

# A Presentation On Potential Utilization Of **RED MUD**

## **INDO –EUROPEAN MEET**

**RESOURCE EFFICIENCY IN THE ALUMINIUM  
INDUSTRY WITH A FOCUS ON EFFECTIVE  
UTILISATION OF RED MUD**

**19<sup>TH</sup> Sept 2019  
New Delhi**

# PLAN of Presentation

- About NALCO
- NALCO's RED MUD
- R&D projects on effective utilization of Red mud
- Suggested Way Forward

# NALCO

## Spreading Wings



**MINES 6.825 MTPA**



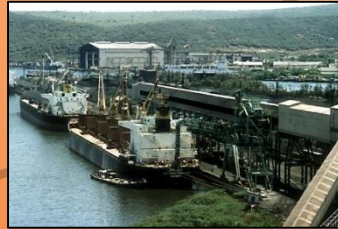
**REFINERY 2.275 MTPA**



**SMLTER 0.46 MTPA**



**CAPTIVE POWER  
PLANT 1200 MW**



**PORT FACILITIES**



**WIND POWER PLANT  
194.8 MW**

**Incorporated in 1981**

**A company under the Ministry  
of Mines, Government of India**

**Largest integrated Bauxite-  
Alumina-Aluminium-Power-  
Port facilities complex in Asia**

*Indian Essence, Global Presence*

**नालको**  **NALCO**

## ALUMINA REFINERY, DAMANJODI



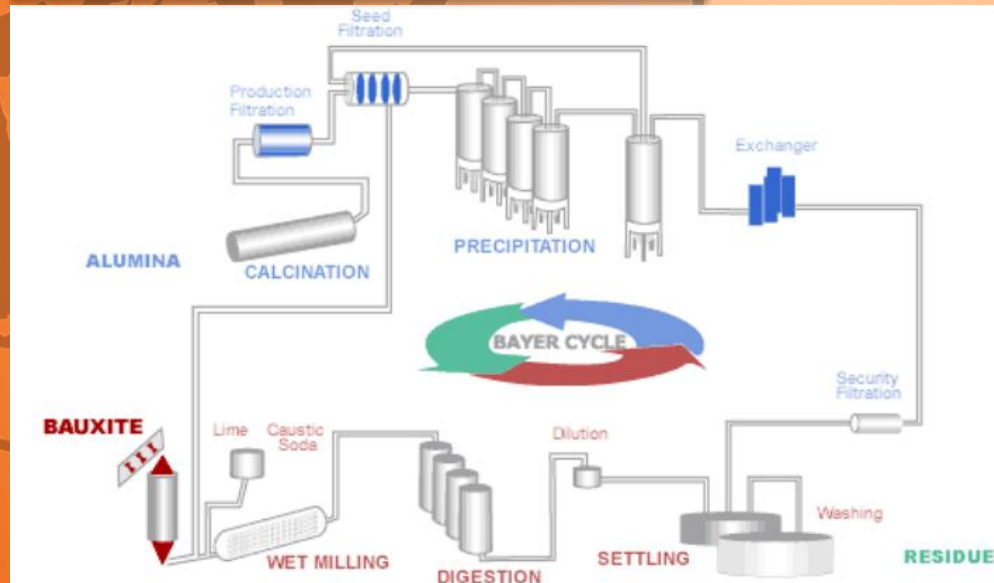
# Red Mud from Alumina Refinery-Bayers Process

## **Input Materials:**

≈3 T of bauxite / 1T alumina  
Caustic soda, lime.

## **Output:**

□ 1.3 - 1.5 T Red mud,  
1 T alumina



Alumina



Red Mud



# NALCO'S BAUXITE

- Gibbsite is the major source in the ore contributing to alumina production.
- Monohydrate or boehmite ( $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ ) is present in insignificant amount.

