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ETI RED MUD CHARACTERISTICS AND EVALUATION OF DEWATERING PERFORMANCE

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Abstract

ETI Aluminium has a capacity to process 550,000 tons of bauxite, generates approximately 260,000 tons of red mud. Red mud slurry is disposed at 30 % (w/w) solids and less than 5 g/L Na_2O. ETI is focusing its efforts in maximizing extraction efficiency in digestion and improving precipitation yield of alumina. The red mud area is one of the most important topics that require serious study in terms of handling, recovery and environmental impact. A study has been conducted to determine red mud characterization with XRF, XRD, TG/DTA, IR, SEM/EDX, BET and PSD analysis. ETI might face red mud disposal area problems in the following years. ETI has initiated a fast track program towards the improvement of the dewatering performance of red mud and increase disposal area life time. ETI has been closely investigated dewatering technologies to select most appropriate one.

Introduction

Red mud handling is one of the most critical issues in an alumina refining process that affects overall economics of a Bayer plant operation, and involves a relevant environmental issue related to the tailings disposal. The first step is to achieve high efficiency in solid liquid separation that can determine plant flow, liquor productivity, product quality and caustic losses. Second, the management of this high quantity of high pH waste product that gives issues raised on storage and environmental problems.

ETI Aluminium has disposed about 6,702,058 tons of red mud on dry basis since 1973. The red mud lake which has 10 million m^3 capacity has been currently almost filled up. Although 6 millions m^3 extra capacity in another lake, it seems appropriate to consider some investment either for a new dam or a dewatering technology within ten years, considering the same production capacity and climate conditions in this region

The present paper describes the physical, chemical and mineralogical characteristics of ETI Aluminium red mud. Mud rheology and filterability tests will also be discussed. ETI has initiated a fast track program towards the improvement of the dewatering performance of red mud and increase disposal area life time. ETI has been closely investigated dewatering technologies to select most appropriate one.

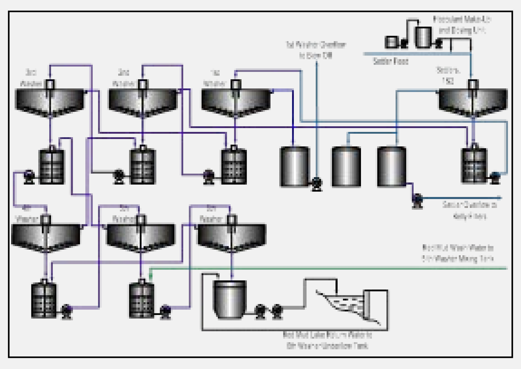


Figure 1. ETI Aluminum red mud clarification area flow sheet

Figure 2. ETI Aluminum red mud dam

ETI Red Mud Physical and Chemical Analyses

Red mud semi quantitative elemental analysis was done ARL Advant'x 2098 Quantas and shown at Table 1. The main phases found are hematite and silica containing minerals shown at Table 2. XRD analyses are supported with XRF analyses.

Table 1: Element Analysis of Red Mud (w/w %)

Element	(w/w) %	Component	(w/w) %
Al	9.870	Al_2O_3	18.650
Ca	2.710	CaO	3.800
Cl	0.047	Cl	0.047
Cr	0.058	Cr_2O_3	0.086
Fe	25.220	Fe_2O_3	36.030
K	0.337	K_2O	0.406
Mg	0.168	MgO	0.279
Mn	0.008	MnO_2	0.013
Na	6.620	Na_2O	8.920
Nb	0.004	Nb_2O_5	0.006
Ni	0.038	NiO	0.049
P	0.015	P_2O_5	0.035
Pb	0.005	PbO	0.006
S	0.041	SO_3	0.102
Sc	0.009	Sc_2O_3	0.015
Si	7.580	SiO_2	16.240
Sr	0.003	SrO	0.004
Ti	3.030	TiO_2	5.050
Y	0.010	Y_2O_3	0.014
Zr	0.046	ZrO_2	0.062

