MAYDENA SANDS PTY LTD

ACN 111 938 428 ABN 65 111 938 428

RETENTION LICENCE NO. 2/2003

MAYDENA, TASMANIA

ANNUAL REPORT

TO

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ABSTRACT

Activities to advance the Maydena Sands project continued despite the lingering global economic malaise which impacts on products based on high purity silica flour and sand.

This year's main focus was on environmental base line studies, product improvement using acid leach techniques as well as removal of carbon contaminants and a successful melting test to gauge the suitability of the silica flour to produce quality glass.

Marketing activities resulted in a number of new contacts and the identification of fused silica production as a potential off-take for Maydena Sands' high purity silica flour.

Progress by TasRail to improve rail freight services continued apace, along with improvements of port facilities, especially at Bell Bay, though regular container shipments direct to Asia remain a matter for further attention.

Keywords:

Maydena; Silica flour;
Silica sand; Glass;
TasRail; Logistics.

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1. INTRODUCTION

This report outlines activities by Maydena Sands Pty. Ltd. during its ninth year of tenure of Retention Licence 2/2003, granted for a four year period to 9.01.2008 and then renewed annually to 09.01.2014.

This tenement has its origins in EL 17/1998 of 7sq.km previously held and operated by J.J. McDonald &Sons Mining Pty. Ltd. The current tenement of 4sq.km is located just south of the sealed Gordon River road approximately 4 km west south west of Maydena (pop. 250 approx.) and about 90 km by road from Hobart (Fig.1). There is good access to and within the prospect area. Power, water, housing and basic facilities are readily available from within a short radius of the prospect. The last few years saw the progressive upgrade of the narrow gauge New Norfolk-Maydena rail line to passenger standard but only as far as the entrance to the Mt Field National Park. After an assets review last year TasRail resolved to donate the Derwent Valley Railway line to tourist and heritage operators in a deal yet to be finalised. In this context, mooted upgrades to freight standard of the entire stretch are now highly unlikely. An alternative rail loading facility, a major freight hub at Brighton, approx. 65km by road east of Maydena has been completed and is close to achieving full operating status.

A 700m long gravel airstrip is located 3 km north west of the silica sand deposit.

The primary target for investigation, assessment and eventual exploitation remains the deposit of silica sand and its silica flour matrix located largely to the west of the Eastern Quarry, about 1 km south east of Pine Hill (Fig.2).

The overall aim of the investigations is to determine if a commercially viable operation can be established, based on products derived from the silica flour, silica sand and silica rock resource in the tenement and other economic factors.

In view of the growing use of solar power locally and overseas, interest was also maintained in the silica rock potential of the tenement. This raw material, if of sufficiently high quality is used in the production of high purity silicon metal which is an essential component of photovoltaic solar cells. Also of potential interest is the coarser, higher purity sand fraction for use in the manufacture of technical glass, optical glass and solar cell cover glass with high light transmissivity characteristics.

2. PREVIOUS WORK

Exploration by Pioneer Silicon Industries Pty. Ltd. in 1988/89 identified a lag deposit of hard silica rock at the Western Quarry containing a small resource of material deemed suitable for the manufacture of silicon. (Fig.2). From this, approximately 19,500 tonnes of crushed, screened silica rock was produced in 1991 and 1992 for shipment, of which some10,000 tonnes were consigned to Pioneer's silicon smelter at Electrona and about 9,500 tonnes went to Temco's Bell Bay ferrosilicon plant. Extraction, by Duggans Pty. Ltd. under M.L.1396 P/M, virtually ceased upon closure of the Electrona smelter south of Hobart in 1992, although a small parcel of 850 tonnes of silica rock is reported to have been mined in 1995. At the end of the earlier exploration work, a small cutting of white silica sand, first exploited in the 1970s by ANM (now Norske Skog), was located between Pine Hill and the Styx Road in an area now known as the Eastern Quarry Area. Pioneer investigated this deposit in the vicinity of the Eastern Quarry by 23 shallow RC drill holes. Preliminary estimates suggested a resource in the order of some 0.75 – 1.5 million cu. m. of mostly low iron silica sand containing about 10% of high quality lump silica. Pioneer terminated operations at Electrona before any of this latter material could be used for silicon production.

Assay results from a number of subsequent, excavator generated samples by the North West Bay Co. Pty. Ltd. from a number of shallow pits supported the high quality of the resource and, together with sizing determinations on a bulk sample, indicated that the sand might be suitable for the manufacture of table ware glass.

During its tenure of EL 17/1998, which contained these deposits, J.J. McDonald & Sons Pty. Ltd., using the air core drill sampling method, completed 43 drill holes totalling 553 m which outlined a raw material resource of about 6 million tonnes of loose silica ranging in size from very coarse to very fine.

The drilling also demonstrated that the deposit is more variable, complex and higher in iron oxides and other impurities than previous data suggested.

Laboratory sizing determinations indicated that the deposit is a possible source of silica flour as well as glass sand, while geological mapping and interpretation pointed to a small resource potential for hard rock silica as well.

Preliminary bench scale beneficiation and bulk sample processing tests, including acid wash tests on samples of the glass size fraction sand, showed that the -250 micron fraction could be upgraded to a high quality product containing only about 50ppm Fe_2O_3 without major environmental impact, with levels of iron as low as 10ppm a possibility.

Sources of good quality limestone and dolomite were noted in relative proximity to the silica sand deposit for eventual acid neutralization uses.

The company's activities in the marketplace identified the natural silica flour as potentially the deposit's most important component economically. This material provided the major focus for ongoing geological, processing and marketing activities, though the coarser size sand fractions and the hard-rock silica potential remain of interest for future attention under the appropriate market conditions.

In early 2004, EL tenure over the area was converted to a Retention Licence

In late 2004, Directors of J.J. McDonald & Sons Mining Pty. Ltd. formed a new holding and operating company, Maydena Sands Pty. Ltd., to which the Retention Licence and all of the former company's interests in the Maydena area were transferred in April 2005.

Since then, all activities are being conducted under the new Company name.

Details of past activities and outcomes are provided in reports listed in Sections 7 and 8 below.

3. ACTIVITIES FOR PERIOD

These included:

3.1 Work Done

- Drilling – All drill chip material was moved from Tasmania to Victoria for centralised storage and ease of access.

- Dating – zircon focused – suspended. Alternatives under consideration.

- Beneficiation:

  Investigations to remove organics/carbon end product contamination commenced. – Ongoing.

  Acid leaching – Use of oxalic acid to remove Fe staining initiated and initial tests nearing completion.

  Glass mix melting test – Successful

- Market related activities:

  Ongoing market research and monitoring – silica sand, silica flour, display panels, fused silica and polysilicon.

  Visit to SGGC – Germany – foam glass.

  Attendance at China Glass 2013 – Beijing, providing contacts with:

  - LDK Solar – China – Silica rock
  - Cencera Corporation – fused silica
  - Innoceram – China – fused silica
  - Pyrotec – China – silica refractories and fused silica
  - Ruitai Materials – China – silica refractories and fused silica
  - Sinoma Advanced Materials Co. Ltd. – China – fused silica
  - Vesuvius – China, Europe – refractories and fused silica

  Attendance at Gulf Glass 2013 – Dubai, providing contacts with:

- SIBELCO – silica flour, silica sand
- MULTIMIN – Egypt - silica flour, silica sand and silica rock
- Skyfuel - USA – silicon

Contacts or meetings with:

- Shinwon Materials, S.Korea – Silica flour, silica sand.
- Samsung – Sydney, Australia – Silica flour.
- Sojitz, Japan (Syd.Office) – Silica powder, silica flour.
- Cheng Kuen Ahn – South Korea – Silica flour, silica sand.
- Naturastone – Melbourne - Silica flour, silica sand.
- Stratum Resources, Australia – Silica flour, silica sand.
- SDI - Australia – Silica flour.
- Fundere Art Foundry – Australia – Silica flour.
- W.J. Pratt - Australia – Filter sands.
- Chase Reynolds - Holland – Silica flour, silica sand.
- Wong Chee Leong - Malaysia – Silica sand.
- Dong-xu Group – China – Silica flour.

Small test samples sent to:

- S. Hansen – Australia – Silica flour.
- A. Keith – Australia – Silica flour.
- SIBELCO – Belgium – Silica flour.

Glass mix test sample to:

- Tasmanian Glassblowers – Australia.

- Project Planning:
  - Discussions with Robmet, Brisbane re review and update of pre-feasibility/feasibility studies.
  - Contacts with ERIEZ re purchase price of HIMF equipment..
  - Discussions, monitoring TasRail modernisation progress.

- Discussions with Toll Tasmania re logistics, transport optimisation and freight cost estimates.
- Continued with environmental base line studies– In progress.
- Contact with surveyors re toposurvey of proposed processing area.
- Monitoring transport logistics systems in Tasmania – Ongoing.
- Monitoring activity outcomes from Tas. Gov.-established Freight Logistics Team addressing long term freight strategy for Tasmania.
- Monitoring activity outcomes from Cross Industry Task Force addressing Tasmanian freight issues.
- Monitoring progress on IGA Agreement.

