

Bauxite Residues
APP project ATF-06-03

**Management and Re-Use of
Bauxite Residues**



Aluminium Task Force - Meeting 5
Sanya, Hainan Province, China
Thursday 4th December 2008



Australian ATF-06-3 Project Activity



- Project Commenced May '08 ✓
- Literature reviews Oct '08
 - Deferred release of “paper review” due to realization that the static format was inadequate for the purposes of the project
 - Commenced database development “*Bauxite Residue and Disposal Database*” – see slides 4-6
 - Conventional review documents for issue **Q1 '09**
- Report on progress (this meeting) Dec '08 ✓
- Priority list for gaps in knowledge (i.e. research required) Feb '09
- Undertake R&D activities on promising re-use options Jul '09
- Application reviews – construction & industry feedstock Nov '09
- Engage industry partners, identify financial mechanisms, plan commercial trials, benchmark etc Nov '09 – Nov '10

Australian ATF-06-3 Project Activity



- Project promotion planned through TMS Light Metals 2009 paper on ATF-06-3 (February, San Francisco, USA)
- Testing of magnetic separation methods for residue by-products
- Other potential re-use options are being explored

Residue Management Issues - why we took the database route



- Initial steps in writing a review involved assessing (world-wide) the size of the bauxite residue problem/opportunity – a major task
- Economic re-use of residue for the high volume possibilities (e.g. for steel, concrete and agriculture) will depend on a knowledge of resource size, chemistry and location
- Therefore we needed to develop a *data management tool*

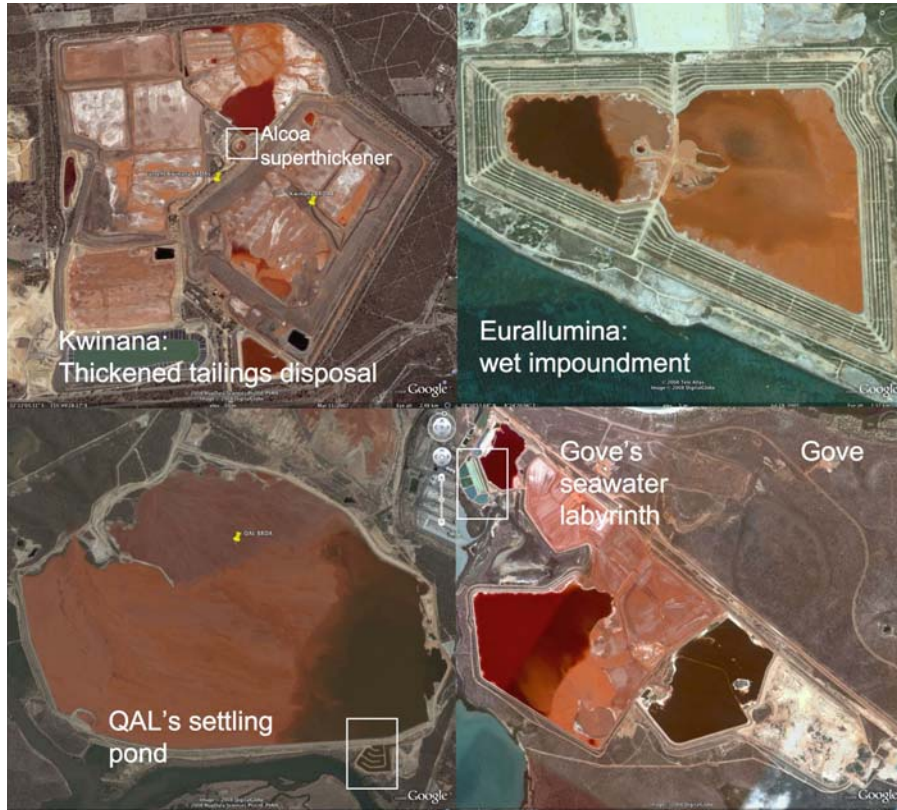
Residue is not Generic



- All refinery steps after *clarification* have an impact on disposal
- Design of the disposal area is dependent on the physicochemical properties of the residue
- Stabilization of the residue (e.g., dust prevention, sealant maintenance) is an ongoing requirement
- All of these processes can be fine-tuned against each other to achieve long-term storage solutions and improve the residue as a re-use candidate

Illustration of differences in bauxite residue disposal strategies

Local climate and topography influence which disposal strategy is pursued.



