productivity, availability, wear-and-tear of bucket teeth, power consumption, production efficiency and cost of mining.an empirical relationship between the production efficiency, defined as the ratio of actual production rate to the theoretical one, and the bench height and width, height of slices, specific cutting resistance of the overburden material and its clay content, consumption of explosives, and conveyor length has been established

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