Table 2: Mineral Phases in Red Mud

Mineral Phases in Red Mud	(w/w) %
Hematite, Fe_2O_3	35.54
Sodalite, $Na_4Al_3SiO_3O_{12}Cl$	6.08
Cancrinite, $3NaAlSiO_4.NaOH$	6.45
Sodium Aluminosilicate hydrate, $Na_6(AlSiO_4)_6.4H_2O$	26.54
Calcite, $CaCO_3$	1.34
Gibbsite, $Al(OH)_3$	1.09
Boehmite, AlO(OH)	0.62
Diaspore, AlO(OH)	4.64
Goethite, FeO(OH)	0.54
Sodium Titanate, $Na_2Ti_6O_{13}$	1.06
Rutile, TiO_2	2.55
Anatase, TiO_2	1.34
Tridymite, SiO_2	2.34
Amorphous	4.42

- Particle size distribution of red mud has been analyzed via using Malvern Mastersizer. It has been found that 90 % of red mud is finer than 7,309 µm
- Specific surface area of red mud has been defined as 28.378 m^2/g
- The density of red mud has been measured as 3.0346 g/cm^3

Evaluation of Applications For The Best Red Mud Dewatering Performance

Another objective of this study has been to undertake determining the most appropriate red mud dewatering technologies that will be needed in the nearest future at ETI Aluminium. Currently, the solid content from conventional last washer thickener is about 30 % (w/w) before red mud is pumped to the pond. The most important issue to extend life time of the current red mud disposal area is to bring down moisture level of red mud slurry. From latest technological paste thickening application point of view, in the range of 33 to 40 % solids in the underflow seem achievable with the existing ETİ Aluminium red mud characteristic.

Also using vacuum filtration and centrifugal decanter technology, the achievable cake solids content is around 47% and 55% respectively. However, higher red mud cake solids like 70% is required to prevent any undesired disposal area issues and environmental concerns, therefore different waste dewatering applications like vacuum filtration, filter press, centrifugal decanter, etc. need to be taken into consideration.

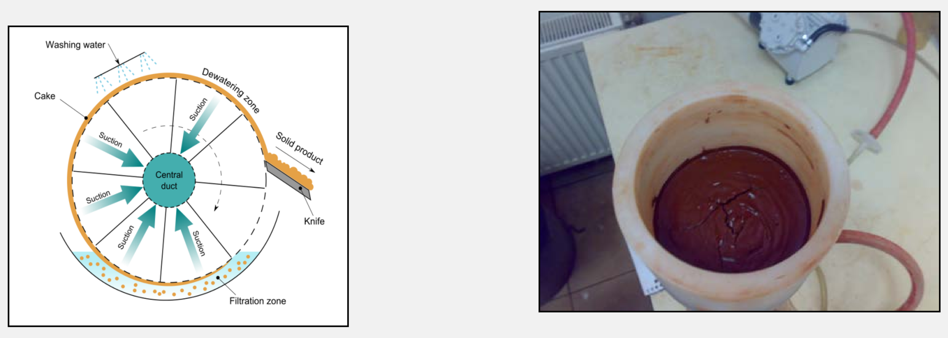


Figure 3. Vacuum filtration diagram and lab test.

Dewatering of ETİ Aluminium red mud using centrifugal decanter pilot unit (which was first around the world for the red mud) was performed (see figure 4.). However, discharge cake solid content from centrifugal decanter was remained around 55% which was unsatisfactory value for red mud pond lifetime.