- Community relations:

  Occasional contacts with Maydena Development Association.

- Environmental

  Checked on re-growth progress at latest rehabilitated and re-seeded drill sites.

3.2 Statistical Summary

Test Samples generated:

Glass Melt tests	:	1 X 110Kg
Promotion	:	1 X 8.5Kg
S. Hansen		1 X 2.5Kg

No. of Samples Analysed	:	92 (approx.)
No. of Analyses	:	621 (approx.)

3.3 Expenditure

To Dec 2012 (RL Tenure only)	:	$846,825.00
Period Jan – Sep 2013	:	$103,381.00
Estimate Oct – Dec 2013	:	$ 35,000.00 (approx.)
Estimated Cumulative Total		

for period of RL Tenure (to Dec 2013) : $985,206.00 (approx.)

4. RESULTS

4.1 Palaeodating

4.1.1 Zircon

Processing of approximately 7kg of silica sand and rock at Monash University early this year was to obtain sufficient (20-30) zircon grains of a minimum size of 50 microns deemed necessary for successful age determination for the introduction of granite-related, silica-bearing solutions into the dolomite at the prospect.

Previous investigations (Osterloh,2002; Keays in Krummei,2011) indicated that some zircon grains of this, or greater size can occur in this material.

Unfortunately, all zircons found in the samples processed were well below the minimum size required. Consequently, the project was temporarily suspended.

4.1.2 Other

It has been suggested that apatite could possibly be a suitable alternative to zircon for dating purposes in this case. This approach is currently under discussion with a CODES researcher at the University of Tasmania.

Furthermore, it emerged that radiocarbon dating has been used recently to date soil horizons near the Maynes/Styx Roads junction (McIntosh, et.al 2012)(Fig.2). Organic-like material intersected at 24-25m and 32-33m in Drill Hole 133 may be suitable for this purpose.

This matter will be pursued further as a positive result in the former case could provide a guide to the date of introduction of silica fluids into the host dolomite and in the latter case and indication of the formation of the sand deposit.

Information gained could be useful in regional exploration for similar, high purity silica sand deposits.

4.2 Beneficiation

4.2.1 Oxalic Acid Leach Tests

The background to these tests is outlined in Krummei (2012). An investigation, with ancillary tests, has been carried out throughout most of this year as to the effectiveness of oxalic acid as a leach medium in the removal of iron stain, and possibly other metal contaminants from the silica flour. To this end 6 X 0.5kg separate samples were selected from drill cuttings previously generated at the prospect.

These samples are:

Hole 87:	5363992mN	466092mE	RL 413.540
70210 OX	9-10m	Pale orange-buff fine sand	
70210 ROX	10-11m	Light brown fine sand	

Hole 102:	5263834mN	465990mE	RL 413.561
70419 ROX	4-5m	Buff sand	
70311 OX	5-6m	Buff sand	
70413 ROX	6-7m	Red brown sand	
70312 OX	7-8m	Bright orange brown sand	

Note: All co-ordinates are AGD 1966.

The 45-250 micron fraction was recovered from each sample by wet screening. This fraction was then dried and subjected to magnetic separation at 16000 gauss, using a Reading Roll Magnet.

The Head and the non-magnetic fractions were assayed for Al_2O_3, Fe_2O_3, CaO MgO, TiO_2, K_2O and Na_2O.

The non-magnetic fractions were then leached with oxalic acid solution to investigate the effectiveness of this reagent in reduction of iron levels and to assess its potential in removal of other metal contaminants.

Various strength oxalic acid solutions of between 1 and 100 gpl were applied at 20°C and 45°C, over a 24 hour period, using magnetic stirrer agitation, bottle roll agitation and static leaching.

The results can be summarised as follows:

1. A minimum of 10gpl acid strength is required to obtain effective iron removal.

2. Solution strengths above 10gpl did not improve iron removal.

3. Final iron contents of all samples were between 20 and 30ppm Fe_2O_3 after iron removal had ceased, as judged by cessation in iron removal from solids, determined by sampling of iron content in leach liquor.

4. Leach rates were approximately 3 times faster at 45°C than at 20°C.

5. Surprisingly leach rates were identical when using either vigorous mechanical agitation (magnetic stirrer), gentle agitation (bottle roll) or no agitation (static leaching).

6. Iron removal was thus a function of time only, given oxalic concentration was at or above 10gpl.

7. Although there was some reduction in TiO_2 levels, very little effect was noted in removal of Al_2O_3, CaO, MgO, K_2O or Na_2O. This was not surprising as the oxalates of these metals are insoluble in water.

8. Aqua regia digests of the solids from these leaches at 100°C for 3 hours also had little effect on removing these metals, suggesting the presence of complex silicates as a contaminant. These perhaps may be removable or reducible by intensive attrition followed by physical separation (options include wet screening, upward flow classifier, wet tables, etc).

The possible presence of any such silicates is currently being investigated by a CODES researcher using LA-ICP-MS, SEM and microscopic techniques. A preliminary report is pending.

In any event, the reduction of iron content to final levels of 20-30ppm Fe_2O_3 can be deemed to be a significant result, even though the target of 10ppm or less of Fe_2O_3 proved elusive.

Full details of procedures, ancillary tests and results are given in Appendix 1.

As the HIMF method of magnetic separation yielded a high quality, low iron product, it was decided to determine if the feed for this end product would also encounter a "leach barrier" using oxalic acid as the leach medium.

The results of this comparative investigation are imminent.

4.2.2 Native Metals and Alloys

Previous mineralogical inspections of the silica sand and flour and derived magnetic products indicated the presence of native metals and alloys (Mather in Krummei 1999 and in Krummei 2002), thought at the time to be most likely drill-derived contaminants.

Last year's SEM scans of silica flour material also revealed minute traces of native Fe and Ti, as well as alloys of Fe-Ni-Cr and Fe-V-Ti-Ni, the origins of which are enigmatic in this setting and in no way drill-related. These rare and unusual contaminants captured the attention of researchers at UTAS/CODES who also identified native metals, as well as Cu-Ni and Cr-Fe alloys associated with the silica. A research proposal is currently being formulated to investigate the origins of these materials. If implemented, the outcomes of this work may contribute to better beneficiation procedures and an end-product of higher purity.

4.2.3 Organic Particles

Organic particles in the end product silica flour and, by extension, also silica sand are undesirable visual and chemical contaminants, the latter by virtue of their metallic content.

The focus of this investigation, undertaken at UTAS, was to shed some light on why some organic carbon particles in the sand material float and can be removed by washing and others sink to become incorporated with the silica flour and silica sand end product. Preliminary inspection under the microscope of some material identified organic particles coated with carbonate and/or silica and pyrite/marcasite growths, probably increasing their specific gravity and causing them to sink.

Subsequent, more detailed inspections showed the “floats” to be a mixture of organic material including leaves of mosses, fragments of fine stems of plants and a small proportion of charcoal fragments. The latter may have extraneous chemical material sorbed into it. The “sinks” were broadly similar to the above, with more and larger charcoal fragments with bits of silica attached to them.

A partial explanation of the sink/float characteristics of the organic/carbon particles has been achieved and a cost-effective method for the removal of this visual and chemical contaminant warrants further investigation.

A brief report on this work so far is presented in Appendix 2.

4.2.4 Melting Test

Arrangements were put in place with J. Dodson, Tasmanian Glass Blowers, of Launceston, to undertake a melting test using the Maydena Sands low iron silica flour.

The purpose was to gauge the quality of glass produced and to see if gaseous or solid inclusions in the silica impacted on glass quality.

Approx. 225kg of raw material were processed at the ALS Metallurgy laboratory at Wivenhoe to produce approx. 110kg of +40 -250micron silica flour assaying 30ppm Fe_2O_3, <10ppm TiO_2, 80ppm Al_2O_3, 380ppm CaO, 70ppm MgO, and 10ppm or less of each of Na_2O and K_2O.

This material was the starting point for the production of approx. 160kg of test mix for soda-line glass by Artisand of Castlemaine, Vic. This material was forwarded to Tasmanian Glass Blowers for the melt test using that company’s

small production furnace and standard melting procedures. The melting temperature of the mix was approx. 800°C which was then lowered to approx. 624°C for refining purposes, mainly to remove any bubbles from the melt. Thereafter, the furnace temperature was raised to, and maintained at, 1100-1120°C to ensure appropriate viscosity for working purposes.

The glass produced from the Maydena sand mix was clear, white, bubble-free and judged to be of excellent quality and visually comparable to that produced from competitors' material. It will be a satisfactory product, among others, for TFT-LCD and other display glass substrates, tableware glass, laboratory glassware, art glass and feed for the production of fused silica material and products.

4.3 Project Planning

4.3.1 Plant Site

A new, suitable, relatively flat site for the location of a processing plant and associated infrastructure has been identified in clear-felled coupe 37G, some 800m north, and downhill, from the silica sand deposit and close to the sealed Gordon River Road.

