

Mining, Process and Rehabilitation Practices in Indian Rare Earths Chavara, Kerala



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Salient Features

Location of Deposit

- Lat. N 08° 56' 03" - 09° 08' 24"
- Long. E 76° 27' 36" - 76° 32' 34"
- Kayamkulam Pozhi at North
- TS Canal at East
- Arabian Sea at West
- Neendakara Port at South
- Kollam District (Kerala State)

Geology

- > Deposit
Essentially a placer deposit
- > Source Rock
Granite, Gneiss, Charnockite in Western Ghats
- > Conditions favourable for formation of deposit
Tropical Climate
Heavy Rainfall
Good Drainage
Strong intermittent wind & obstacles

Geology (contd...)

Processes of formation

- > Weathering - To liberate mineral from source rock
- > Transportation - Mountain to sea by rivers
- > Deposition - At seashore by wave action*

*A breaking wave takes all the fore shore mineral to the beach but back wash carry only the lighter minerals back to sea. Repeated action results in sorting and concentration of Heavy Mineral deposit.

Minerals Present

- ILMENITE
- RUTILE
- ZIRCON
- SILLIMANITE
- LEUCOXENE
- MONAZITE

Methods of Mining

- Two Methods employed:-
- (i) Beach Washings Collection
 - (ii) Dredge Mining

Beach Washings Collection involves :-

- Taking out a slice (200 mm) of sand from the shore by Front end Loader
- Stacking it away in a safer place from the action of waves
- Transportation of heavy minerals by tippers to the Plant
- Timely collection of Beach Washings is very important
- Grade of Beach Washings vary from 45 to 80 %
- Approx. 40 to 50 % production at Chavara comes from Beach Washings collection

Dredge Operation

- ❖ Dredging Operation in Dredge & Wet Upgradation Plant
- ❖ The Plant is a Pontoon mounted dredger with integrated separating equipments
- ❖ The whole plant floats in an artificially created pond
- ❖ The Pond keeps moving forward due to mining at the front end and simultaneous back filling with the tailings at the rear end.
- ❖ The Dredging unit is a Suction Cutter Dredge

Dredge Operation(contd..)

- A Bucket Wheel Cutter at the front end to cut and loosen the mineral deposit
- The Cutter feeds to the suction of a Dredge Pump
- Both the Cutter and the Dredge Pump are operated hydraulically
- Maneuverability of dredge is achieved by operation of slew winches and spuds.
- Dredge Pump discharges the slurry to the Trommel Screening System
- Trommel removes oversize materials (like pebbles, roots, shell etc.)

Dredging Operation (contd...)

- Trommel underflow less than 3 mm is collected in a Surge Bin
- Surge Bin is provided with density control system to maintain constant density of slurry to the Spiral Concentrators
- Spiral Concentrators use the principle of Gravity Separation Technique to separate heavy minerals from the undesired light minerals, i.e, Quartz
- Heavy mineral concentrate is collected at the centre of the Spiral Concentrator and lights are collected at the outer side as tailings.

Dredging Operation (contd...)

- Heavy minerals are treated in various stages till the desired grade and recovery is achieved
 - Heavy Mineral Concentrate (called Heavies) are pumped to a Stacker erected on land and trucked away to Heavy Upgradation Plant for further upgradation
- Common Spiral Circuits in DWUP :-
- Primary or Rougher Circuit
 - Scavenger Circuit
 - Cleaner Circuit
 - Recleaner Circuit

Tailings Disposal and Land Reclamation

- Tailings disposal and Land Reclamation done simultaneously
- The light minerals (rejects) are collected in a Bin. A high head slurry pump throws the tailings from the bin to a longer distance by means of a Floating Tailing Stacker
- Height of the Stacker can be varied by a winch to spread the tailings uniformly in mined out area
- The volume loss of 20 – 25% is replenished by beach washing tailings from MSP. Hence the original level and topography of the area are restored.
- Plantation of selected species are done over mined out area

Separation of Individual Mineral

- Heavies received from DWUP contain 80 to 85 % HM
- Heavies are further treated in Heavy Upgradation Plant (HUP) to enrich the content to 95-96 % HM
- The Heavies obtained from the HUP is stockpiled and dried to reduce moisture content to 4-5%
- The heavies are fed to Mineral Separation Plant (MSP) to separate individual heavy minerals
- Depending upon physical properties, individual heavy minerals separate from one another