- **Kwinana:** thickened tailings disposal with water sprinkler system to prevent dust formation.
- **Euralumina:** wet impoundment of seawater treated residues. Dust is prevented by sprinkling supernatant liquor from one deposit area onto a neighbouring deposit.
- **QAL:** seawater neutralisation with settling pond for solids prior to discharge of supernatant liquor into the adjacent ocean bay.
- **Gove:** seawater neutralisation of supernatant liquor for the sequestration of vanadium (as VO_4) in hydrotalcites

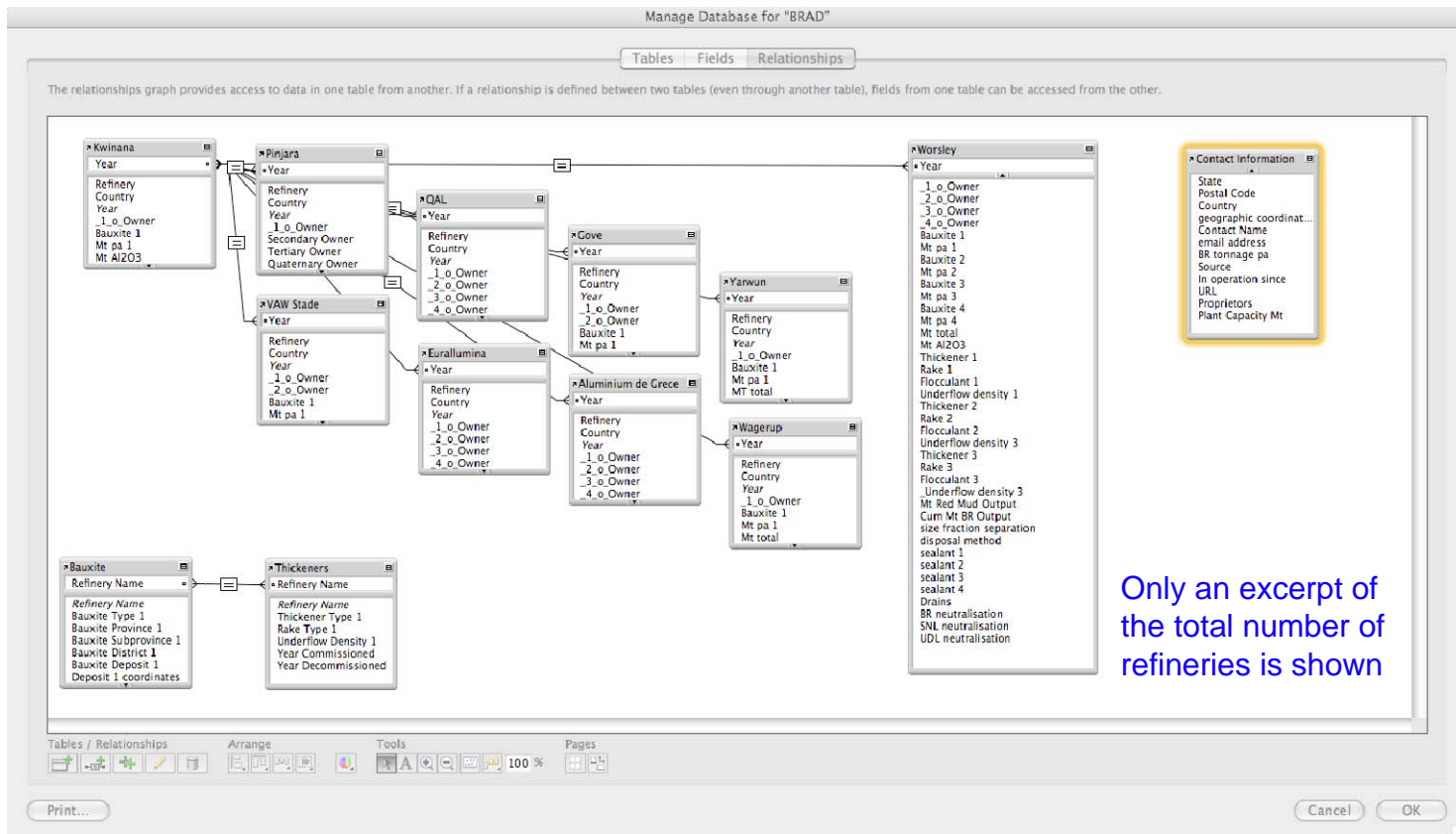
Data-basing as opposed to reviewing



- Conventional reviews of bauxite residue management fail to capture the diversity of refineries and the refinery changes over time
- > 90 alumina refineries across six continents - essential to quantify all residue data as a function of time
- A database capturing both technological decision making and management strategies is much more valuable than a conventional snapshot review

