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MINE PLANNING OF ROCK PHOSPHATE MINE USING DATAMINE SOFTWARE

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Abstract - *As the demand for raw materials is increasing at a steady rate and in order to bridge the gap between supply and demand, technological advancement and automation in production method is needed. To maximize extraction level and aiming for zero mining waste, while adhering to all safety and regulatory norms. A mine plan - most accurately reflects the real - time reality of the geological structure in the ground, the process capabilities and the economic unpredictability of demand and commodity markets; which results in a productive, predictable and profitable system within mining structure. In this project , an effort have been made to estimate the resource using Datamine software for orebody modeling of rock phosphate mine and ultimate pit is optimized using Raw Mix Scheduler to get maximum mineable reserve and minimum losses which increase the life of mine significantly. The three year planning has been done by creating pushback using NPV scheduler and production planning using Interactive Short Term Scheduler, which helps in day to day planning. Mine planning of rock phosphate mine has been done using Datamine Software and its other modules and compared with conventional method.*

Key Words: **rock phosphate planning, Datamine software, rock phosphate mine, open pit planning, surface mine planning,**

1.INTRODUCTION

In light of everlasting demand of ore, limited availability of suitable deposits, environmental compulsions and many other factors like reclamation, mine closure plan, governmental policies for taxation etc., have forced the technocrats towards the efforts for enhancing the productivity as well as maximum percentage of extraction. In the specific Indian deposits, advancement and availability of heavy earth moving machinery and increased scope of bulk mining are the major factors which have given preference to opencast mining. It is the need of hour and it has become imperative to enhance maximum productivity from the mine by the help of proper planning and scheduling the operation.

As *Sevim & Lei, 1998* stated that open-pit mine planning requires simultaneous solution as it is a multi-parameter optimization problem, all the parameters as input to mine planning are interdependent to each other, thus the very fact causes the most proper planning becomes tedious and eventually faulty if the effect of each parameter upon each other is not taken into account. In this project, an effort was made to estimate the resource developing orebody models using Datamine software and then Optimising the form of the pit and ultimate pit design to enable maximum extraction of the deposit. A proper mine planning is required which can be done by software using Interactive Short Term Scheduling process in every stage of mining which eventually helps the management in taking appropriate decisions. For the purpose of the planning by the Datamine, a Rock phosphate deposits were considered of an existing large Rock Phosphate mine.

1.1 Software in Mining Industries

The mining deposits were evaluated in past by conventional methods, which takes lot of time in the data compilation, plotting, interpolation and interpretation. The same sequence of exploration activities is followed today using the software and the use of this tool provide a high quality route to the rapid analysis and display of exploration data in the field, for reserve estimation and with more options in hand for mine planning grade control and production scheduling, which has helped in improving the economics of mining operations.

The study involves collection of exploration data and then those data are analysed and subsequently the analysed data were used to generate the block model using Datamine software and the same was analysed with the field data to know how much accuracy level between the model created by DATAMINE software and manual model, and also the reserve calculated by both the methods. The methodology can be summarized as:

- Collection of Exploration data
- Importing the same to the DATAMINE software
- Generating holes in Software and then creating topography either collar data or contour file
- Solid 3D structure of the ore body
- Geostaticcal analysis of the exploration data
- Generating waste and ore block model and then combining it to make a single resource model

- Geological Reserve Calculation and then comparison with the manual technique of reserve calculation
- Ultimate pit generation and calculating Mineable reserve and life of mine
- Comparison of Conventional and Computerized methods

1.2 Mine Planning and Production Scheduling

Matheron's geo-statistical method (the estimation of ore reserves) has been developed to the point at which real-life problems may be handled effectively (*David and Blaist 1997*). The steps involved in the method are obtaining the Variogram, Fitting a model, and producing block estimates.

Following the development of several 2D mathematical methods for determining the best UPL on vertical sections, multiple studies were conducted to integrate 2D sections and create 3D pits (Johnson & Sharp, 1971; Wright, 1987). Later, Koenigsberg and Mamer (1982) and Wilke & Wright (1984) were able to address the 3D pit design problem using dynamic programming directly. One of the most often used algorithms in the open-pit optimization sector is Lerchs and Grossmann's algorithm (1965). After that, other researchers (Huttagosol and Cameron, 1992; Yegulalp and Arias, 1992; Zhao and Kim, 1992; Hochbaum, 2001) attempted to build more efficient methods for the UPL problem (Espinoza et al 2013).

2. FIELD INVESTIGATION AND LABORATORY WORK

For production Scheduling of Rock phosphate mine the ISTS module of Datamine software was used for which the requirement was latest survey of the mine. Then the block model was generated and then compared it with the existing mines production techniques. After the reserve calculation it was compared with the method adopted at mines in terms of quantity, quality, cut-off grade and life of mine. The resource modelling is carried out based on 184 drillholes. The drillholes are vertical and is regular with spacing of the holes varying from 100 m to 150 m. Rock Phosphate has been categorised as Low, Medium or High Grade ore based on actual P_2O_5 content;

High Grade Ore (***HGO***) : +25% P_2O_5

Low Grade Ore (***LGO***) : less than 25% P_2O_5

2.1 Field Work

1. Collection of Exploration data (Assay, survey, collar and litho) of Rock phosphate deposit.

   a. Assay file include chemical composition of deposit.

   b. Survey file include only if holes are inclined as it having the information related to dipping of the borehole.

   c. Collar file include coordinate of borehole.

   d. Litho file include lithological information about the rock formation.

