A STUDY ON BLAST INDUCED AIR OVERPRESSURE

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Abstract: Blasting is the important operation in extraction of mineral from the earth's crust. Blasting operations involves drilling the holes, charging the explosives, stemming with the incombustible material and blasting the holes, here blast waves break the huge size rocks to fragments and make easier to collect the broken material and send for beneficiation of ore, alone with the breakage of rock blasting, it also associated with the unavoidable outcomes like ground vibrations, air over pressure, fly rocks, toxic dust etc. Among all air overpressure has more severity on environment, In this paper an analysis has been done on blast induced air over pressure and result shown that scaled distance is inversely proportion to air over pressure, high air over pressure will archived when there is a low scaled distance and vice versa and also it is found that there is a difference between predicted value and actual value of blast induced air over pressure.

Index Terms **– Drilling, Blasting, Explosives, Blast induced Air overpressure.**

I. INTRODUCTION

The mother earth is with full of natural resources, the resources need to be utilized in an optimum manner. For the betterment of live hoods, good infrastructure is needed. Almost all industries directly or indirectly depend on mining industry. Mining industry is considered as back bone for the development of the Nation. In India mining industry contributes 2.2% to 2.5. Mining is the process of extraction of minerals from the earth crust in a safe and economical manner. Mining activity is carried out in various stages namely prospecting, exploration, development, exploitation and reclamation. Mining is carried in two ways, surface mining and subsurface mining. Surface mining means extracting the outcrop minerals, which is in the shallow depths. The surface mining operation is followed by four sequences of operations drilling, blasting, loading and transportation. Drilling and blasting are the two important operations in mining industry. Drilling is the process of making holes into the face or ore body in specific pattern by considering the nature of orebody. Blasting is the process of breaking the huge hard mass into fragments with the help of explosives. However, blasting operations not only gives fragmented rocks, but it also gives some negative outcomes like fly rocks, ground vibrations, toxic dust, air over pressure etc. Among all Ground vibrations and air over pressure have major impact on the environment. Air over pressure has a high potentiality to cause major damage to the environment.

The Blast Induced Air Over Pressure mainly affected by controlled and uncontrolled blasting parameters. burden, spacing, type of explosive and delay sequence are the controlled blast parameters and the strength of the rock the density of the rock and rock type are the uncontrolled parameters. The uncontrolled parameters are mainly affected by the physical and mechanical properties of rock, whereas the controlled parameters are affected by the blasting operation. In this study the Blast Induced Air Over Pressure was monitored at various blasting sites and the observed reading are compared with USBM predicting equation.

METHODOLOGY

Three different datasets of various Blast Induced Air Over Pressure were collected from various researchers by carrying some literature reviews on various blasting related published research articles. Drilling and blasting are the most popular techniques used for extraction of ore. Generally rotary, percussive and rotary percussive are the three methods used in drilling. Prior to drilling marking of holes in a specific pattern is followed, then drilling of holes is made by deploying machinery like down the hole in opencast mines. After the drilling of the holes, holes are charged with various types of explosives depending upon the nature of rock and another factors. High density of explosives is generally used for hard rocks and low density of explosives are generally used for soft rocks. Explosives are charged with detonator for low explosives and high explosives are charged with boosters due to the sensitive characteristic property. These charged explosives are tightly packed along with incombustible material, this process is called as stemming. After this, the charged holes are connected in series or in parallel or in combination of both series and parallel, the end is connected to exploder and with help of the exploder charged holes are blasted. Blasting process not only break the huge hard rock into small fragments but also negative outcomes like fly rocks, ground vibrations, toxic dust, air over pressure etc. which may lead to damage of structures, machineries, and loss of property and life. However, it is not possible to eliminate this negative impact completely but, with the help proper methodologies these negatives impacts are reduced and prevent loss of life and property.

Generally, the drilling is practiced in three methods, percussive drilling method is process of impact hitting the number of strokes on the surface to make the hole, but it is applicable to few meters in the earth's crust. Rotary drilling method is process of making the hole in the earth's crust by rotating action on the surface. Rotary-percussive is the combination of both rotary and percussive, this method is advance of both methods. Depending upon the geological characteristic of rock and availability of drilling machinery, according to that drilling method is adopt in the mines. After drilling the holes in a specific pattern, explosives are charged with boosters or detonators depending upon the sensitivity of explosive, direct or indirect initiations system is followed for blasting the charged holes. During the blasting operation the Blast Induced Air Over Pressure was monitored with the help of a special equipment called minimate, this instrument mainly consists of two major components namely Geophone and Microphone. The Geophones connected to micromate measures ground vibration in three directions vertical, transverse and longitudinal. These

geophones will measure a frequency range which will obey the standards given by ISEE (International Society of Explosive Engineers) its frequency range varies from 2 to 250 Hz, to measure air overpressure which is produced during blasting activity the linear microphone is used it can be directly connected to the port provided on micromate apparatus with the help of cable the figure of the minimate is depicted in Figure 1.