Total $\text{Al}_2\text{O}_3$	40-44%
Total $\text{SiO}_2$	3-4.50%
Reactive $\text{SiO}_2$	2.3-3.6%
$\text{Fe}_2\text{O}_3$	24-26%
$\text{TiO}_2$	2-3%
$\text{V}_2\text{O}_5$	1-2%
$\text{P}_2\text{O}_5, \text{Ga}_2\text{O}_3$	Traces
REE	148.07 ppm
Lol	23%

# NALCO'S RED MUD

## *Composition of Red mud*

Component	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	TiO <sub>2</sub>	LOI	Na <sub>2</sub> O	CaO	REE
Wt %	17.89 ± 2.62	52.23 ± 2.78	5.75 ± 0.22	4.88 ± .56	12.73 ± 1.30	4.68 ±0.22	1.39 ± .23	222.11ppm

Composition of Red mud indicates it has potential for application in construction sector, recovery of metal and other valuables, soil amendment sectors. Area of concern is high pH.

# RED MUD DISPOSAL

- Present rate of generation of Red Mud is 1.3-1.5MT per MT of Alumina Production i.e. about 3.2 Million T per annum.
- Till date generation is about 55 Million T .
- Initially Red mud was disposed in the form of slurry, having solid content 25-30% by weight.
- The method of disposal was changed from wet disposal to environment friendly Thickened Tailings Disposal (TTD) system in the year 2001, where the solid content is enhanced to 55-57% by weight.
- TTD system not only enhances life of the pond due to sloped deposit (2.5 to 3.0%), but also ensures easy reclamation & rehabilitation of the pond area due to consolidation of mud at higher solid consistency.
- The liquor from the RMP which gets diluted with rain water is reclaimed back to process for washing of the mud before disposal. Presently the reclamation is on an average about 30-35% higher than the input to RMP.



# Problems Associated With Red Mud

- High alkalinity pH ranges typically 11-13.
- High ionic strength.

## **The environmental problems associated with red mud:**

- ☐ Its high pH.
- ☐ Chances of alkali seepage into underground water.
- ☐ Alkaline airborne dust emissions.
- ☐ Vast area of land required for disposal.
- ☐ Minor and trace amounts of heavy metals and radio nuclides (some sources-not Indian Bauxite) may mix with ground water.



# R&D efforts towards safe disposal and utilization of Red mud

## Potential utilization of red mud in Metal extraction

SNo	Title	Institute/agency	Summary	Remarks
1	Production of Sponge Iron or Pig Iron.	VAMI, Russia sponsored by NALCO.	The Romelt process developed could not give desired result due to high soda content in red mud.	Techno commercial viability poor due to cheap source of iron ore in country.
2	Plasma smelting of Red mud for production of Pig/ Cast iron and Alumina rich slag.	IMMT, Bhubaneswar/NALCO.	Process was developed for extraction of pig iron from red mud.	Commercial viability could not be established.

## Potential utilization of red mud in Metal extraction

SNo	Title	Institute/ agency	Summary	Remarks
3	Extraction of Iron concentrates from Red mud	GAMI, China	Disperse magnetic calcination & magnetic separation process is developed. 62% of iron recovery could be obtained	Lab scale study not found techno-commercially viable for NALCO red mud.
4	Study on iron recovery and 100% utilization of Red Mud process	Shenwu, China	Trial was taken in rotary hearth furnace for extraction of metallic iron along with rock wool based on zero discharge concepts.	Successful. For commercial viability all data not received from Shenwu.

# Potential utilization of red mud in Construction sector

Sl No	Title of the Project	Institute/agency	Summary	Remarks
1	Use Red Mud for production of OPC	NCB, Ballabgarh/ NALCO	OPC- 33, 43 & 53 grade could be produced using Red Mud, Lime & Shale.	Commercial viability not established.
2	Special Cement	RRL Bhubaneswar/ NALCO	Brick having strength of up to 250 Kg/cm <sup>2</sup> using red mud, lime stone & phospo-gypsum could be developed.	Commercial viability not established.



