

# Management of Red Mud

S. K. TAMOTIA

*Indian Aluminium Company, Limited, Calcutta, India*

## ABSTRACT

*There is no commercial use of red mud and utilisation of red mud is still on experimental basis. However, red mud tiles, sheets, bricks, doors windows etc. are developed but are yet to be promoted for regular use. Red mud can also be used for pigment manufacturing. Since no commercial utilisation of red mud is established, this is to be disposed off. Further, the red mud contains traces of caustic, it is essential to dispose it off in the most environment friendly manner and to allow proper rehabilitation of land filled up with disposed mud.*

*In the present paper, available mud disposal techniques which are being practised in alumina refineries worldwide have been discussed. Further, on-going R&D efforts towards potential uses of red mud have also been presented.*

**Key words :** *Red mud, Waste, Environment, Mud disposal technique.*

## INTRODUCTION

Aluminium is one of the 92 naturally occurring elements which have been around since the earth was formed. It is the second most abundant metallic element. It makes up about 8% of the earth's crust, surpassed in quantity only by Oxygen at 47% and Silicon at 28%. Despite being the most abundant metallic element, aluminium remained invisible for long, until it was first produced in 1886 using Hall & Herault process.

Bauxite is the main ore for the production of aluminium metal. India has about 3000 million tonnes of bauxite deposit, which is 7.5% of the share in world and is sixth in ranking. Major bauxite deposits in India are on East Coast, mainly Orissa and Andhra Pradesh, having about 80% of the total deposits in India.

Chemical composition of the average quality of bauxite is-

$\text{Al}_2\text{O}_3$	:	40-45%
$\text{Fe}_2\text{O}_3$	:	15-20%
$\text{SiO}_2$	:	1-5%

The process of aluminium production is first to refine the bauxite by chemical process to alumina powder, which is then converted to aluminium metal by electrolytic process. During the refining of bauxite to alumina by chemical process i.e. digestion of bauxite with caustic soda, the waste material is produced which is called 'RED MUD.' On average 1.2 tonne of Red Mud is generated during production of one tonne of alumina. The composition of red mud is 10-20%  $\text{Al}_2\text{O}_3$ , 5-10% silica, 50-60%  $\text{Fe}_2\text{O}_3$  and is highly alkaline having pH of 9-10.

As the commercial use of red mud is yet to be established and utilisation of red mud is still on experimental basis, it is essential to dispose it off in the most environmental friendly manner. There are various methods available for disposal of red mud. However, there are several important factors that influence the final choice of the scheme to be selected for efficient and safe disposal of mud. These are :

- Thickening characteristics of red mud to achieve higher solid content.
- Rheological characteristics of red mud slurry with particular attention to filterability of the mud at increased solids concentration.
- Geographical location of the selected disposal site and distance from alumina refinery.
- Topography of the selected disposal site.
- Climatic conditions.

### AVAILABLE DISPOSAL METHODS

These are a number of different mud disposal techniques available and being practised in alumina refineries all over the world. These disposal methods may be broadly classified into the following three categories:

- a) Conventional wet disposal
- b) Thickened slurry disposal
- c) Disposal as filter cake

### **Conventional Wet Disposal**

In the conventional wet disposal system the red mud produced from the washing circuit is directly pumped to a big settling pond (lined) at a solid content of 20-30%. In this pond the solids settle while the supernatant caustic liquor is recycled to alumina refinery. Such system typically consists of centrifugal pumps, pipes, distribution header and water reclamation system.

While the conventional wet disposal scheme is comparatively easy to operate and does not involve costly equipment, it suffers from many inherent drawbacks. The major disadvantages of this system are:

- Risk of ground water pollution due to seepage because of alkaline water present in the mud pond.
- Large pond area requirement due to high volume throughput and poor settling rate.
- Unavoidable excessive ingress of rain water in the red mud pond which can adversely affect the overall water balance of the alumina refinery.
- High cost of land reclamation and particle reclamation during use is normally not possible.
- Requirement of high dykes/dams, sometimes the dam height may become a constraint due to excessive hydrostatic pressure.