This site of approx. 7ha is well located and provides a number of planning options. It has been burned and re-seeded, revealing some topographic irregularities, including minor drainage courses. A topographic contour survey is planned. Tenders for this work are being sought. Contacts with Forestry Tasmania regarding the proposed use of this site remain positive, although no feed-back on road usage costs and charges, or compensation for the eventual removal of any trees in the area, has yet been received.

4.3.2 Environmental Base Line Study

Environmental Baseline studies, commenced last year, continued through into 2013, using SEMF Consultants of Hobart.

Current status:

- Water quality sampling: Completed. 2 sets of readings – winter and summer. No apparent issues. (viz. Krummei, 2012; Keserue-Ponte, 2013).

- Dust monitoring: Completed. 12 monthly readings at 4 stations. Dust levels recorded are generally low, except during periods of heavy rain.

- Flora and Fauna Surveys: Basic survey completed. No significant issues. Masked owl nesting habitat requires further assessment, based on seasonal considerations. First round of follow-up night spotting and owl call back surveys completed; second round due for completion year end 2013/early 2014. Spotted-tailed quoll dens, grey goshawk nesting habitat and migratory species habitats in the area require further assessment closer to commencement of any mining activities in the area.

- Geoconservation Survey: Completed. No significant issues identified.

- Aboriginal and European Heritage: Planned to commence in the 4th quarter of 2013/early 2014.

No “show stopper” issues have emerged from the various studies to date.

4.3.3 Logistics

Rail:

Reliable rail freight facilities and services remain critical to the Maydena Sands Project in terms of getting product to port and markets beyond.

In this context, the modernisation of TasRail was monitored throughout the year. The historic lack of adequate rail infrastructure is now being remedied along the main rail corridors and the replacement of deteriorating assets is being addressed, along with capital works in progress. This is due in large part to significant Australian and Tasmanian Government funding support which is likely to continue to 2018/19.

There is significant progress over a broad front (TasRail 2012/2013)

- Order placed for 191 new rail wagons including :
    - 120 intermodal wagons (for containerised freight)
    - 17 coal wagons
    - 18 cement wagons
    - 36 ore wagons.
- 17 new locomotives under construction in the USA.
- Re-railing in progress.
- Downer EDI contracted to do ballast clearing across the rail network to prepare for concrete sleeper installation.
- Rail freight services resumed on the Bell Bay line.
- Refurbishment of Bell Bay Intermodal Terminal at George Town – a focal point for container and log movement.
- Tenancy Agreement for the Brighton Transport Hub signed with the Toll Group.

All the above are encouraging developments and inspire confidence in the renewal of the Tasmanian rail system for the benefit of the Tasmanian economy. However, despite these major achievements, substantial work remains to be done and full facilities are still one to two years away.

Ports:

It is encouraging to note that the Bell Bay rail line has been re-opened to port for rail freight, including containers. Equally pleasing to note is the refurbishment of the Bell Bay Intermodal Terminal at George Town.

These are positive developments at the end of the mine-site-to-port logistics chain. Their impact will be to lower CIF product prices to overseas customers.

Road:

Intermittent discussions were held with Toll Tasmania regarding land transport options from mine site to port. Several interesting road and road/rail options were proposed by Toll, some focused on the Brighton Transport Hub. Indicative freight cost estimates, based on the source of containers, received from Toll for the land component combination (road/rail) are in the order of $ 61.91 – 85.10 /tonne to Bell Bay or $105.20 - 139.50/tonne to the Melbourne overseas terminal. However some of the options, and costs, depend on the availability of a reliable and economic rail service to Bell Bay.

Costs for seaborne freight to several overseas destinations are awaited.

The cessation of regular, direct container shipments from Bell Bay to Asia remains of major concern, although there is some indication that a shipping company is showing interest in revitalising this service, conditions and time frame unknown. This matter is being pursued by a Cross Industry Task Force. Furthermore, a State and Federal Government sponsored Freight Logistics Co-ordination Team is addressing the matter of a long term Tasmanian freight strategy and investigating avenues for Tasmanian businesses to export to state and international markets. A draft report is expected towards the end of 2013.

4.4 Marketing

4.4.1 Overview - Polysilicon

During the year, spot prices for polysilicon feeding into the photovoltaic industry continued to languish around the US$20/kg mark. This situation is predicted by industry analysts to prevail for another 2-3 years at least, due to lower uptake, past overproduction and ongoing high stock levels.

The problem is illustrated by the fact that projected total polysilicon demand in 2015 is likely to be in the range of 285-312K MT as against a total production capacity of approx. 350K MT.

These conditions are not conducive to exploration in the short to medium t for high purity silica rock for PV polysilicon production.

4.4.2 Overview – Display Glass

Although prices for display glass substrates are reported to have fallen slightly, there has been a marginal increase in demand during the year. Market leader Corning is cautiously optimistic about future trends.

4.4.3 Marketing Activities

Despite the continuing global economic malaise, enquiries for low iron silica flour and sand were generated from East Asia (incl. China), Europe and Australia, although at a reduced rate compared with the last two years.

China Glass 2013 and Gulf Glass 2013 were visited to promote Maydena Sands and to gauge market demand for its potential products.

A possible new area of application in the glass industry was identified in the area of fused silica, the production of which uses crushed, low iron glass feed. It is in this context that the Maydena Sands' melting tests (See Section 4.2.4) are also relevant. Other silica-based refractories offer some low-volume market potential.

The most promising of the contacts for further follow up were:

- Cencera Corporation: China: Require high quality glass cullet for the production of fused silica used to make rollers and similar equipment for the flat glass industry. High purity silica is a desirable starting point for the manufacture of the required glass cullet.

- Sinoma Advanced Materials Co. Ltd.: China: The company produces objects using fused silica. Quality requirements as above.

- Ruitai Materials: China: Manufacturer of silica refractory and fused silica products for the glass industry. Quality requirements for fused silica production as above.

- Pyrotek: China: Manufacturer of silica refractory and fused silica products for the glass industry. Quality requirements for fused silica production as above.

- Samsung, Korea/Sydney: Continuing interest in Maydena products. Awaiting FOB and CIF product prices.

- Shinwon Materials: South Korea: Marketing and distribution of raw materials. Possible facilitator for entry into the South Korean silica market.

- SDI : Australia: Uses high purity silica in the manufacture of speciality glass for dental applications. Repeat enquiry. Annual demand increased but low.

- Chase Reynolds: Holland: Processing, marketing, warehousing and distribution of raw materials. Interest expressed in Maydena materials.

- NaturaStone, Australia, (producer of acrylic engineered stone) and Sojitz, Japan/Australia (Marketer – fine silica) remains of interest.

- SIBELCO, Belgium: Major international supplier of raw materials to the glass and ceramics industries from global operations. Tested and confirmed quality of Maydena Sands' silica flour end product. Preliminary discussions with SIBELCO Australia initiated.

Contacts were also maintained with a number of other parties listed in Section 3.1.

4.5 Environmental

This year's activities had no environmental impacts

Rehabilitation

None was required as no disturbance occurred. A routine check on re-growth progress at the latest rehabilitated and re-seeded drill sites in 2011/2012 was carried out.

4.6 Community Relations

A few enquiries from local residents about Maydena Sands' activities in the Pine Hill area were dealt with. There were no significant issues. Occasional contacts with members of the Maydena Development Association were maintained.

5. CONCLUSIONS AND RECOMMENDATIONS

- The global PV polysilicon industry remained in the doldrums in 2013, with significant near-term improvements unlikely. This scenario does not invite investment into exploration for high purity silica rock as a feed for polysilicon production, but a monitoring brief will be maintained on the situation.

- Despite the continuing difficult global economic conditions, demand for high quality display glass remained steady, though prices fell slightly.

- Marketing and promotion activities this year again generated several useful contacts but the number of enquiries was down slightly on last year.

- Zircon palaeodating as an aid to regional exploration was deferred due to lack of suitably large grains to work with. This project could be re-visited in the future but, meantime, other methods should be investigated more closely.

- The oxalic acid leach tests were unsuccessful in achieving a target of 10ppm or less of Fe2O3. However, reduction of Fe2O3 to 20-30ppm levels represent a significant achievement and the cause of the leach barriers encountered should be investigated.

- Investigation into the nature and complete removal of organic particles from the sand and silica flour should continue.

- Investigations by CODES researchers into the nature, extent and origin of trace metals and alloys associated with the silica deposit should be encouraged and supported. The end result could be a cleaner, premium quality silica flour product.

- No issues significantly detrimental to the project or unmanageable were identified by the environmental base line studies this far.

- A detailed review of capex/opex costs could not proceed meaningfully because of slower than expected progress with the oxalic acid leach tests, lack of information forthcoming on cost imposts by Forestry Tasmania, uncertainty about power pricing, direct container shipping facilities to Asia and the uncertain political situation in Tasmania.

- The significant progress being achieved by TasRail to upgrade rail and port-side services provide a long overdue boost to investor confidence that existing logistical difficulties besetting Tasmania will be overcome.