Welcome to *BRaDD!* Bauxite Residue and Disposal Database

Compiled from literature, books, company reports, stock exchange reports and magazine articles in six languages



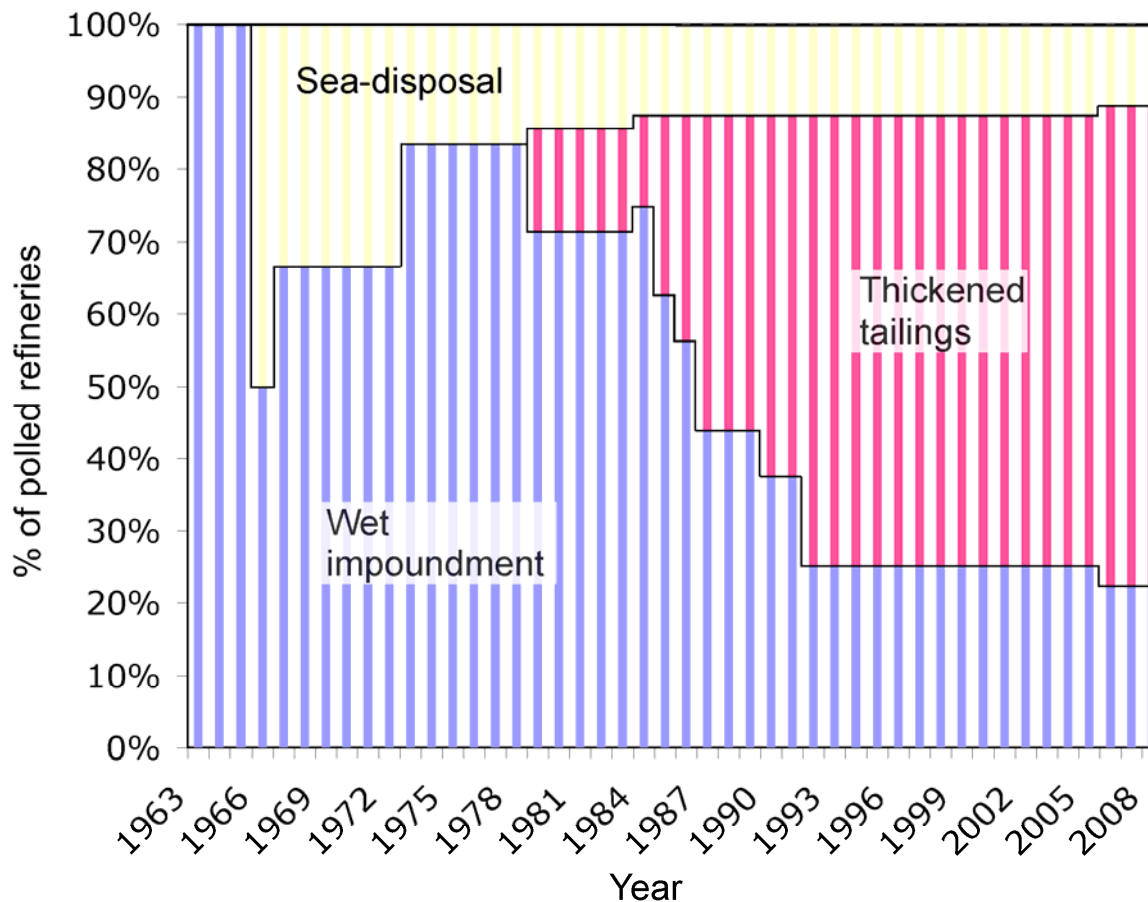
English, French, Spanish, Portuguese, Russian and German – Chinese to come

BRaDD capabilities



1. Overviews of each individual refinery with the option of summary reports on specific operating parameters (e.g. residue output vs. alumina production)
2. Comparisons between refineries:
 - a. individually (e.g. Kwinana against Gove)
 - b. as groups (e.g. European against Indian against Chinese)
3. Summary reports for refinery attributes and operating parameters (e.g. types of thickeners in use):
 - a. history of technology and practice (e.g. numbers and types of thickeners used over time)
 - b. current practice (e.g. out of all refineries, how many use Alcan Deep Thickeners, dry-stack, but are not in Europe)
4. Lists of refineries against operating parameters (e.g. list of all refineries that used lagooning as a residue storage method between 1990 and 2008).

