DESIGNING SUITABLE MINING METHOD AND PROCESSING PLANT FOR KUKURAMPOLA MAGNETITE ORE BODY

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ABSTRACT

Evaluation of mining methods for the exploitation of Kukurampola ore body is considered in this report. Minerals take millions of years to form, but exploitation takes only few decades. Therefore, mineral deposit is a wealth which must be used for the maximum benefit of the country. Iron is one of the most important metals in the world for many industries. Therefore, exploitation of iron ore is essential for the industrial development of a country. The Magnetite deposit in Kukurampola contains high purity Magnetite; hence it is a valuable resource need rational exploitation. Mining methods evaluated include open pit and underground, and based on geological, engineering, environmental and economical factors combination of both open pit and underground mining are considered as the most suitable mining method. Consequent to open pit mining underground mining will commence for future ore-body development and exploitation. A processing method is designed to produce feed material for palletizing those will include crushing, grinding and magnetic separation. If ample deposits are found in the future, there's a possibility of constructing a palletizing plant which need ore reserves for more than 25 years. Also, occurrences of magnetite in the neighborhoods are identified for further expansion of mining operations Special consideration is given to minimize environmental impacts. Remedial methods are proposed in this report to minimize adverse environmental impacts.

KEY WORDS

Acid mine drainage, crushing, magnetite ore mining, palletizing, primary blasting and secondary blasting

INTRODUCTION

The objective of this project is development of methodology for rational exploitation of Kukurampola Magnetite ore body. The Project also assesses developing mining methods and designing processing plants. It is also expected to identify occurrences of magnetite in the neighborhood for further expansion of mining operations.

The proposed Magnetite quarry site will be located within a 65 acre land area within the jurisdiction of Kumaragama Grama Sevaka Division, Which is belongs to the Buttala divisional secretary of Monaragala district, Uva province.

Geologically, the project area consists;

- Central magnetite vein system defined by a linearly arranged, sub vertical, with approximate N-S / NNE-SSW orientation
- Outcrops / in-situ boulders and
- Boulder-float or gravity-transported peripheral magnetite bodies in both West and East slopes.

Designing and developing suitable mining method is carried out, according to the ore reserve estimation and geological assumptions made in previous investigations. An open pit mining method is designed to exploit the deposit at the top part of the mountain, which will help to confirm the vein. Then, underground mining will be used to mine introduced to excavate deeper parts of the ore body.

A processing plant is proposed for crushing, grinding, magnetic separation and palletizing. Special consideration was given to minimize environmental impacts during mining and in the construction and operation of processing plant.

Locations of magnetite occurrences surrounding the deposit are found and future surveys could be carried out to confirm these veins and to extend the mining method accordingly.

METHODOLOGY

Magnetite occurrence near to Horakagodakanda are also located and given in Figure 1. Mining method was design status made in based on the geological data and ore reserve previous investigations. The team studied necessary documents including Environmental Impact Assessment (EIA) Report (Welideniya et.al, 2006) as a desk study.

Investigations were carried out to find out the locations of magnetite occurrences surrounding the deposit. The investigation team found that magnetite out crops few kilometers away from the deposit.

Designing of mining method

Underground mining method is designed for vein type ore body where out crope will be mined by multiple bench open pit. Total reserves are around 0.4 millions of tons.

Designing of open pit mine

The mine design depends on of factors such as; geometric outline of the ore body, topography, stability of overburden rock. The open pit mining method is designed to exploit the deposit at the top part of the along N-S direction and to confirm the vein.
Primary Bench blasting which 33-51mm diameter due holes length variation 8-12 feet deep would be done. The blast geometry is consist with 30- 35 holes having burden, spacing, hole length etc.
The Bench blasting would account factors such as distribution of Magnetite vein and environmental factors. According to the blasting method proposed, the surface excavation of the open-pit will bench a dip on of 15 m having a length of 750 m on N- S direction.

Ammonium Nitrate Fuel Oil (ANFO) with Gelignite will be used in blasting mud cap blasting and rock breakers will be used in secondary blasting.

Designing of underground mining

Mining will commence after sufficient information has been obtained from open pit mining and exploratory drilling.

Underground mining consists of blasting ore by successive horizontal lift and extracting from the slope. Mucking of the ore is done with a scraper or loader towards a chute, developed during backfilling the void then created is filled with material that can differ from one mine to the next, such as sand, gravel, ore residues. The backfill put in place serves as a floor while supporting the walls. This cut - and – fill mining method could be used in combination with other underground mining methods such as Open stopping Shrinkage stopping etc.

Considering maximum width of the vein, length, ore rock properties, starting location and dimensions of the adit is chosen. The proposed tunnel is arch shaped considering engineering properties of the host rock. Tunneling will employ drilling length could varying between 8-12 feet. Cut hole will be charged with Gelignite and surrounding holes with ANFO and Gelignite prime.

Underground Excavation

Cut-and-fill mining is suitable for a steeply dipping mineral deposits mass with moderate host rock stability. It removes the ore in horizontal slices starting from a bottom cut and advances upwards, allowing the slope boundaries to be adjusted to follow irregular mineralization. This permits high-grade sections to be mined selectively, after mining the mined out space is mine next slice and this sequence of work progresses to the upper boundary of the stop.