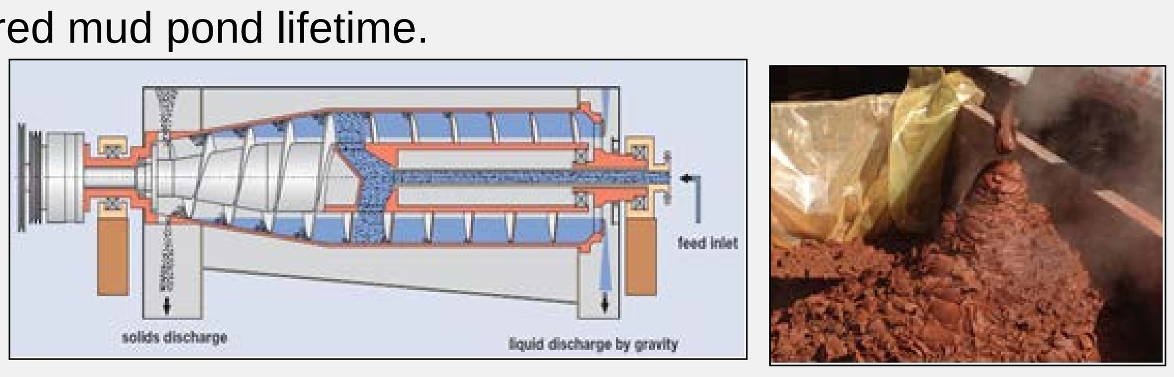


Figure 4: Centrifugal decanter internal view and red mud cake discharge.

The best performance was achieved in terms of both solid content and leachable soda level in the cake with filter press trials, as it is shown on Figure 5. Preference of filter press technology is also promising better filtration rate, filtrate quality, cake release, cake thickness and cycle time.

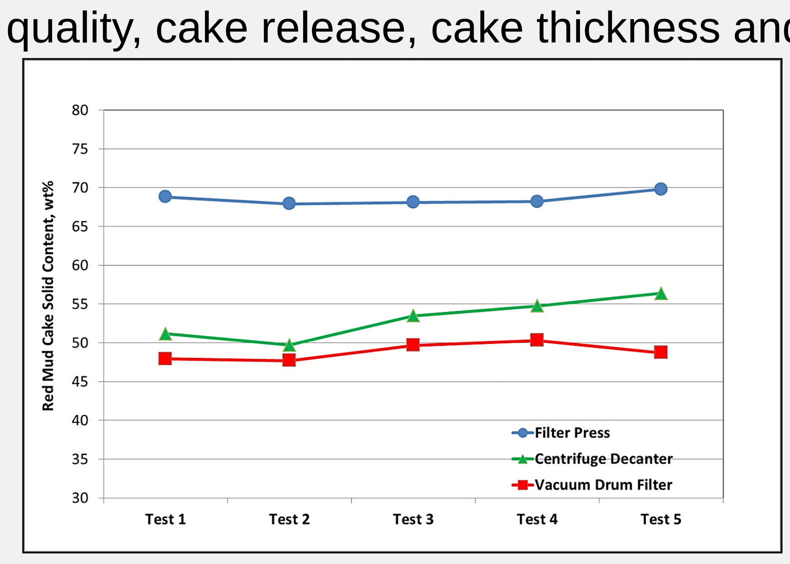


Figure 5: Red mud cake solid content level from different application

Figure 6: Current ETİ Aluminium red mud disposal area and filter press red mud cake

If the PSD of red mud becomes coarser, the yield stress curve will shift to the right. Conversely, if the PSD is more fine, then the curve will shift to the left (refer to Figure 7). The magnitude of the curve shift (left or right) will depend on how much the PSD changes during the production process.