BRaDD Examples

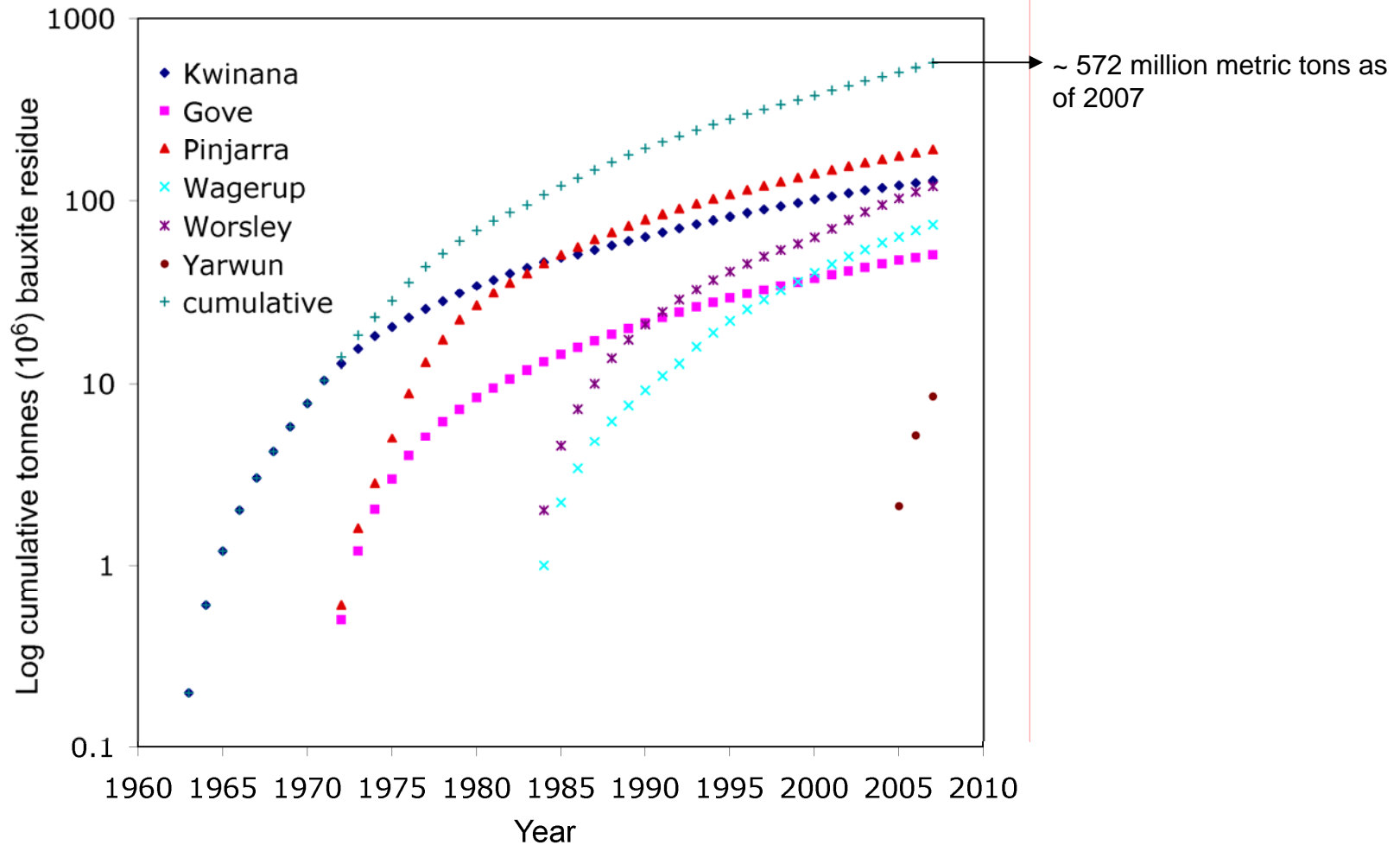


Polled refineries:

- Kwinana: 1963 -
- Alu de Grece: 1966 -
- QAL: 1967 -
- Pinjarra: 1973 -
- Wagerup: 1984 -
- Gove: 1973 -
- Eurallumina: 1973 -
- VAW Stade: 1973 -
- Worsley: 1985 -
- Yarwun: 2006 -

Example #1: History of residue disposal methods for Australian and selected European refineries.