6. PROPOSED FUTURE ACTIVITIES

- Complete Environmental Base Line studies currently in progress.
- Complete oxalic acid leach tests currently in progress, plus any follow-up.
- Investigate and, if warranted, apply alternative palaeodating methodologies to clarify the timing of the silica introduction into the dolomite and the formation of the sand deposit.
- Encourage and support investigation by CODES/UTAS researchers into the nature and origin of native metals and alloys found in the silica material.
- Ongoing reviews of process plant and design, sand extraction concepts and capex/opex estimates.
- Investigate the possible digitisation of the prospect's geological and geochemical data base in order to assist with eventual pit design.
- Produce a ground contour plan of the proposed plant site at Coup 37G to assist with site layout planning.
- Continue with product marketing, including attendance at China Glass 2014 as well as follow up activities on 2013 market contacts, opportunities and enquiries.
- Continue with product development, improvement and promotion and investigate new sales opportunities with the aim of securing off-take arrangements.
- Continue monitoring logistic support systems in Tasmania.
- Maintain contact with State and local regulatory authorities, as well as local civic associations, groups and individuals, on project related matters.

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APPENDIX 1

OXALIC ACID TREATMENT FOR IRON REMOVAL FROM OXIDISED ORE

MAYDENA SANDS PTY LTD

OXALIC ACID TREATMENT FOR IRON REMOVAL FROM OXIDISED ORE

C.J.BROWNE

September 2013

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SUMMARY

This project was aimed at investigating the possibility of using magnetic separation and oxalic acid leaching for the removal of iron contamination from silica particles contained in mostly heavily iron-stained sand intercepts in drill holes 87 and 102 at the Pine Hill silica sand deposit, Maydena, Tasmania.
This, and similar, iron-stained material is currently classified as being unsuitable for the production of high purity silica flour and silica sand for use as TFT-LCD TV and other display substrates, optical glass, high quality laboratory glassware and other technical glass which ideally require a maximum iron content amounting to no more than 10ppm as Fe_2O_3.

The investigation was confined to six samples representing this material derived from the above drill holes, from which the 45-250 micron fraction was extracted and then subjected to magnetic separation using a Reading High Intensity Laboratory Magnetic Separator. A magnetic field strength of 16,000 gauss and a roll speed of 100 rpm were chosen, as these are the standard settings used for removal of magnetics in the beach sands industry.
The non-magnetic fraction obtained from this procedure was then leached with oxalic acid solution over a range of conditions selected on an economic basis. To minimise external contamination, leaching was conducted in glass beakers using agitation provided by magnetic stirrers.
The initial test results were inconsistent and residual solids iron levels were at or above 50 ppm Fe_2O_3.
The magnetic separation step was then repeated on all six non-magnetics samples, again at 16,000 gauss, but with a reduced roll speed of 80 rpm, which is a setting normally used in the beach sands industry for removal of coarse or feebly magnetic material.
Leach tests using the non-magnetics from this procedure were found to produce consistent and repeatable results over all six samples. These results established that a residual solids iron level of 30 ppm Fe_2O_3 could be achieved after 3 hours, by using an acid strength of 20 gpl and a leach temperature of 20^oC. Unfortunately, higher acid strength, longer leach retention time, or increased leach temperature did not improve this result.
Sealed bottle roll tests were then carried out using equivalent leach conditions to further reduce any possible external contamination, but with identical results.
As a last resort, static leach tests, involving no agitation at all, were carried out. Surprisingly, these tests also produced identical results, indicating that agitation is not required. This would imply that the most economic practical process may involve heap or vat leaching, as distinct from tank leaching.
The disappointing aspect of this investigation is that once again, as with previous investigations conducted on other samples from this deposit involving use of mineral acids, a barrier has been encountered, albeit at a somewhat lower residual iron level.
On reflection, the improvement gained as a result of the reduction in roll speed from 100 to 80 rpm, suggests that even slower roll speeds should be tried. Other possibilities worth consideration would include upward flow classification post leaching, or perhaps pressure leaching.
There appear to be several options available in overcoming any environmental issues involved in the use of oxalic acid, including conventional calcium oxalate precipitation and recycling options based on iron extraction using zeolite or known solvent extraction technology.

1. INTRODUCTION

The following report details and discusses the results of a comprehensive investigation into the possible effectiveness of oxalic acid leaching, in association with magnetic separation, as a means of reduction of the high iron levels found in samples from oxidised, iron-stained material in the Pine Hill sand deposit to allow the production of silica sand and silica flour for use as TFT-LCD TV and other display substrates, optical glass, high quality laboratory glassware, and other technical glass, which ideally require a maximum iron content amounting to no more than 10 ppm as Fe_2O_3.

Previous attempts to achieve this result on other samples obtained from this deposit, by use of a combination of magnetic separation and leaching based on mineral acids have proved to be unsuccessful.

Oxalic Acid, formula $(COOH)_2$, is an effective reagent in dissolving ferric iron, by the reaction:-

$$\mathbf{Fe_2O_3 + 3(COOH)_2 \rightarrow Fe_2(C_2O_4)_3}$$

In this regard, it finds wide application in removal of ferric iron staining, such as in removal of rust from concrete pathways and in industrial scale whitening of clay.

It will be seen from the reaction depicted above that three molecules of oxalic acid are required to dissolve one molecule of Fe_2O_3. This would dictate that 1 gram of oxalic acid will dissolve 1.19 grams of Fe_2O_3.

As the Fe_2O_3 content of the non-magnetic fraction of the samples to be leached is likely to be considerably less than 2,000 ppm (2kg/tonne), consumption of oxalic acid is likely to be low, with a reagent cost of considerably less than $2/tonne of product.

It therefore appeared economically desirable to compare the effectiveness of oxalic acid as a leaching agent, with mineral acids such as sulphuric acid.

Six heavily oxidised samples were obtained ex drill cores from exploration boreholes 87 and 102.

The scope of the investigation was to be confined to the 45-250 micron size range in each sample.

The samples contained varying quantities of oxidised iron, both as free fine clay-like matter and as an adherent surface coating on sand grains.

The samples also contained a range of other iron bearing minerals along with minor quantities of alumina, calcium, chromium, sodium, magnesium, potassium and titanium.

It was hoped that oxalic acid would remove all of the iron, but also prove effective in reducing the levels of the other contaminants, which have proved to be difficult to remove in previous test work.

2. SAMPLE PREPARATION

2.1 Treatment of Head Samples

A head sample from each ore type had been previously submitted to ALS for analysis. The general appearance of each ore type was noted and each was then wet screened for recovery of the 45-250 micron fraction. This fraction and the undersize and oversize fractions were then dried, weighed and stored. The results were as follows:-

Sample Type	Colour	Source		Fe_2O_3 Content	Size Distribution (%)		
		DrillHole	Section	ppm	+250u	+45-250u	+45u
70312 OX	red	102	7-8m	**29200**	28.5	38.1	33.4
70413 ROX	pink	102	6-7m	**11700**	34.2	38.3	27.5
70210 OX	brown	87	9-10m	**6260**	18.0	35.7	46.3
70210 ROX	dark brown	87	10-11m	**7390**	23.0	44.5	32.5
70311 OX	white	102	5-6m	**3830**	37.1	43.2	19.7
70419 ROX	white	102	4-5m	**6630**	33.8	46.3	19.9

2.2 Magnetic Separation of 45-250 Size Fraction

The 45-250 micron fraction recovered from each sample was then subjected to dry magnetic separation using a Reading High Intensity Laboratory Magnetic Separator. The standard conditions for removal of Beach Sands magnetics (field strength 16,000 gauss, roll speed 100 rpm) were used in this step.

The non magnetic fraction from each sample was then submitted to ALS for analysis and the results were as follows:-

SAMPLE	Wt %	ANALYSIS									
		Al_2O3	CaO	Cr_2O_3	Fe_2O3	MgO	MnO	TiO_2	V_2O5	Na_2O	K_2O
		%	%	ppm	ppm	%	%	%	%	%	%
70210 ROX L HEAD	97.6	0.089	0.035	17	**940**	0.009	<0.001	0.014	<0.001	0.008	0.007
70210 OX L HEAD	94.8	0.055	0.035	9	**1160**	0.009	0.001	0.009	<0.001	0.004	0.003
70312 OX L HEAD	95.8	0.083	0.044	11	**2380**	0.01	<0.001	0.012	0.001	0.007	0.004
70419 ROX L HEAD	96.6	0.021	0.025	2	**100**	0.007	<0.001	0.001	<0.001	0.006	0.002
70413 ROX L HEAD	96.3	0.031	0.028	3	**1190**	0.009	<0.001	0.011	<0.001	0.003	0.002
70311 OX L HEAD	96.1	0.027	0.024	2	**130**	0.007	<0.001	0.003	<0.001	0.007	0.002

3. LEACH METHOD USED

3.1 Sample Size

As it was likely that a considerable number of tests would be required to identify an optimum set of leach conditions and considering that only around 500 grams of the relevant size fraction had been generated from each sample, it was decided that tests would be based on 10 gram samples

.