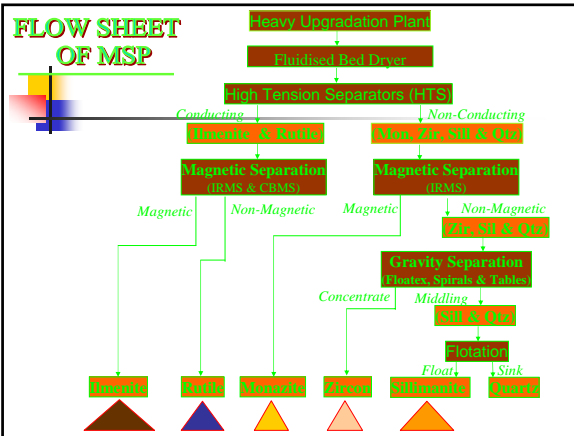
Mineral Separation Techniques involves :-

- ✓ High Tension Separation
- ✓ Magnetic Separation
- ✓ Gravity Separation
- ✓ Floatex Hindered Settling Separation
- ✓ Froth Flotation

Physical Properties of Minerals:-

Minerals	Physical Properties
ILMENITE	Electrically Conducting & Strongly Magnetic
RUTILE	Electrically Conducting & Non Magnetic
ZIRCON	Non Conducting, Non Magnetic & High Specific Gravity
SILLIMANITE	Non Conducting, Non Magnetic & Low Specific Gravity
MONAZITE	Non Conducting, Feebly Magnetic & High Specific Gravity
QUARTZ	Non Conducting, Non Magnetic and Lighter than all the above minerals

FLOW SHEET OF MSP



Rehabilitation Activities :-

- Topography of Mined out area is restored to original level by replenishing the volume loss by beach washing tailings brought from MSP
- Soil condition and fertility of the soil is re-established quickly by planting fast growing creepers which die out in the summer season.
- Green belt is developed in the area by systematic plantation
- A good infrastructure is developed by constructing well-built roads, water and electric power supply

Rehabilitation Activities (contd...)

- The area is divided into different plots and handed over to the willing displaced people for construction of residential houses
- In course of time a good township develops over the mined out area with all infrastructure and facilities
- Company also provides a number of Welfare Amenities for improving the standard of living
- Those who opt for compensation are given cash amount as per negotiated purchase package

Land Purchase Scheme

- For purchase of land required for continuous mining there is a Negotiated Land Purchase Scheme
- This scheme is established with the assistance of district revenue authorities

Compensation Package includes :-

- Basic Land Value fixed by revenue authorities
- Value of trees, buildings and other structures.
- Solatium on the above
- Shifting charges
- 4 cent plots free of cost for rehabilitation

Status of Land Purchase & Rehabilitation :-

- ❖ 752 families were rehabilitated
- ❖ 258 families were given alternate land in mined and refilled land and balance were given compensation
- ❖ IREL made all arrangement for roads, electricity, water etc.

Welfare Activities:-

- ✓ 200 families from sea erosion area of VT/Ponmana area were rehabilitated to a safer place
- ✓ 160 metre long protection wall was made as a protection against sea erosion at VT Mining area
- ✓ Maintenance of ASUP School building was made
- ✓ A sand barrier was made in Karithura and Puthenthura villages near sea wall to prevent inrush of sea water
- ✓ Rs 30 Lakhs is paid annually towards Mining Area Welfare Fund

Welfare Activities (contd...)

- ✓ A dispensary at Kovilthottam is being run by IRE for local villagers
- ✓ Financial assistance is being made for running Balakairali in some villages
- ✓ School uniforms and study materials are being donated every year to students of nearby schools.
- ✓ About 300 locals are employed in loading work of Beach Washings

Social Issues that require constant attention:-

- Locals as well as the displaced persons are demanding jobs
- Mining Areas are thickly populated
- Inhabitants are relatively well educated with more social and political awareness
- Constant increasing demand for more and more welfare amenities from the locals

Environmental Impacts of Mining:-

Dredging & Processing Operations are wet processes and hence no dust generation

Dredge and Wet Upgradation Plant draws water from its own pond created by dredging and hence no water pollution to nearby water bodies

All equipments are electric and hydraulic power operated and hence produce less noise compared to conventional diesel operated Heavy Earth Moving Machines

Environmental Impacts of Mining (contd...)

Radio active mineral (Monazite) is taken out from the sand. Thus the dredged and rehabilitated areas are better places of habitation than before.

The plant provided a good working environment for the operating staff.

