STUDY OF FRAGMENTATION SYSTEMSIN AN OPEN CAST IRON ORE MINE

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ABSTRACT:

This paper effort has been done to study the fragmentation systems in an open cast iron ore mine. For the economic expansion of any country mining industry plays an outstanding role.In open cast iron ore mine, drilling and blasting plays an important role for the production.from an open cast iron ore mine the information is taken to study the fragmentation systems.Itissoenticing to haveauniformfragmentdistribution,avoiding bothfinesandoversizedfragmentstooverallcost ofmining.Here, few situations which regulate the fragmentation i.e., explosive properties, geometry of the strata etc.Inmining operationtheprimaryaimisto achieveultimateextractionofmineralscareinaspecttheenvironmental,economic andlease compulsion. The fragmentation of the rock depends upon drilling and blasting operations.Developmentinproductionhasbeenaccomplishwiththehelpofgenerouscapacity opencast machineries,endlessmining systemwithbetter-qualitydesign.

Keywords: Environmental, Economical, Fragmentation, Production.

1. INTRODUCTION:

The Drilling and blasting performances are conducted for extraction of iron ore in open cast mines[1]. Due to blasting air blast, flying rocks, back breaks, noises etc. These arenot escapable and cannot be completely eradicate but certainly minimize up to permissible level to eliminate damage to the neighboring environment with the present structures. Among all the adverse effects, ground vibration is a matter of major burden tothe planners, designers and environmentalists. A number of inquirers have considered several methods to dilute the ground vibration level in the meanwhileof blasting operation. Ground vibration preciselybank on the quantity of explosive used and

distance between blast face to checking point as well as geological and geotechnical conditions of the rock units in excavation area[2].

Blast convinced ground vibration is consequence from the use of explosives that has historically been a very difficult problem to effectively reduce. Many irregular and site constants are involved in the equation that when get combined, result in the creation of a compound vibration waveform formed by the restricted detonation of an explosive charge. The function of appropriate field controls during all steps of the drilling and blasting operation will help to minimize the poor impacts of ground vibrations, providing a well-designed blast plan that has been engineered[3]. This design will help in address in mind the appropriate hole diameter and pattern that would echo the efficient application and distribution of the explosive's energy burdened into the blast hole. It would also provide for the correct amount of time between neighboring holes in a blast to provide the explosive the excellent level of energy detention. When the blast is perfectly designed, then the specification that have the extreme effect on the composition of the ground vibration waveform are:

- Geology between the blast site and the control location
- correct timing between blast holes in a detonation sequence

Explosive is the most commonly used power to fragment of rock mass in mining engineering projects. Themain intension of blasting in mining projects is to achieve the maximum output wit desired fragmentation in a secure manner with minimum side effects like ground vibrations, noise and fly rock. Blast outcome can be classified into two groups of desirable fragmentation and unwanted results like back break, toe formation etc. A number of factors dominating the blast results, which can be organized into controllable and uncontrollable factors. Fragmentation control through adequate blast design and its effect on productivity is a demanding job for the practicing blasting engineer due to deficient knowledge of substantial explosive energy released in the borehole, effect of changing initiation practice in blast design and its effect on explosives energy release component.

Geological and geotechnical circumstances and distance between blast face to checking point cannot be changed but the only factor, i.e. quantity of explosive can be conventional based on certain empirical formulae anticipated by the different investigators to make ground vibrations in an acceptable limit[4]. A convenient and rock friendly blasting can be only alternate for smooth improvement of the rock eliminated process.

2. ROLE OF FRAGMENTATION SYSTEMS IN AN IRON ORE MINE:

The role of fragmentation systems are playing mainly this sense to reduce the size of rock. By the traditional mining operations like drilling, blasting, loading, haulage and crushing methods will arise a successful fragmentation. Theproductionof awellfragmentationandlooselypacked muckpilethathasnot beendistributedaround theexcavationarea promoted loadingandhauling operations.

Fragmentationcharacteristicscontrolmuckingproductivity,crusher throughput andenergy utilization,plantefficiency,outputandrecovery,orthepriceitselfoftheendproductinthe caseofindustrialmineralsand aggregates.Therearecontrollableparametersand the uncontrollable parameters to control the fragmentation[5]. Controlparameters are types of explosives,delaytime,benchparameter,firingpatternetc.

Thecontrollableparametersareaccommodatingsuch thattogetoptimum fragmentation theproduction of riprapwillinvolvetheuseof holeswitha spacing greater than thelargestblock size required.