3.2 Leach Solution

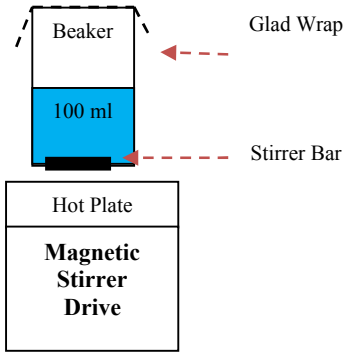
For practical purposes a solids/liquid ratio of 1/10 would be used (100 ml leach liquor). The scope of the work would initially be confined to Oxalic Acid solution strengths of 1-50 gpl.

3.3 Leach Temperature

Practical processing economic considerations dictate that leaching be conducted at ambient temperature. Leach temperatures of 20^{o}C and 45^{o}C were chosen, both to reflect ambient temperature and to assess the effect of using the highest leach temperature considered to be practically achievable in the field.

3.4 Method of Agitation

A critical consideration in these tests was sensitivity to contamination, particularly with respect to iron. Accordingly this risk was minimised by the use of covered (glad wrap) glass beakers with agitation provided by magnetic stirrers, using Teflon stirrer bars, such that no iron bearing materials were in contact with leach liquor.



3.5 Sampling Procedure

Solution samples were withdrawn at suitable intervals during leaching using a plastic syringe and disposable “millipore” filters. An aliquot from these solution samples was immediately analysed for Fe using an AA machine, with the balance stored and the results recorded. Leaches were deemed to be complete when two consecutive identical analysis results were obtained.

At the conclusion of each leach, the batch was filtered using a ceramic Buchner funnel. In each case, a reference sample of the final leach solution was retained, along with the final solids, which were dried and stored in plastic bags for subsequent analysis by ALS.

4. TESTS BASED ON SAMPLE 70312 OX

It was decided to focus the initial investigation on the non magnetic fraction obtained from the 45-250 micron fraction from Sample 70312 OX, as this was clearly the "dirtiest" sample, judged by appearance, exhibiting a deep red colour.
This colour appeared to be the result of a strongly adherent layer, which was likely to contain considerable ferruginous matter on the sand grain surfaces, as the sample also contained the highest iron level after magnetic separation (2380 ppm). Reduction of iron levels in this sample to below 10 ppm therefore appeared to present a considerable challenge.

4.1. INITIAL LEACH TESTS

A series of 13 leaches were conducted on this sample, using solution strengths of 1, 5, 20 and 50 gpl at both 20°C and 45°C. Two leaches (at 20 and 50 gpl acid strength) were conducted on recycled leach liquor from previous batches.
Samples of selected final leach solids were then submitted to ALS for analysis.

4.1.1. Test Results

The results are shown in Table Nos 1A and 1 below and are also visually presented as Graph No 1.

TABLE No 1 A
INITIAL TESTS 70312OX
SOLUTION ANALYSIS*

LEACH NUMBER	Leach Conditions				Solids Fe_2O_3 (ppm) vs Time Elapsed (hr)									
	Oxalic Acid (gpl)	S/L Ratio (%)	Temp (°C)	Agitation	0.0	0.5	1.0	1.5	2.0	3.0	4.0	6.0	8.0	10.0
1	1	10	20	Mag Stirrer	1930		680		420	400				**400**
2	5	10	20	Mag Stirrer	1930		880				430	370	320	**320**
3	20	10	20	Mag Stirrer	1930		220		215	210		205	200	**190**
4	50	10	20	Mag Stirrer	1930			300	230		130		50	**50**
5	50	10	20	Mag Stirrer	1930			300			80			**80**
6	20	10	20	Mag Stirrer	1930			550		320		110	110	**110**
7	50	10	20	Mag Stirrer	1930			510		90		90		**90**
8	1	10	45	Mag Stirrer	1930					560	490	320	320	**320**
9	5	10	45	Mag Stirrer	1930					250		180		**130**
10	20	10	45	Mag Stirrer	1930					120	100	100		**100**
11	50	10	45	Mag Stirrer	1930		40			**40**				
12	20**	10	20	Mag Stirrer	1930	300	160	150	**120**					
13	50**	10	20	Mag Stirrer	1930	150	90	80	**80**					

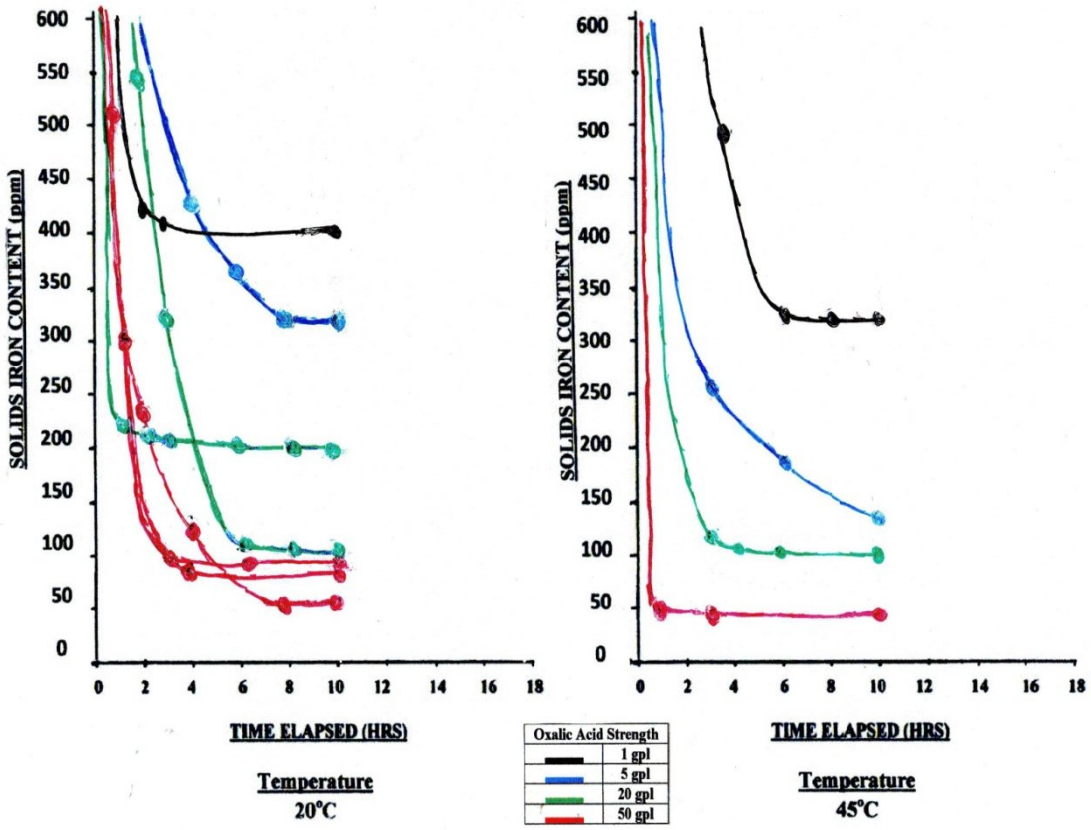
* Final results corrected to solids analysis
** Recycled leach liquor

TABLE No 1 B
FINAL SOLIDS ANALYSIS

SAMPLE	ANALYSIS									
	Al_2O3	CaO	Cr_2O_3	Fe_2O3	MgO	MnO	TiO_2	V_2O5	Na_2O	K_2O
	%	%	ppm	ppm	%	%	%	%	%	%
Head Sample	0.083	0.044	11	**2380**	0.010	<0.001	0.012	0.001	0.007	0.004
Residues										
Leach 1	0.032	0.026	4	**400**	0.007	<0.001	0.004	<0.001	0.010	0.003
Leach 2	0.032	0.033	2	**320**	0.008	<0.001	0.005	<0.001	0.008	0.002
Leach 3	0.033	0.033	2	**190**	0.008	<0.001	0.004	<0.001	0.011	0.003
Leach 4	0.021	0.030	2	**50**	0.007	<0.001	0.003	<0.001	0.005	0.002
Leach 5	0.026	0.032	4	**80**	0.008	<0.001	0.004	<0.001	0.005	0.002
Leach 6	0.023	0.031	2	**110**	0.008	<0.001	0.004	<0.001	0.004	0.002
Leach 7	0.025	0.031	3	**90**	0.008	<0.001	0.004	<0.001	0.007	0.002
Leach 8	0.029	0.031	8	**320**	0.008	<0.001	0.004	<0.001	0.006	0.002
Leach 9	0.030	0.033	3	**130**	0.009	<0.001	0.005	<0.001	0.004	0.002
Leach 10	0.032	0.034	6	**100**	0.009	<0.001	0.005	<0.001	0.008	0.003
Leach 11	0.020	0.032	2	**40**	0.008	<0.001	0.002	<0.001	0.005	0.002
Leach 12	0.033	0.034	2	**120**	0.009	<0.001	0.006	<0.001	0.004	0.003
Leach 13	0.034	0.033	3	**80**	0.009	<0.001	0.006	<0.001	0.005	0.002

GRAPH No1

SOLIDS IRON CONTENT vs TIME



4.1.2 Comments on Results

Acid strengths of 1 and 5 gpl were clearly inadequate in obtaining acceptable residual iron levels at 20°C, although the 5 gpl acid strength appeared to show some promise at 45°C.
Higher acid strengths (20 and 50 gpl) appeared capable of achieving reduction in residual iron levels to 100 and 50 ppm respectively in around 6 hours at 20°C and in around 4 hours at 45°C.
Similar results were obtained with recycled liquor at both 20 and 50 gpl, as expected from the considerable stoichiometric excess of acid present in each case.
Higher acid strengths and temperatures were not tried, as it was felt that these conditions would prove to be economically unattractive.
However, the somewhat erratic nature of these results, along with poor repeatability, indicated the existence of some other underlying problem, the main suspect being the efficiency of the magnetic separation step.
Thus, these initial results were disappointing in the context of the objective of the investigation, which was to reduce the residual Fe_2O_3 to below 10 ppm.