Most environment- friendly method of Mining

IREL, Chavara has been recommended for both ISO 9001: 2000 and ISO 14001 certification for maintaining excellent Quality and Environment Management Systems

CONCLUSION

Laws relating to Environment and its protection becoming more stringent day by day.

Many companies failing to adhere to norms are facing closure.

IREL's adoption of Dredge Mining is most appropriate mining method in the present time.

The Rehabilitation scheme of displaced persons are accepted and appreciated at all levels.

Gives competitive advantage to IREL to compete with private players in this field.

THANK YOU

REHABILITATION OF MINED OUT AREAS

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INTRODUCTION

Reclamation:
General process for returning the land surface to some form of beneficial use
Restoration:
Reinstatement of original ecosystem in all its structural and functional aspects
Rehabilitation:
Progression (or journey) towards the reinstatement of original ecosystem

LEGISLATIVE ASPECTS

- No mining activities without approved mining plan
- Mining plan to include measures from top soil management to restoration of original ecosystem
- Guide lines are given in Mine Closure Plan for rehabilitations efforts and fixed minimum amount to be spent (Rs 25000/-per Ha for Cat 'A' Mines).

SOCIAL ASPECTS

- Business activities are carried out in different social, economic and political environment.
- These factors differ from place to place and business to business.
- Rehabilitation Programmes are site-specific.

Methods of Rehabilitation

- 1) Ecological Rehabilitation
- 2) Community Rehabilitation

Ecological Rehabilitation:

- > The purpose is to re-establish the capability of the land to capture and retain natural resources – energy, water, nutrients, species.
- > Most ideal for mine sites located in forest areas and sparsely populated areas

Ecological Rehabilitation (contd...)

- ❖ Removal & Storage of top soil
- ❖ Tailings are levelled to smooth contour
- ❖ A thin layer(150 cm) of top soil is spread over the bare sand
- ❖ Wind breaks are erected and a cover crop with indigenous seeds are sown into the top soil
- ❖ Within a few days a green-carpet is formed on the dune

Ecological Rehabilitation (contd...)

- ❖ After 3 months wind breaks are removed and after 12 months the cover crop dies off leaving behind the indigenous species
- ❖ The grass lands replace pioneer weeds and trees suitable for the area
- ❖ Establishment of broad-leaved forest tree species
- ❖ Animal and Bird communities colonise the rehabilitated area
- ❖ Area matures into a Self-sustained dune forest typical of the region

Community Rehabilitation

This type of rehabilitation is undertaken where mines are located in relatively heavily populated areas.

Community requirements first choice.

- ❖ Social factors to be considered in practical rehabilitation planning
- ❖ Close consultation with the local communities needed

SOCIAL FACTORS IN CHAVARA

- Areas are thickly populated.
- Standard of living of people in the surrounding area is high.
- Inhabitants are well educated with high social and political awareness.
- Acute unemployment of locals and displaced people.
- Increased awareness of locals for protection of environment.

RAHABILITATION ACTIVITIES IN CHAVARA

- Back filled sand is not sufficient to restore the area to the original level.
- Filled with tailings from HUP & other places to restore original topography.
- Area is planted with cover-crop (pea-creeper variety), coconut trees, and cashew trees.
- A good infrastructure is provided
- Area is handed over to the displaced people for constructing their houses.
- IREL ensures that the infrastructure facility provided to the rehabilitated inhabitants is always maintained in good condition.

PRE DREDGING AREA



DREDGING & BACKFILLING



REFILLED AREA LEVELLING



COVER CROP & COCONUT TREE PLANTATION



REHABILITATED AREA



WELFARE MEASURES

- > Welfare measures are provided for the rehabilitated community as well as the local people
- ☑ Construction of sea-walls and retaining walls
- ☑ Amenities for school education
- ☑ Medical facilities
- ☑ Direct and indirect jobs where ever possible

CONCLUSION

- ☑ Degradation of land due to mining is well known to all
- ☑ The social and legislative frame works are very stringent day by day
- ☑ RQPs have been instructed to consider an amount of minimum of Rs 25000/- per hectare towards the cost of rehabilitation expenses of category 'A' mines while preparing mine closure plans (CCM Circular No.19,dated, 2ndJan'04).
- ☑ with the increased social awareness towards environment all the rehabilitation programmes in the mined out areas must be implemented in true spirit
- ☑ The objective is to restore the environment to original situation as it existed before mining.

Thank You