Figure 1 : Minimate equipment at field

Air over pressure (or) Blast over pressure is the pressure caused by a shock wave over and above normal atmospheric pressure. The shock wave may caused by sonic boom or by explosion and resulting overpressure receive particular attention when measuring the air over pressure. Air over pressure commonly occurs during the blasting operation. The energy that released after the blasting that creates an air over pressure. that is also known commonly known as "air blast" in the form of propagation wave. An empirical equation is use to predict the air over pressure based on the scaled distance and site values.

The empirical equation used to predict the air overpressure is

$$AoP = \alpha(SD)^{-\beta}$$

$$SD = \frac{D}{\sqrt[3]{W}}$$

Where,

- AoP = Air over pressure, pa
- SD = scaled distance m/$kg^{0.33}$,
- D =distance in meters,
- W = amount of explosive in kg,
- α *and* β are the site factors.
- These site factors are computed by regression analysis method, there may varied from place to place depend on the geological conditions.

IV. RESULTS AND DISCUSSION

The Blast Induced Air Over Pressure was measured at three blasting areas with the help of mininmate equipment and the observed reading are tabulated in Table 1, Table 2 and Table 3

Table 1 : Data set of Site A

serial number	Distance (m)	weight (kg)	scaled distance ($(m/kg^{0.33})$)	Predicted AOP (pa)	Actual AOP (pa)
1	180	9	87.17	39.649	39
2	115	92	25.86	218.362	220
3	140	8.5	69.09	54.9	33.08
4	120	9	58.11	70.064	75
5	165	9	79.9	44.805	34.13
6	39	9	18.88	339.626	350.01
7	85	15	34.78	144.031	154
8	60	36	18.39	352.4	370.11
9	94	27	31.69	164.139	155.99
10	126	9	61.02	65.419	61.08

Here at site A the site factors are the are 261.54, -0.706

Table 2 : Data set of Site B

serial number	Distance (m)	weight (kg)	scaled distance $m/kg^{0.33}$	Predicted AOP (pa)	Actual AOP (pa)
1	73	134.5	14.48	39.6321	33.6
2	220	369	31.28	23.008	23.49
3	80	265	12.73	43.403	44.1
4	195	309.5	29.38	24.048	20.46
5	110	317	16.44	36.2335	33.57
6	35	266	5.54	78.094	82.41
7	135	101	29.43	24.019	25.47
8	270	45	76.87	12.195	11.5
9	55	336	8.06	59.8	50
10	212	49.5	58.54	14.781	16.11

Here at site B the site factors are 1833.8 and -0.981

Table 3 :Data set of Site C

serial number	Distance (m)	weight (kg)	scaled distance $(m/kg^{0.33})$	Predicted AOP (pa)	Actual AOP (pa)
1	30	293	4.6	410.38	410.8
2	50	229.5	8.31	229.732	214.99
3	40	123.5	8.16	233.8	279.98
4	28	348.5	4.05	464.984	490.52
5	50	400	6.92	274.92	225.04
6	30	225	5.02	376.67	260.09
7	50	118	10.35	185.223	200.01
8	145	104	31.31	62.529	76.92
9	120	161	22.43	86.733	84.34
10	217	50	59.67	33.215	37.67

here at site C the site factor values are 21014 and -1.404,

CONCLUSION

Blasting is the important operation in mining activity. Air overpressure, fly rock, back break toxic dust, ground vibrations are unavoidable outcomes of blasting in opencast mines. Air overpressure is considered as the most dangerous outcome if it crosses it safety limit. Therefore, it needs to be below the danger levels, to make it to be happen prediction of air overpressure is good idea, there are empirical equations and artificial intelligence techniques for predicting the air over pressure. In this paper an empirical equation is used to predict the air over pressure and the actual air over pressure was compared with actual values and the results shown that the empirical predicted values are generally higher than the actual value recorded while blasting, 10 blast shots at three different areas were predicted and compared with actual value, most of the shots were predicted higher value than the actual value, some are varied due to environmental conditions like temperature inversion, wind direction, clouds, weather, topography or surface condition and the stemming length, material used, geological conditions nearer to it and some other factors. Further it is observed that the value of air over pressure is more when the scaled distance minimum and vice versa.

It is recommended to predict air over pressure before performing blasting operations, if high air over pressure is noticed, precautions can be taken against it so that the impact of air over pressure can be minimized

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