4.2 POSSIBLE EFFECT OF RESIDUAL MAGNETICS

The residual solids analysis results were compared to those obtained in sulphuric acid test work on different samples from this deposit, conducted by Roche in 2004. It was noted that the results for sulphuric acid leaching at 20-60 gpl were similar to those obtained with oxalic acid but that in both cases there appeared to be a relationship between residual iron and titanium levels.

One of the possible contaminants present may have been ilmenite or similar minerals such as titaniferous magnetite. The ratio of Fe/Ti was then calculated for all tests in each case (see Table No 2) and the results were plotted as Fe/Ti Ratio versus Residual Iron Levels (see Graph No 2).

The purpose of this exercise was to investigate any correlation between this Fe/Ti ratio and Fe_2O_3 content, in particular that found in the residual leach solids, with that found in ilmenite (1.17:1)

TABLE No 2
INITIAL TEST RESULTS

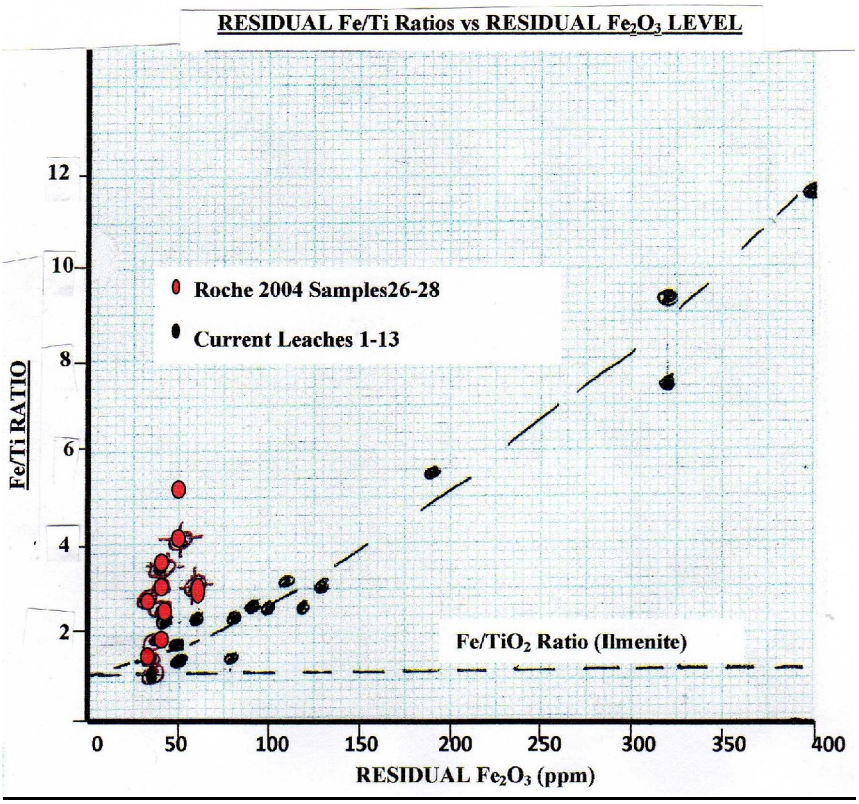
Leach No.	Sample	Oxalic Acid Strength (gpl)	Temp (°C)	Residue Fe_2O_3 (ppm)	Residue TiO_2 (ppm)	Residue Fe (ppm)	Residue Ti (ppm)	Residue Fe/Ti Ratio
1	70312OX	1	20	**400**	**40**	280	24	**11.7**
2	70312OX	5	20	**320**	**50**	224	30	**7.5**
3	70312OX	20	20	**190**	**40**	133	24	**5.5**
4	70312OX	50	20	**50**	**30**	35	18	**1.9**
5	70312OX	50	20	**80**	**40**	56	24	**2.3**
6	70312OX	20	20	**110**	**40**	77	24	**2.3**
7	70312OX	50	20	**90**	**40**	63	24	**2.6**
8	70312OX	1	45	**320**	**40**	224	24	**9.3**
9	70312OX	5	45	**130**	**50**	91	30	**3.0**
10	70312OX	20	45	**100**	**50**	77	30	**2.6**
11	70312OX	50	45	**40**	**20**	28	12	**2.3**
12	70312OX	20	45	**120**	**60**	84	36	**2.3**
13	70312OX	50	45	**80**	**60**	56	36	**1.6**

TEST RESULTS ROCHE 2004

Leach No.	Sulphuric Acid Strength (gpl)	Temp (°C)	Time (min)	Residue Fe_2O_3 (ppm)	Residue TiO_2 (ppm)	Residue Fe (ppm)	Residue Ti (ppm)	Residue Fe/Ti Ratio
24.1	20	20	15	**60**	**20**	42	12	**3.5**
24.2	20	20	30	**50**	**20**	35	12	**2.9**
24.3	20	20	45	**50**	**20**	35	12	**2.9**
24.4	20	20	60	**50**	**20**	35	12	**2.9**
24.5	60	60	60	**70**	**20**	49	12	**4.1**
24.6	35	35	60	**60**	**30**	42	18	**2.3**
24.7	60	60	60	**60**	**20**	42	12	**3.5**
26.1	25	20	15	**60**	**30**	42	18	**2.3**
26.2	25	20	30	**50**	**40**	35	24	**1.5**
26.3	25	20	45	**50**	**50**	35	30	**1.2**
26.4	25	20	60	**80**	**30**	56	18	**3.1**
26.5	25	60	60	**50**	**40**	35	24	**1.5**
26.6	25	35	60	**50**	**30**	35	18	**1.9**
26.7	10	60	60	**50**	**40**	35	24	**1.5**

GRAPH No 2

INITIAL TEST RESULTS/ROCHE TEST RESULTS



4.3. REPEAT OF MAGNETIC SEPARATION

The results indicated a tendency towards the Fe/Ti Ratio (1.17:1) found in Ilmenite, as the residual iron level approached the minimum values obtained in these tests, thus indicating that a proportion of the residual iron may be present as ilmenite
It was therefore decided that the magnetic separation step would be repeated on the non-magnetic fraction from all six sample types, at a lower roll speed of 80 rpm, in an attempt to maximise ilmenite removal along with other possible iron-bearing free minerals.

This material was then used for all subsequent test work.

4.4. REPEAT OF LEACH TESTS ON SAMPLE 70312 OX

4.4.1 Description of Test Procedure

The leach tests using 20 and 50 gpl Oxalic Acid were repeated on the non-magnetic fraction obtained from Sample 70312OX, using the lower roll speed of 80 rpm, at both 20°C and 45°C.

4.4.2 Test Results

The solution analysis results are shown below as Table 3A and the final solids analysis as Table 3B.

TABLE No 3A
SOLUTION ANALYSIS*

LEACH NUMBER	Leach Conditions				Solids Fe_2O_3 (ppm) vs Time Elapsed (hr)									
	Oxalic Acid Conc (gpl)	Solid/Liquid Ratio (%)	Temp (°C)	Agitation Method	0.0	0.5	1.0	1.5	2.0	3.0	4.0	6.0	8.0	10.0
16	20	10	20	Mag Stirrer	1350		100			40				**40**
17	50	10	20	Mag Stirrer	1350		30			30				**30**
18	20	10	45	Mag Stirrer	1350		60			40				**40**
19	50	10	45	Mag Stirrer	1350		30			30				**30**