There are two forms of rock breakage viz., rock penetration and rock fragmentation. The former includes drilling, cutting, boring etc., while the latter includes blasting etc. The term rock penetration is preferred for all methods of forming a directional hole in the rock. There are many types of rock penetration depending on the form of energy application, viz. mechanical, thermal, fluid, sonic, chemical etc. The mechanical energy, of course, encompasses the majority (about 98%) of rock penetration applications today. The application of mechanical energy to rock can be performed basically in only one of the two ways: by percussive or rotary action. Combining the two results in hybrid methods termed roller-bit rotary and rotary-percussion drilling.

2.1.Drilling*:*

The drilling operation can be adopted for to blast the overburden and ore depodits.in this open cast iron ore mine rotary percussive type of drilling machines are used. Mostly iron ore mines are preferring rotary type drilling machines. Zig-zag and square patterns are using for drilling. The drilling operation can affect the fragmentation of the rock.

2.2.Blasting*:*

Theblastingoperationmustbecarriedout to providequalityand quantityrequirementsof production.Theproductionof awellfragmentationandlooselypacked muckpilethathasnot beenscatteredaround theexcavationarea facilitates loadingandhauling operations. Fragmentationcharacteristicsinfluencemuckingproductivity,crusher throughput andenergy utilization,plantefficiency,outputandrecovery,orthepriceitselfoftheendproductinthe caseofindustrialmineralsand aggregates.The fragmentation can be done by the controllable factors

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2.3*The parameters required for optimum blasting:*

1. Bench height
2. Blasthole diameter
3. Burden
4. Initiationsequence for detonation of explosive
5. Nature of the rock
6. Powder factor
7. Spacing
8. Sub-drilling
9. Type, weight, distribution of explosive

2.4 *Mechanism of rock fracturing by blasting:*

Themechanismbywhich rock is fractured by blasting is based on thedesign ofblasting patterns, whetherforproduction[6].Whenanexplosiveisdetonated,itistransformedwithinafewthousands of secondinto ahightemperatureand high-pressuregas[7].Whenrestrictedinblasthole,thisrapid, reactionproducespressures,tobeexertedagainsttheblastholewall.Thisenergyis transmitted intotheneighboringrockmassintheformofacompressivestrainthattravelsatavelocityof 2000-6000m/s.

(A)

(B)

Fig. No. 1(A&B) : Fractured rock after blasting

Fig. No.2: Mine surface

3. Field observations&Data collection:

The visited iron ore mine is regular workings with two shifts of mining operations. For the drilling operation Bigger drilling machines are used. For the blasting operation, ammonium-based explosives are used.

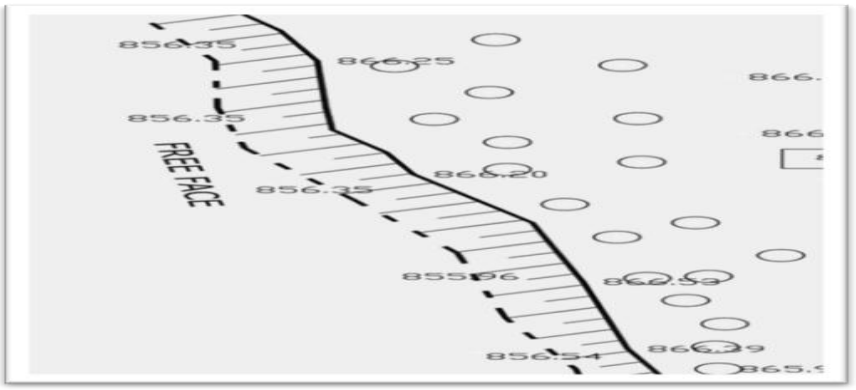
Fragmentation: It is accessible that fragments build by the blasting operation must not only physically fit into the bucket of excavator but must do so without inappropriately reducing the bucket load or fill time. If the size of the fragments in a muck pile is larger than the size that machinery can handle, it will reduce the productivity of excavator. It is accessible that finely fragmented muck pile will improves the dig capacity of an excavator.

The data is collected from an open cast iron ore mine in region of Bellary, in the state of Karnataka regarding the blasting session of the regular mine operations. The blasting session is conducted once in the day for the two shifts of the mine operations.