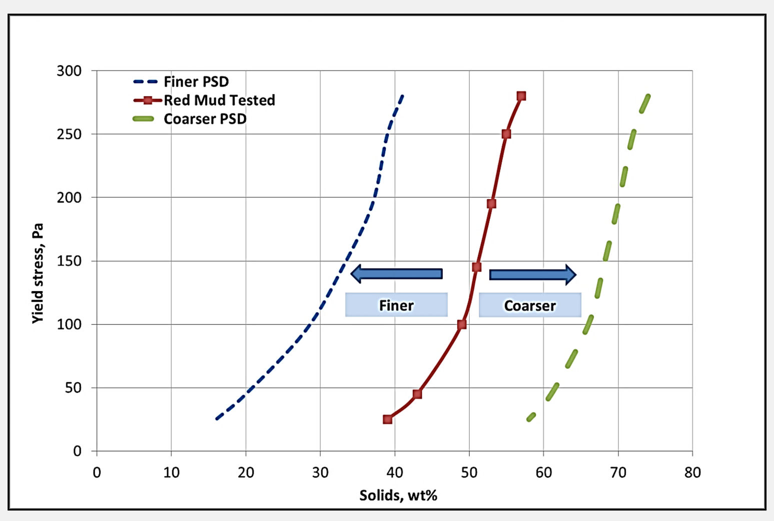
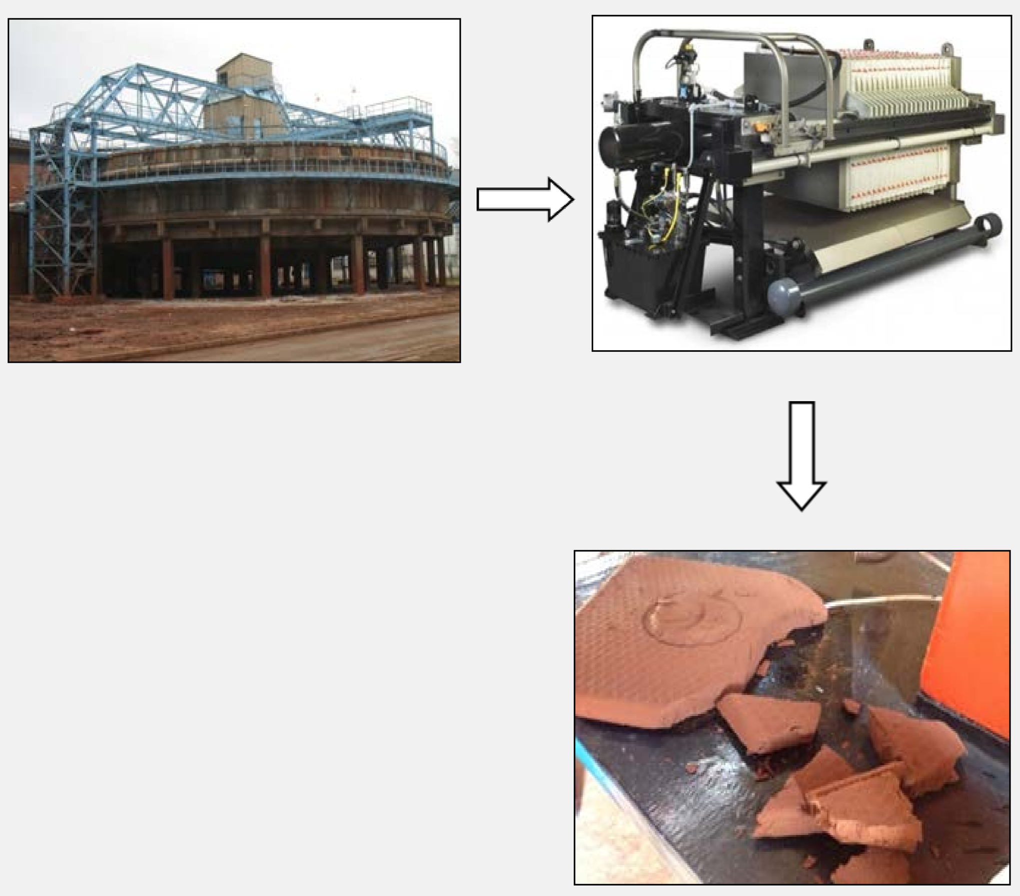


Figure 7: The effect of underflow solids and PSD on the yield stress

Conclusions

- Current red mud product can be dewatered with the mentioned filter press technologies.
- Reduce the disposal area required for red mud storage
- Minimize the potential for liquor release to the surrounding environment
- Maximize the recovery of the caustic rich liquor to the plant
- Reduce the consumption natural source water during red mud washing process
- Thus this study will enable the development of best practice red mud dewatering process options to reduce the reliance on disposal area and make storage more environmentally acceptable.



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