* Final results corrected to solids analysis

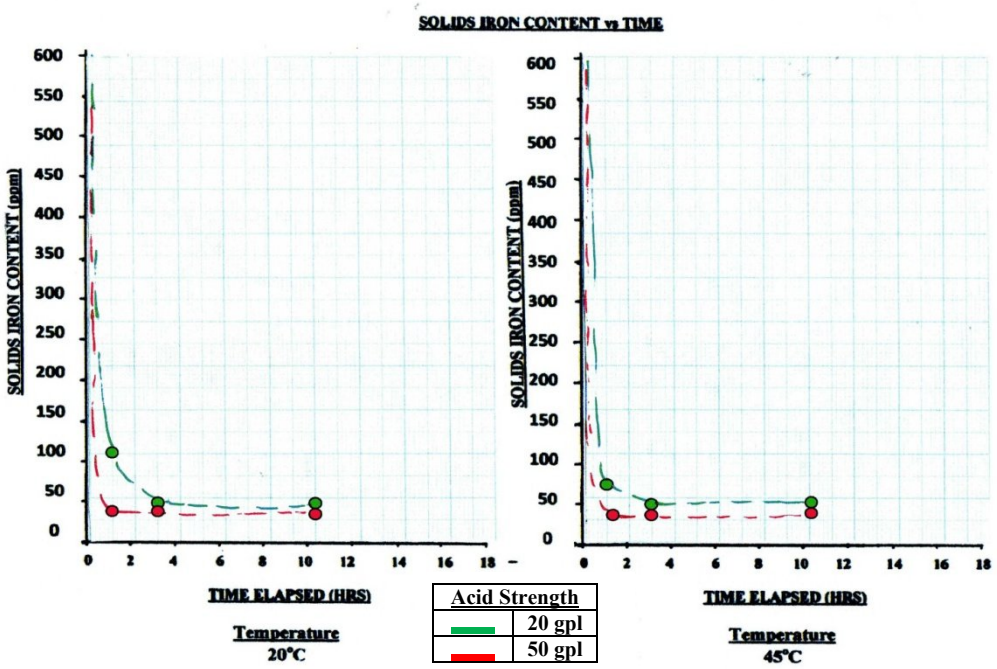
TABLE No 3B

FINAL SOLIDS ANALYSIS

LEACH NUMBER	ANALYSIS										Fe/Ti Ratio
	Al_2O3	CaO	Cr_2O_3	Fe_2O3	MgO	MnO	TiO_2	V_2O5	Na_2O	K_2O	
	%	%	ppm	ppm	%	%	%	%	%	%	
16		0.028	<1	**40**	0.008	<0.001	0.003	<0.001	0.003	0.001	**0.64**
17		0.028	<1	**30**	0.008	<0.001	0.003	<0.001	0.001	0.001	**0.85**
18		0.029	<1	**40**	0.007	<0.001	0.005	<0.001	0.001	0.001	**1.07**
19		0.027	<1	**30**	0.008	<0.001	0.002	<0.001	0.001	0.00	**0.57**

These results are also presented as Graph No 3 below.

GRAPH No 3



4.4.4. Discussion of Results

These results clearly show that the reduction in roll speed from 100 rpm to 80 rpm in the magnetic separation step resulted not only in a reduction in iron content, but also in vastly improved leaching performance and repeatability across all samples.

It was also notable that the residual solids Fe/Ti ratio also fell below that of ilmenite.

In marked contrast to the initial results, a much shorter leach time of around 3 hours at 20^{o}C was indicated for both 20 and 50 gpl acid strengths, with little or no benefit observable with increased temperature.

The reduced influence of leach temperature is further evidence that leach resistant minerals, possibly including ilmenite, have been removed from the non-magnetics at the lower roll speed.

However, a barrier of resistance has once again been revealed, in that there appeared to be a consistent final iron content of 30-40 ppm Fe_2O_3, as has been encountered in all previous leach test work on this material, albeit at a slightly higher level (50-60 ppm) Fe_2O_3.

The results suggest that either iron compounds may be included within the silica crystal lattice, that highly leach resistant iron compounds are present, that iron compounds may be present in deep cracks and lesions in the silica crystals or that a combination of all of these factors is at play.

4.5 AQUA REGIA DIGEST

In an attempt to throw further light on the problem. It was decided to investigate the effect of aqua regia digestion on residual iron content.

A composite sample of final solids from Leaches 16, 17, 18 and 19 was prepared and split into two 20g samples. One sample was reflux leached for 3 hours at 100^{o}C in 100 ml of aqua regia.

This sample was then recovered by filtration, washed thoroughly with 3 consecutive 200 ml lots of distilled water and then oven dried.

Both samples were then submitted to ALS for analysis.

The results were as follows:-

SAMPLE	Al_2O_3 (%)	CaO (%)	Cr_2O_3 (ppm)	Fe_2O_3 (ppm)	MgO (%)	TiO_2 (%)	Na_2O (%)	K2O (%)
Composite Leaches 16-19	0.019	0.028	< 1	**30**	0.008	0.004	0.004	0.001
Aqua Regia Digest	0.017	0.026	<1	**30**	0.008	0.004	0.005	0.001

These results indicate that no reduction in iron level was achieved. Other components were also largely unaffected. This result is a strong indication that iron compounds may be included within the silica crystal lattice, or to the presence of an\extremely inert iron compound or compounds.

5. BOTTLE ROLL TESTS

A further, albeit unlikely, possibility was contamination by iron generated by glass being ground from the beaker surfaces during leaching.

It was therefore decided to conduct further leach tests using a bottle roll machine with leaching carried out in plastic bottles, thus eliminating all possible sources of external iron contamination. The speed of the bottle roll was adjusted to give a tumbling action within 500 ml plastic bottles, similar to that encountered at the "critical speed" used in ball milling.

Three leaches were carried out at room temperature (20^{o}C) using 10, 20 and 50 gpl oxalic acid respectively and 10 % solids/liquid.

The results were as shown in Table No 4 below.

An accidental mechanical stoppage occurred shortly after the start of the 20 gpl test, which was then repeated. However subsequent analysis of the solution from this batch surprisingly suggested that the leach rate had been unaffected by the stoppage.

Accordingly, two leaches were conducted using 10 and 20 gpl oxalic acid without agitation, simply by standing in a covered beaker.

The results from these two batches, also shown below, indicate that leaching is independent of agitation

TABLE No 4
BOTTLE ROLL AND STATIC LEACHES

Leach No	Oxalic Acid Conc (gpl)	Solid/Liquid Ratio (%)	Temp (^{o}C)	Agitation Method	Solids Fe_2O_3 (ppm) vs Time Elapsed (hr)									
					0.0	0.5	1.0	1.5	2.0	3.0	4.0	6.0	8.0	10.0
20	10	10	20	Bottle Roll	1350					40				**40**
21	20	10	20	Bottle Roll	1350		100			30				**30**
22	50	10	20	Bottle Roll	1350		30			30				**30**
23	10	10	20	Static Leach	1350					40				**40**
24	20	10	20	Static Leach	1350		100			30				**30**

However, once again a barrier was struck at 30-40 ppm residual solids Fe_2O_3 content, thus eliminating external contamination as being the source of the problem.

6. TESTS ON OTHER SAMPLES

As Sample 70312 OX was clearly the most heavily contaminated it was assumed that similar or better results may be obtained from the remaining 5 sample types.

A series of tests were carried out using 20gpl oxalic acid solution at 10% solids using all three methods of agitation, on all sample types. In each case the non-magnetic fraction was that obtained at field strength of 16,000 gauss, using the lower roll speed of 80 rpm, as described previously.

In order to control analysis costs only a selected number of the final residue solids samples were submitted for analysis, as a clear pattern was obvious in the results, which are shown below.

TABLE No 7

LEACH RESULTS ON OTHER SAMPLES

SAMPLE TYPE	LEACH PARAMETERS				Solids Fe_2O_3 (ppm) vs Time Elapsed (hr)									
	Oxalic Acid Conc (gpl)	Solid/Liquid Ratio (%)	Temp (^oC)	Agitation Method	0.0	0.5	1.0	1.5	2.0	3.0	4.0	6.0	8.0	10.0
70413ROX	20	10	20	Mag Stirrer	900		50			50				**40**
	20	10	45	Mag Stirrer	900		30			30				**30**
	20	10	20	Bottle Roll	900		30			30				**30**
	20	10	20	Static Leach	900		50			50				**40**
70210ROX	20	10	20	Mag Stirrer	650		50			30				**30**
	20	10	20	Static Leach	650		50			30		30		**30**
	20	10	45	Static Leach	650		50			30				**30**
	20	10	20	Bottle Roll	650		30			30				**30**
70210OX	20	10	20	Bottle Roll	950		50			30				**30**
	20	10	20	Static Leach	950		50			30		30		**30**
70311OX	20	10	20	Bottle Roll	120		40			30				**30**
	20	10	20	Static Leach	120		40			30		30		**27**
70419ROX	20	10	20	Bottle Roll	100		40			30				**30**
	20	10	20	Static Leach	100		40			30		30		**30**

The end results show a similar pattern to those obtained from the 70312OX sample, indicating that the samples differed only in the nature of the surface oxidised material and all behaved similarly, once this surface had been removed, within the first hour of leaching.

7. ANALYTICAL ISSUES

Some difficulty was encountered with the analytical results received from ALS, necessitating repeat analysis in some cases.

The ALS procedure involves a grinding step prior to acid digestion of the sample, followed by ICP analysis. The problem was traced to contamination during the grinding step.
HRL have a similar procedure, but do not grind the sample before digestion.
It was therefore decided that several leach residue solids samples, which had been analysed by ALS, would be submitted to HRL for analysis as a check, particularly on iron levels.
The results are tabulated below.