## Potential utilization of red mud in Construction sector

SNo	Title	Institute/ agency	Summary	Remarks
3	Use red mud fibre reinforced polymer composite for production of building component and wood substitute.	RRL Bhopal/ NALCO	The developed door panel were tested, characterized and certified by BMTPC. Density: 1.4 to 1.6 gm/cm <sup>3</sup> . Water absorption: 0.4-0.65 % Impact strength: 0.4 N/mm <sup>2</sup> Bond Strength: 12.9 kg/cm <sup>2</sup> .	A commercial unit of M/s. Dual Build Tech Limited started in Pondicherry. However the unit was closed down.

## Potential utilization of red mud in Construction sector

S No	Title	Institute/ agency	Summary	Remarks
4	Manufacture of Construction bricks, blocks & Chips	JNARDDC MRCPL	Radioactive elements found below thresh hold limits. Commercially viable. Process Patent granted.	Pilot scale experiments were done successfully.
5	Light weight foam aggregate using (maximum utilization of 45-50% red mud)	JNARDDC	-Using red mud, Fly ash & foaming agent 'Light weight form bricks' could be produced. - Density 0.9-1.29 gm/cc, - Compressive strength 3.1- 3.6 N/ sq mm. - Patent has been filed.	Potential for commercialisation

## Potential utilization of red mud in Construction sector

SNo	Title	Institute/ agency	Summary	Remarks
6	Utilization of red mud for making ceramic glass tile using 22-30% red mud	JNARDDC	Using Red Mud, Borax & Fly Ash glass ceramic tiles having good glossy finish, good mechanical properties, abrasion resistance developed. Cost comparable with granite and marble.	Lab scale experiments shown encouraging results. Patent filed.
7	Development of Red mud-Fly ash based geopolymer concrete using around 10% red mud	IIT, Bbsr	Using red mud, fly ash & GGBS Geo-polymer concrete has been developed.	Lab scale study indicates good physical properties and economical.

## Other Potential Applications

S No	Title	Institute/ agency	Summary	Remarks
1	Production of Red oxide Primer, paint pigment.	In-House R & D	The developed process consist of leaching of red mud with HCl to reduce soda, filtering , drying and converting it into red oxide pigment/ paint	Lab scale study indicates Techno-economically not viable. economics.
2	Development of Electronic Materials for Device Fabrication.	ITER ,BBSR	Development of some electronic materials (multiferroics) and high purity oxides is being attempted along with synthesis of new materials of different compositions.	Initial study results are encouraging. Further study in progress.

## Ongoing projects on red mud

S No	Title	Institute/agency	Objective	Remarks
1	Recovery of iron values from red mud and processing of non iron material for developing value added products.	JNARDDC IMMT EESAVYASA	Development of an innovative and viable process for recovery of iron values from red mud along with utilization of non iron part for its application as an insulating product with an aim for complete utilization of red mud	Work order awarded .
2	Development of sacrificial material for core catcher	BARC	Use of Red mud for nuclear applications , as a suitable material for core catcher .	MOU with BARC



## BARRIERS FOR INDUSTRIAL UTILISATION OF RED MUD

- Its physical properties, location, capital, transport, dryness, end user location .
- **Volume:** Application that consume large quantities of red mud are required.
- **Performance:** The performance of red mud in any application must be competitive with alternatives in relation to quality, cost and risk.
- **Costs & Risks:** No strong economic case has been established. Associated risks in any application must be established.
- Waste handling legislations

# Way forward for effective utilisation of red mud in INDIA

- Utilisation in cement industry.
- Recovery of vaulables : Iron, Alumina, Titania, Silica , REE components and converting residual part into insulating product
- Utilisation in construction sector- bricks, chips , pavement blocks, geopolymr concrete etc
- The research organisations and regulatory authorities need to develop appropriate standards and issue suitable orders for mass utilisation of red mud.
- Funding by industry :Mandate as well as subsidy by Govt to encourage mass utilisation of red mud including in cement industry.
- Cooperation between business partners and R&D institutions for pilot scale studies.



धन्यवाद  
THANK YOU