### **Thickened Slurry Disposal**

In this system, the mud slurry is thickened to high solids consistency using specially designed thickeners. The thickened mud slurry is pumped to the selected disposal area where it is systematically discharged through permanent spigots from an elevated position. Some of the important advantages in favour of this system are:

- Mud disposal is at a slope of 2-5° which facilitates a self drainage system.
- Provides increased mud storage capacity for the same storage area because of sloped deposit and increased bulk density of the consolidated mud.
- Eliminates the need for big dams/dyke walls.

Two types of methods are available for stacking of the red mud:

- Thick layer deposition
- Thin layer deposition

### *Thick layer deposition :*

In thick layer deposition method, the thickened slurry released at one point comes to rest at a slope governed by the viscosity or mobilised shearing strength of the following mass. A low cone - shaped hill of the tailings developed below the discharge point. To provide a good surface for reclamation, the slope of such hill is to be controlled to less than 5%. The slope angle is controlled primarily by the degree of thickening prior to discharge. Furthermore, because of the low water content, segregation is inhibited and all solid particles are deposited without sorting, regardless of distance from the discharge point. This effectively eliminates the need for a conventional settling pond with its inherent possible seepage problem.

### *Thin Layer Deposition :*

In the thin layer deposition method, the mud slurry is stacked in various zones to facilitate natural evaporation. At a time only one zone is under filling while the other zones are exposed for natural evaporation. The zone widths are carefully selected in such a way that desired slopes are available for stacking as a sloped deposit. The actual thickness of the deposited layer is decided based on climatic conditions and the extent of thickening achieved.

### **Disposal as Filter Cake**

This scheme involves filtration of red mud and then transportation of the mud cake to the mud disposal area by one of the following methods:

- Transportation by dumpers
- Pumping of mud cake by means of specifically designed positive displacement pump.

Of the above two methods, transportation by dumpers is more problematic as well as less environment friendly for obvious reason. The modern method is to pump the red mud cake with high solids content (55-60%) by means of specifically designed positive displacements pumps.

Considering the environmental aspects, and the land required for the pond, thickened slurry disposal system is modern method for red mud disposal and is being adopted by most of the projects being implemented.

### **POTENTIAL USES OF RED MUD**

There is no technically and economically viable and feasible solution available so far for the utilisations of red mud. Worldwide, research is going on for finding application of red mud for miscellaneous uses.

*S. K. TAMOTIA*

- (a) Red mud generated by aluminium industries can be used for low cost building materials.
- (b) Red mud can be additive to cement because of its high iron content. Red mud can replace pyrite cinder in the manufacture of high strength cement without affecting the settling time.
- (c) It can replace a part of clay in brick manufacture.
- (d) Ceramic products are also attractive proposition from red mud, since it contains most of the required ingredients.
- (e) Attempts are being made to use red mud as a land fill material as it is or after treatment in many countries. It is being treated as a material to be used for land reclamation from marshy lands or abandoned mines.
- (f) In the Middle East, red mud is used for stabilisation of deserts/ lands in the coastal areas.
- (g) Use of red mud in making paints (because of iron oxide and titanium dioxide in it), as an absorbent and catalyst are some of the fields where extensive researches are in progress.
- (h) Research is being made to extract iron from the red mud but at present is not a viable proposition.
- (i) Mixture of red mud and Ash is used as fertiliser to improve the productivity of land.

## **CONCLUSION**

Due to large amounts of mineral content of value in red mud, there has been increased interest in developing new processes and improving the old ones, for the recovery of these minerals and utilisation of red mud, which otherwise goes waste. In the recent past there has been some R&D efforts directed to these special problems associated with utilisation of this valuable "waste" and some improvement has been possible. Yet, a lot remains to be achieved.

The National Metallurgical Laboratory - Jamshedpur has taken much initiative in this regard and this seminar will provide an appropriate forum to discuss the recent developments and put forth new ones.