BRaDD Examples



Example #2: Bauxite residue output in Australia (QAL data not ascertained yet).

Advantages of the database solution



- Links chemical and physical bauxite residue properties to disposal practice & management
- Links re-use research results to known bauxite residue deposits
- Provides a current measure of amount & type of residue available for potential reuse
- No further re-researching and re-compilation of source articles is necessary as inputs are bibliographically auto-cited
- Database can be expanded to encompass both “red” and “white” sides of refineries (e.g. High Silica project)

Planned Improvements to the Database



Information structure:

- Current database design is based on a refinery by refinery model
- A more efficient alternative structure is being explored

Data is not always readily available due to:

- Multilingual sources
- Diffusely distributed
- Clearly many gaps in information at this stage
- It would help us if APP countries could volunteer this information

Steps ahead for *BRaDD*



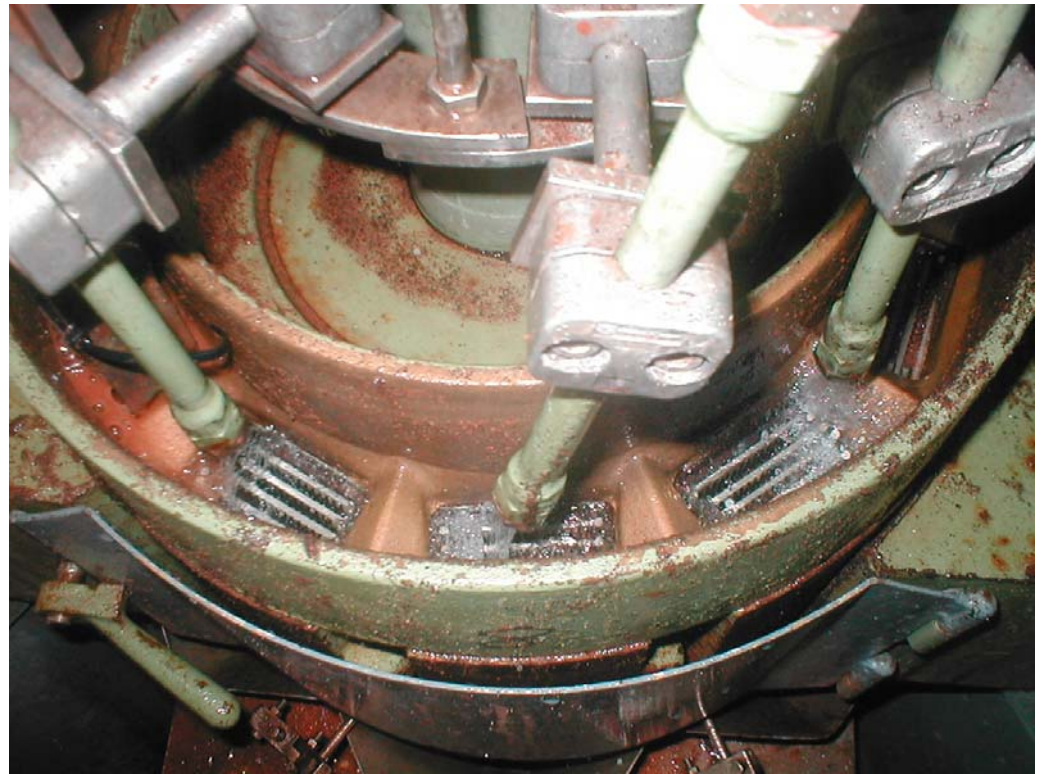
- Additional online data searches to fill in data gaps
- Data input to fill in all off-line publicly available data
- We plan to make BRaDD accessible to APP members through the internet

- Broader participation in populating the database with information from APP countries will strengthen its value as a knowledge management tool.
- *Please provide us with information on your refineries*