Sublevel stopping is also considered as an alternative mining method for thicker deposit having large strike length. Hadapanagala tank could be considered as the surface water supply for mining and processing

Processing

The crude ore is hauled to the primary jaw crusher, where it is reduced to chunks less than 150 mm in size. From the crusher, the ore is conveyed to a Tromel type screening unit. -500mm size lumps are fed into the jaw crusher by a vibrating feeder. By vibrate screener, 19-25 mm sized particles would be passed to grinding process. Larger particles are conveyed to a secondary cone crusher.

Then, particles are passed in to autogenous mill for grinding. Further grinding can be done in grinders and pebble mills which also operate autogenously. The output particles of size below 1-2mm are passed to magnetic separation. High intensity electro magnetic separator is used for Magnetite separation from crushed ore. Subsequent to the production of concentrated ore (made by magnetic process) dewatering begins as the material is thickened in large settling tanks. Vacuum disc filters are used for dewatering the concentrate for pelletizing.

The Pellet Plant proposed for the future will use -200m mesh. Powdery iron ore concentrate with a small amount of bentonite clay binder and a carbonations matter rolled into marble-sized pellets in balling drums.

The unfired pellets, or "green balls", are conveyed to the furnace where the temperature is gradually increased to dry and pre-heat them. The pellets then enter the huge rotary kilns where they are hardened by firing at temperatures above 1200 C^0. The pellets leaving the kiln enter a cooler where they are cooled to a temperature suitable for conveying.

Environmental aspects

The mining and processing plant is designed considering environmental effects and Special consideration is given to minimize the environmental impact.

Back filling and re-plantation methods are introduced for the deforestation and landscape degradation as remedial methods. Also, the mining method is designed to minimize effect on the nearly forest. (e.g.: introducing an adit). To minimize Acid Mine Drainage (AMD), water is directed to a tank or series of tanks and caustic soda (NaOH) is added to precipitate $Fe(OH)_3$.

Wet drilling, water spraying and dust covers are used to minimize the affect from dust. Ground vibration, noise, air blast over pressure and fly rocks could be minimized by professional blasting methods complying will standards. Self monitoring and random monitoring of the out side experts could be done on to monitor blasting, dust levels, ground vibrations, air blast over pressure, noise, fly rocks, water quality, safety factors, structural damages in the area. As well as rehabilitation and re-planting programmers, etc.

RESULTS

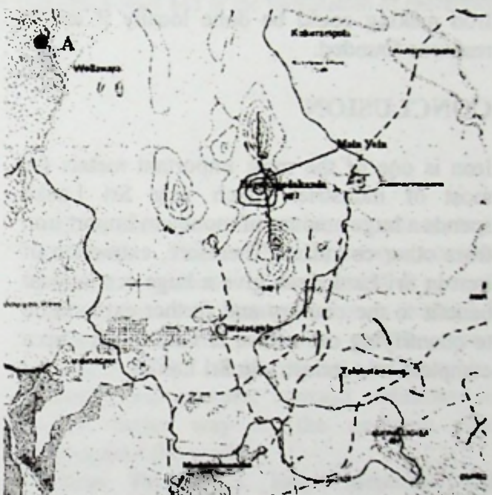

Figure 1: Surrounding magnetite Occurrences

At A (242277 E, 166431 N)
At B (245684E, 159626N)

DISCUSSION

Very high purity magnetite is found in the magnetite deposit located in Horakagodakanda, Kukurampola, Butthla. Exploitation of this magnetite deposit can make a significant impact on the economy of Sri Lanka.

According to the geological data the nearly vertical vein is located in the center of the Horakagodakanda mountain, extending in North-South direction. The existing geological data is being used to model the deposit to a 50 m depth from the area of the Horakagodakanda. There's a certain amount of possibility, that this vein could extend grater deposit.

There's a reasonable possibility to find more deposit on the area. Mining could be extended to those deposits as well.

Mining could be both cut and fill, Sub -level caving or combination based on the experience acquired in mining of Kukurampola deposit.

This will be bright for the Iron industry in Sri Lanka where palletizing and Iron making could be done locally if ample resource founded.

CONCLUSION

Iron is one of the most important metals for most of industries. Each year Sri Lanka spends a huge amount of money to import iron from other countries. Therefore, extraction of iron in Sri Lanka can give a huge economical benefit to the country and further exploration to quantifying ore-resave is vital to set - up a complete iron industry in Sri Lanka.

RECOMMENDATIONS

Kukurampola deposit is recommended to mine by open-stoping and underground mining. Both methods could be used respectively for shallow and deep sections of the deposit. Processing initially will confine to crushing, grinding and magnetic separation. Pellet Plant is a possibility for future depending on ore reserves. Blasting with 20 bore holes is recommended as there are no dwellings close to the mining area. Transport of ore could be done with 20 ton 10 wheeler dump trucks. Rehabilitation subsequent to mining will require indigeneous plants. Reforestation of the land will preserve the original land profile. 30,000 tons per month is recommended and this will constitute 30 blasts each with 20 bore holes.

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