2. Contour data collection which is going to be used for the generation of surface topography.

3. Study of various types of radical present in Rock phosphate deposit such as P_2O_5, SiO_2, CaO, MgO, R_2O_3, LOI, etc.

4. Study of field geometry such a forest land, Coastal Regulation Zone (CRZ) line, high tension line etc.

5. Study of current technique of production scheduling and conventional method of reserve estimation and mine planning.

Table -1: Raw data files

Files	Fields
Collar	BHID, XCOLLAR (Easting), YCOLLAR (Northing), ZCOLLAR Collar (Elevation)
Assay	BHID, FROM, TO,P_2O_5, SiO_2, CaO, MgO, R_2O_3, LOI, CR.
Lithology	BHID, FROM, TO, ROCK TYPE, ROCK CODE

2.2 Computing Lab Work

1. Geological Block model using DATAMINE software.
2. Ultimate pit optimisation of the rock phosphate deposit using mines parameter with the help of DATAMINE and NPV.
3. Calculation of Geological & Mineable reserve and compare with the conventional mines method of reserves calculation in terms of quantity, quality, cut-off grade and life of mine.
4. Production scheduling using ISTS module of Datamine and comparison of it with mine production scheduling technique.

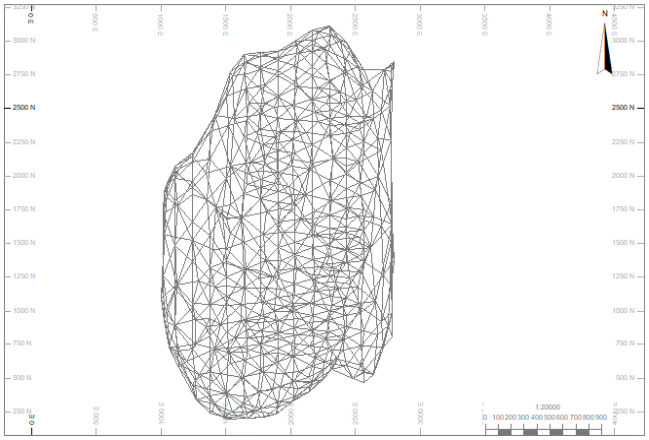


Figure -1: Wireframe model of Rock Phosphate

3. RESULTS AND DISCUSSION

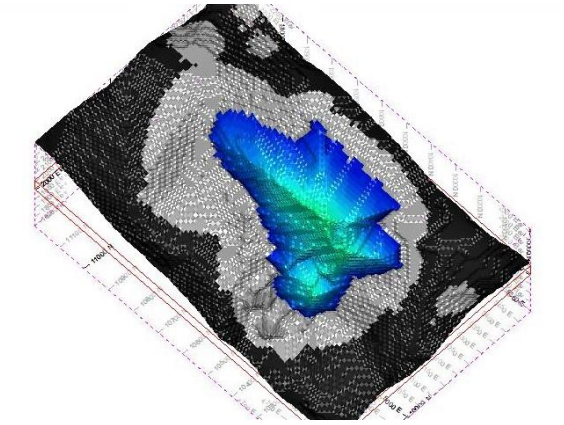
The results obtained after creating resource model using Datamine software with different grade estimation methods and comparing it with the traditional method in terms of quantity and quality. Yearly reserve is calculated by creating pushback using NPV scheduler for three years. Optimized pit is designed based on yearly mineable reserve calculation using NPV scheduler and designing parameter. Various losses have been calculated while evaluating mineable reserve and then quarterly calculation is done, the results of short term planning using ISTS has been discussed.

Table -2: Resources / reserves

Particular	Geological Resources	Mineable Reserves
	Quantity (Million Tonne)	**Quantity** (Million Tonne)
HGO (> 25% P_2O_5)	1.120	0.750
LGO (< 25% P_2O_5)	4.575	1.917
Total:	5.695	2.667

Total waste generation has been calculated till the life of mine and also the area required for the disposal of the waste is calculated. The total waste generated is 0.17 Million Cubic Meter and the area required will be 1.97 hectare.

Fig -2: Production Plan for F.Y 2021-22



4. CONCLUSIONS

On the basis of present study, following conclusions have been drawn and are given as under:

- Geological reserves estimation was carried out by both the methods i.e. Conventional and modern method and it was found to be same as far as quantity is concerned but there is significant difference in the quality in both the methods. Quality analysis from planning software is more resemble to the field data and also software helps to apply checks at every step for correction and back analysis.

- By ultimate pit optimization using RMS (Raw Mix Scheduler) scheduler, maximum reserve can be mined with minimum loss. The life of mine increased significantly as it optimizes the pit in the best possible way.

- Production scheduling is the most important part of mining activity to utilize maximum reserve with minimum loss and also to maintain steady production of mine. ISTS (Interactive Short Term Scheduler) is used for day to day mine planning and also weekly, monthly and quarterly planning.

- Yearly planning using NPV (Net Present Value) scheduler helps the selection of the area from where mining activity should be commenced, so as to maximize the reserve with minimum losses and also maximize the life of mine. Conventional method is not powerful in finding the location of area to be extracted in terms of quality target.

- As compared to conventional method, the analysis of quantity, quality and calculation is much easier and accurate by using Datamine (Planning Software), which helps in utilizing the maximum resources with minimum waste. And also facilitate

the spontaneous changes in planning as compared to traditional methods. It helps the management to take speedy and accurate decisions.

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