Public domain examples of residue re-use

Residue re-use a possible example

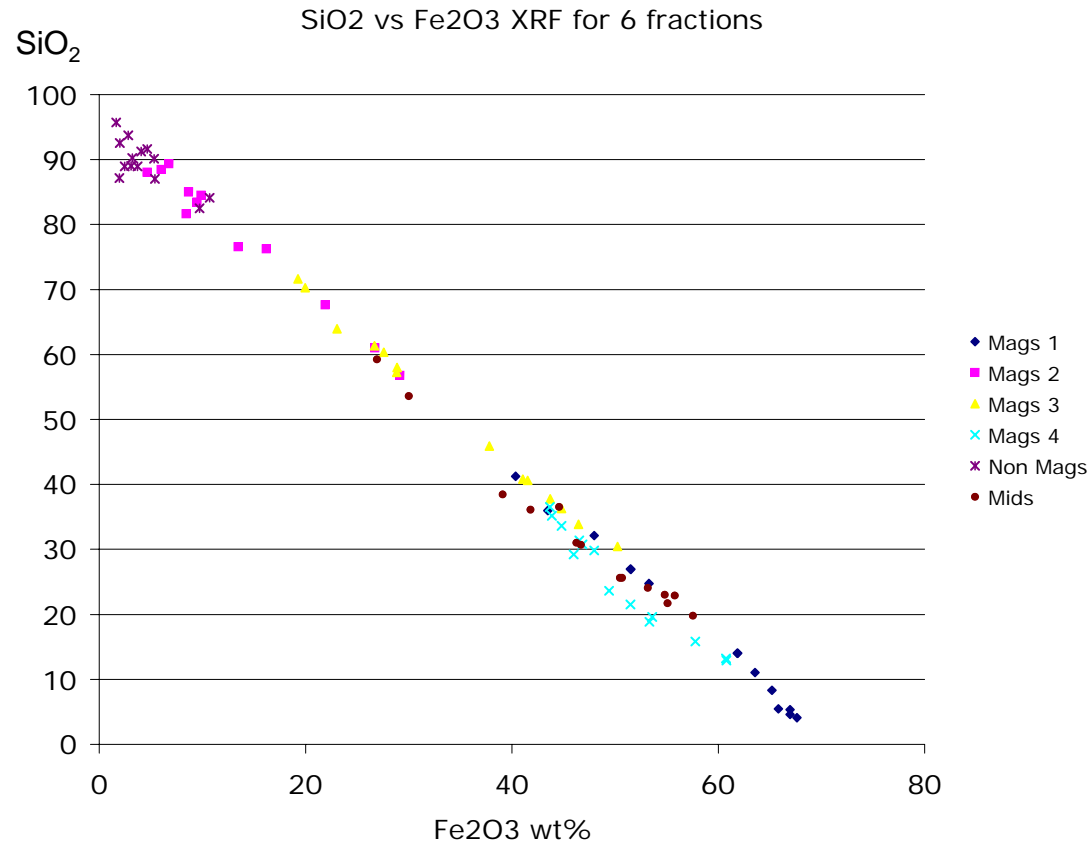
WHIMS (Wet High Intensity Magnetic Separation)
provides one route for simple by-product upgrade



Producing low and high iron content coarse fractions



CSIRO Waterford Laboratory



Residue re-use



- Approaches being taken by CSIRO and other Australian researchers include:
 - Soil amelioration (improve sandy soils)
 - Acid mine drainage treatment (neutralize and capture ions)
 - Construction sand (concrete, road fill etc)
 - CO₂ capture/residue neutralization (e.g. Alcoa process)
 - Zero waste processing
- We are attempting to tailor new or match existing potential re-use options with local synergies – again important to have a data management tool.

Next steps



- Release “static” paper version of the general literature review which will give some description of BRaDD **Q1 '09**
- Beta-release of BRaDD database (internet access) **mid '09**
- Priority list for gaps in knowledge (i.e. research required) **Feb/Mar '09**
- Need technical inputs from APP countries on their parallel activities on re-use options. **Q1 '09**
- Need APP country inputs for the database. Please contact Dr Craig Klauber **by end Q1 '09**
- Undertake R&D activities on promising re-use options **Jul '09**
- Application reviews – construction & industry feedstock **Nov '09**
- Engage industry partners, identify financial mechanisms, plan commercial trials, benchmark etc **Nov '09 – Nov '10**

Alignment with industry needs



- APP activity is well aligned with the Alumina Industry Technology Roadmap
- APP activity provides a resource for assessing likely sustainability of residue disposal practices, past and present
- APP activity (especially the database) provides a strong foundation to understand potential re-use options
- Potential to leverage APP outputs for future bauxite residue projects including those planned by IAI (e.g. *in situ* remediation of residue, re-use projects and bauxite residue disposal metrics)

Contact details for further information



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Thank you for your attention