



FINAL PROJECT STATUS REPORT FORM

Project Number: ATF-06-03	Task Force: Aluminium	Date of Project Status Update: 21/12/2010
Title of Project: Management of Bauxite Residue (Red Mud)		
Lead Partner Country: Australia		
Participating Partner Countries and Organizations: China – China Non-ferrous Metals Industry Association (CNIA) India – Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC)		
Location of Project: <i>Country, State/Province/City</i> Australia – Western Australia, Perth China – Beijing India – Nagpur		
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Actions Since Last Update: <i>Please provide a brief description of the Activity undertaken.</i>		
<i>Australia</i>		
The three detailed literature reviews completed on: <ul style="list-style-type: none"> • current bauxite residue management, disposal & storage: practices, engineering & science; • bauxite residue reuse options; and • residue alkalinity and associated chemistry, were re-edited and submitted to <i>Hydrometallurgy</i> for publication and complimented with a fourth journal paper on the challenges and possibilities for in situ bioremediation of residue. A 10-year Case History of Virotec Global Solutions as an example of commercialisation of residue was written for the project and a draft review of the Sumitomo SO ₂ scrubbing technology has been written but not finalized. <p>Titration chemistry on the sodalites and related solid alkalinity is continuing to progress, but the micro-characterization work is well advanced. This entails examining the effects of five common neutralization methods on metal speciation in bauxite residues (no neutralization (control), H₂SO₄, SO₂, CO₂, seawater, bitterns). For each system core slices are analyzed sequentially, first by XRF, ICP, Rietveld-XRD and QEM-SEM before beamline analysis via μ-XRF, μ-XANES, μ-XRD, and μ-CT methods. Since the last ATF update the CSIRO team has made a total of four beamline trips to Brookhaven NSLS.</p> The BRaDD database has been fully launched with an improved interface.		



China

Nil

India

The present status of the R&D activities on the red mud utilization and products generation are summarised as follows:

Development of Stabilized Blocks and Fired Bricks

- Work on stabilized blocks and fired bricks is over with completion of first Phase to establish process technology, production of constructional blocks / bricks & artificial ceramic stone chip utilizing red mud as the main base material at a pilot plant scale in which 70% bauxite residue has been used. The final phase of the project i.e setting up a demonstration unit at plant site will be started soon. The fired bricks/ blocks showed good compressive strength (200-250 kg/cm²), and almost nil caustic leaching in water as well as saline water. The artificial ceramic stone chips prepared by firing at 1250-1300°C has been tested as an aggregate. The Standard concrete mix (M25) trials test carried out with gravel and artificial ceramic stone chips (-20 mm + 10 mm) showed the strength is comparable after 7 and 28 days of curing.

Development of Light weight aggregates

- Lab.scale optimization of raw-mix for light weight foamed brick (LWFB) was completed. The maximum amount of red mud used was increased from 15 % to 45 % and the product developed had shown low bulk density (less than 1gm/cc). Numbers of entrepreneurs in the recently concluded CERAGLASS-2010 International expo at Jaipur, India, have shown interest in the product due to its light weight. The possible application of the product is for internal partition walls. The physical and chemical characterization of LWFB has shown nil efflorescence, negligible soda and heavy metal leaching. The determination of thermal conductivity and environmental assessment are in progress.

Development of Glass Ceramic Tiles

- Lab scale studies were carried out for optimization of raw-mix for producing different colored glass ceramic tiles. Similarly, good number of entrepreneur have shown interest in the glass ceramic tile due to its glossy surface finish, good wear strength in the recently concluded CERAGLASS-2010 International expo at Jaipur, India. Presently, work is in progress to produce different size tiles and colors by altering the composition.

Soil Amendment

- After the comprehensive literature survey on the soil amendment using red mud, some field trials have been carried out using red mud along with soil. The results are encouraging. Certain plant species have been identified and future work is to grow these species in the amended soil.

Deliverables Since Last Update: *Please list the outputs delivered by this project.*

Australia

M. Gräfe, M. Landers, P. Austin, R. Tappero, G. Hutomo, B. Gan, A. Grabsch, and C. Klauber, Combined application of QEM-SEM and hard X-ray microscopy to determine the mineralogical and chemical speciation of trace metals *Journal of Environmental Quality* (accepted)

G. Power, M. Gräfe and C. Klauber, Bauxite Residue Issues: I. Current management, disposal and storage practices, *Hydrometallurgy* (submitted).

C. Klauber, M. Gräfe and G. Power, Bauxite Residue Issues: II. Options for residue utilization, *Hydrometallurgy* (submitted).

M. Gräfe, G. Power and C. Klauber, Bauxite Residue Issues: III. Alkalinity and associated chemistry, *Hydrometallurgy* (submitted).