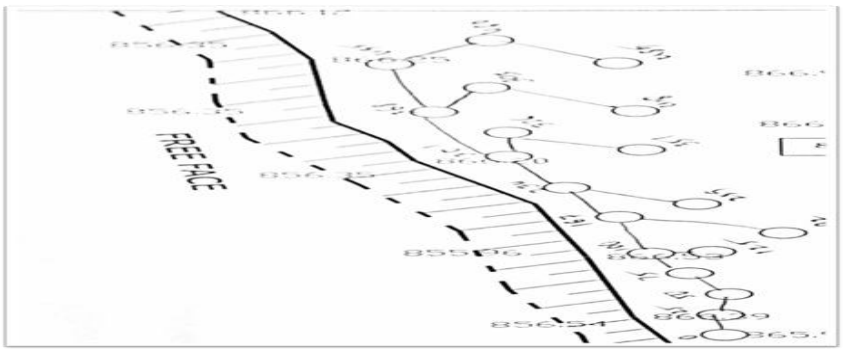
Sl. No	Parameters	Blast No.1
1	Location of Blast	RL:860 TOP
2	Diameter of Blasthole (mm)	250
3	Burden (m)	7

4	Spacing (m)	9
5	Drilling Pattern	Staggered
6	Depth of Blasthole (m)	15
7	Stemming (m)	Avg 7.5
8	No. of Rows	03
9	No. of Blastholes	19
10	Explosive Charge/Hole (kg)	350
11	Maximum Charge/Delay (kg)	390

Table No.1: Details of the blast



(A)



(B)

Figure No.5: Blasting pattern

3.1 ***Desirable optimum fragment size affects the mining operations as follows:***

the desirable optimum fragmentation of the rock can affect the regular mining operations.

- Low dig cycle time of the loading equipment
- Decreased cycle time of the hauling equipment
- Decreased or no secondary blasting
- High fill factor for the loading and hauling equipment
- Less energy utilization during crushing
- Appropriate selection of the loading, hauling, and crushing equipment

4. RESULTS AND ANALYSIS:

The fragmentation systems are studied by the traditional mining operations like drilling and blasting. the drilling operation is carried out by the hydraulic driller. For the blasting operation ammonium nitrate-based explosives are used. Explosive appropriately blast geometry and charge loading parameters are analyzed for the open cast iron ore mine.

6. CONCLUSIONS:

By planning correct drilling and blasting systems, enhanced fragmentation, improves muck profile, ground vibrations will be decreased, increasing the efficiency of shovel performance and cut down the cycle of all operations leads to overall cost reduction.

By observing the above practical data through visual observation, we come to conclusion that gravels are formed during blasting operations in present mine. In some cases, secondary blasting may also be necessary. As far as concerned the fragmentation produced best suits the machinery used for casting the overburden and transportation of iron ore.

REFERENCES

[**1**] Akbari, M., Lashkaripour, G., Bafghi, A. Y., & Ghafoori, M. (2015). Blastability evaluation for rock mass fragmentation in Iran central iron ore mines. International Journal of Mining Science and Technology, 25(1), 59-66.

[**2**] Bahrami, A., Monjezi, M., Goshtasbi, K., &Ghazvinian, A. (2011). Prediction of rock fragmentation due to blasting using artificial neural network. Engineering with Computers, 27(2), 177-181.

[**3**] Faramarzi, F., Mansouri, H., &Farsangi, M. E. (2013). A rock engineering systems-based model to predict rock fragmentation by blasting. International Journal of Rock Mechanics and Mining Sciences, 60, 82-94.

[**4**] Esmaeili, M., Salimi, A., Drebenstedt, C., Abbaszadeh, M., &Bazzazi, A. A. (2015). Application of PCA, SVR, and ANFIS for modeling of rock fragmentation. Arabian Journal of Geosciences, 8(9), 6881-6893.

[**5**] Ebrahimi, E., Monjezi, M., Khalesi, M. R., & Armaghani, D. J. (2016). Prediction and optimization of back-break and rock fragmentation using an artificial neural network and a bee colony algorithm. Bulletin of Engineering Geology and the Environment, 75(1), 27-36.

[**6**]Hasanipanah, M., Armaghani, D. J., Monjezi, M., & Shams, S. (2016). Risk assessment and prediction of rock fragmentation produced by blasting operation: a rock engineering system. Environmental Earth Sciences, 75(9), 808.

[**7**] Singh, P. K., & Sinha, A. (Eds.). (2012). Rock Fragmentation by Blasting: Fragblast 10. CRC Press.