M. Gräfe and C. Klauber, Bauxite Residue Issues: IV. Old obstacles and new pathways for in situ residue bioremediation. *Hydrometallurgy* (submitted).



M. Landers, M. Gräfe, R.V. Tappero, P. Austin, B. Gan, A. Grabsch and C. Klauber, Multi-scale characterization of a Western Australian bauxite residue: A synchrotron micro-spectroscopy and QEM-SEM analysis. *Chemical Geology*, (submitted).

The speciation work has also been delivered at ACS Spring 2010 Meeting, San Francisco (21st -25th March 2010), NSLS User Workshop in Brookhaven (May 2010), 19th World Congress of Soil Science 2010, Brisbane (1-6th August, 2010) and an Australian Synchrotron Users Meeting in Melbourne (22-24th November 2010). An extended BRaDD Workshop was presented as part of TMS Light Metals, Seattle, (14th February 2010) and a paper on BRaDD presented at ICSOBA-2010, Zhengzhou, China, (25-27th November 2010).

China

Nil

India

The fired bricks/blocks have been test marketed and around 10,000 bricks were sold to a construction firm who had appreciated the product quality.

Milestones Reached Over Lifetime of Project: *Please list the major milestones attained with timing (month/year).*

Australia

Item	Description of Services	Milestone Date	
		Original	Revised
1.	Signing of Contract (includes travel undertaken to attend Aluminium Task Force meeting in Hyderabad, India, 2007).	Mar 2008	May 2008
2.	Undertake a General Literature Review of technology, practices, re-use options and residue chemistry.	29 Aug2008	15 May 2009
3.	Conduct a Detailed Literature Review of current general storage practices, engineering and science	29 Aug 2008	15 May 2009
4.	Conduct a Detailed Literature Review of all re-use options.	29 Aug 2008	15 May 2009
5.	Conduct a Detailed Literature Review of residue alkalinity and associated chemistry.	28 Nov 2008	15 May 2009
6.	Conduct a Detailed Literature Review of residue alkalinity and associated chemistry.	28 Nov 2008	15 May 2009
7.	Develop a priority list for research into gaps and areas identified in the literature reviews that have the most promising outcomes.	28 Nov 2008	15 May 2009
8.	Attend up to two meetings of the Aluminium Task Force each year throughout the term of the Contract to inform members of project progress, anticipated to be in May and November of each	May 2008 Capetown Dec 2008 Sanya	N/A



	year.	2009 not held Mar 2010 Vancouver Jan 2011 Canberra	
9.	Undertake R&D activities on promising re-use options, and knowledge gaps in residue alkalinity	27 November 2009 30 July 2010	N/A
10.	Facilitate and report on the outcome of up to three annual workshops commencing in 2008 (domestically and internationally) which will act as forums for discussion on the activities and results of the project throughout the term of the contract. For the workshop to be held in Australia, the Contractor will make all necessary arrangements in consultation with DRET.	November 2008 November 2009 November 2010	N/A N/A 30 March 2011
11.	Undertake application reviews and surveys for environmental rehabilitation re-use options; civil construction options; and industrial feedstock options.	27 November 2009	N/A
12.	Engage relevant industries for possible synergies and trial partners	26 November 2010	N/A
13.	Identify financial mechanisms to implement strategies to enhance bauxite residue utilization	30 July 2010	N/A
14.	Develop plans for commercial-sale trials and identify potential candidates to undertake the trials	30 July 2010	N/A
15.	Develop an ongoing implementation plan and benchmarks for future uptake of the technology and practices	26 November 2010	N/A
16.	Compile a report on the activities and findings of the project	28 February 2011	30 April 2011

India

Around 10,000 fired bricks and 20 nos. stabilized blocks were manufactured and characterized (physical, chemical and mechanical properties) – June, 2010

Around 2 tons of Artificial ceramic stone chips were manufactured and characterized (physical, chemical and mechanical properties) – September, 2010

Test marketing of the products carried out – September, 2010

China

Nil



Expected Project End Date: Revised to 30th April 2011 (to allow for final Workshop)	Project Already Complete: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<i>Please provide url address for where activity can currently be found along with new name and/or identification number of project (if applicable).</i> http://www.asiapacificpartnership.org/english/pr_aluminium.aspx#Aluminium_Project_3	
New Contact Information: (If different from above) <i>Please provide point of contact to find more information.</i>	
Other Information: <i>Australia</i> The BRaDD database (Bauxite, Residue and Disposal Database, a CSIRO in-kind contribution to the ATF-06-03 project) is a free, online database collating all publicly available information on bauxites, their processing and the subsequent production and storage of residue. Registration for use at: https://extranet-wf.minerals.csiro.au/BRaDD/ <i>India</i> Nil <i>China</i>	

Please attach any supplemental project information to this form.