TABLE No 6

RESULTS ALS vs HRL

SAMPLE TYPE	ANALYTICAL SOURCE	ANALYSIS REPORTED								
		Al_2O3	CaO	Cr_2O_3	Fe_2O3	MgO	MnO	TiO_2	Na_2O	K_2O
		%	%	ppm	ppm	%	%	%	%	%
70312 OX	**ALS**		0.028	<1	**40**	0.008	<0.001	0.003	0.001	0.002
	HRL	0.017	0.027	<5	**40**	0.008	<0.001	0.003	0.001	0.002
70312OX	**ALS**	0.019	0.028	<1	**30**	0.008	<0.001	0.004	0.005	0.001
	HRL	0.013	0.027	<5	**31**	0.008	<0.001	0.003	0.001	0.001
70312OX	**ALS**	0.017	0.026	2	**40**	0.007	<0.001	0.005	0.004	0.001
	HRL	0.014	0.025	<5	**21**	0.008	<0.001	0.002	0.002	0.001
70413ROX	**ALS**	0.017	0.023	1	**40**	0.007	<0.001	0.002	0.004	0.002
	HRL	0.024	0.024	<5	**33**	0.008	<0.001	0.004	0.002	0.002
70419ROX	**ALS**	0.013	0.022	3	**30**	0.007	<0.001	0.001	0.004	0.002
	HRL	0.015	0.025	<5	**28**	0.008	<0.001	0.006	0.003	0.002
70413ROX	**ALS**	0.017	0.023	1	**40**	0.007	<0.001	0.002	0.004	0.002
	HRL	0.009	0.020	<5	**19**	0.007	<0.001	0.002	0.001	0.001
70311OX	**ALS**	0.011	0.014	<1	**30**	0.006	<0.001	0.002	0.003	0.001
	HRL	0.014	0.019	<5	**26**	0.009	<0.001	0.002	0.002	0.001
70210ROX	**ALS**	0.021	0.024	<1	**30**	0.009	<0.001	0.006	0.005	0.002
	HRL	0.022	0.023	<5	**21**	0.005	<0.001	0.001	0.006	0.002

The results were similar in all cases, but there was a trend toward slightly lower iron levels in the HRL results, which suggests that some minor contamination may have occurred during grinding at ALS, although this might be a case of "splitting hairs".
It should be noted that both sets of analysis results indicate that a considerable reduction in Al_2O_3 and Na_2O level was achieved over all samples in these leach tests.

8. ENVIRONMENTAL ISSUES

Oxalic acid has potential toxic effects through contact and if ingested. It may cause burns if absorbed through skin or in contact with the eyes. In humans, ingested oxalic acid has an oral LD (lowest published lethal dose) of 600 mg/kg. It has been reported that the lethal oral dose is 15 to 30 grams.

The toxicity of oxalic acid is due to kidney failure, which arises because it causes precipitation of solid calcium oxalate, the main component of kidney stones. Oxalic acid can also cause joint pain due to the formation of similar precipitates in the joints.

In practice, discharges of spent oxalic acid solution are treated with lime, which removes the oxalic acid as inert extremely insoluble calcium oxalate, which is disposed of as land fill or as mine backfill.

Another available option is solution regeneration. Only a small proportion of the available oxalic acid is actually used in the leach cycle.

i.e. for leaching of non-magnetics with an assumed Fe_2O_3 content of 1000 ppm at 20% solids with 20gpl oxalic acid, only 0.4 kg of oxalic acid would be consumed/m^3 of leach liquor, which would contain 20 kg of oxalic acid. This represents only 2% of the available oxalic acid. Oxalic acid works by dissolving iron as a water soluble ferric oxalate compound.

Therefore the use of ion exchange techniques, including zeolite and conventional solvent extraction reagents such as Cognis LIX 85 may prove effective in removal of such low levels of ferric iron, thus releasing the oxalic acid for recycling in closed circuit, this eliminating the need for liquid discharge from the leaching step.

APPENDIX 2

ORGANIC MATERIAL

PRELIMINARY SUMMARY REPORT

Float

This is a mixture of organic materials. The most abundant parts are leaves of mosses, fragments of fine stems of plants, charcoal fragments. Some fibres in there look like cellulose fibres to me (and stain with toluidine blue as if they were cellulose fibres). These could come from cloth, or from some sort of paper. There are occasional insects parts. There are also just a few small pieces of plastic.

Overall, this would all be perfectly consistent with contamination from local sources (i.e. stuff off the ground or blown in from the local environment). I would say there is no reason to suspect that the contamination was in the actual sediments.

I have no idea if the amount of material would be sufficient to explain your overall contamination problem. This is partly because I don't know how much material this float was derived from, and partly how much contamination is significant. However, the kinds of material I observed are very high carbon, and very low in everything else (at a wild guess, 99% C, N, O and H). The charcoal component is relatively small, and I think is the only substrate likely to have much extraneous chemical material sorbed onto it.

Sink

The organic bits are broadly similar to those in the float. The differences were that there were largish (several mm scale) clumps of fibrous roots, consistent with a range of semi-aquatic plants, fewer moss leaves, and more (and larger) charcoal fragments. These organic bits apparently sank because of little bits of rock were attached to them.

Perhaps of more interest is that a relatively high proportion of the rock fragments in this sample were slightly discoloured with an orange/brown tint, often only in one part of the fragment.

There were also a very few tiny pieces of soft inorganic material, perhaps lumps of clay rich inorganic soil.

Overall

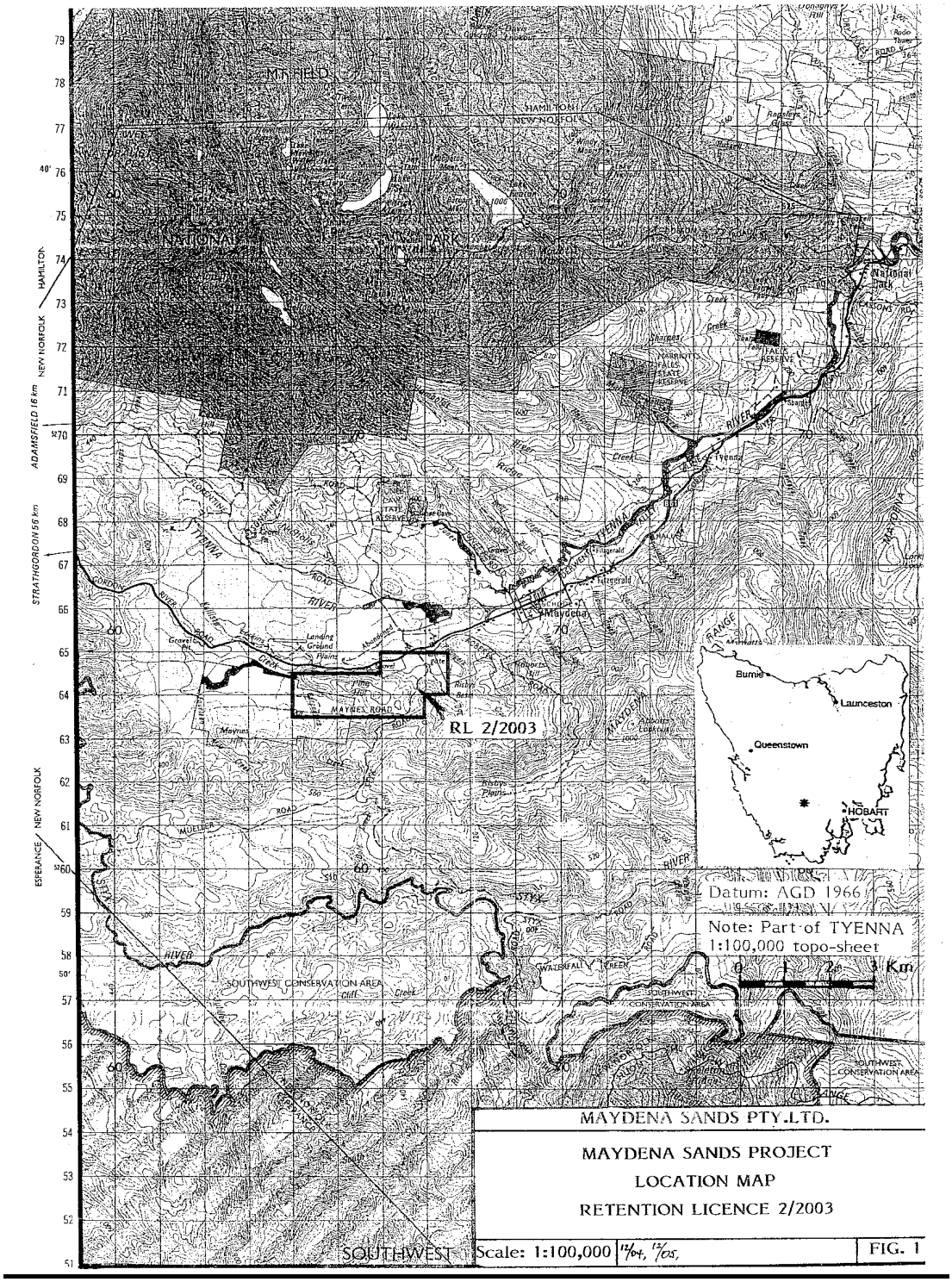
The float and sink contained a moderate amount of organic material and charcoal fragments. All of this is perfectly consistent with recent contamination from local material, either wind blown or washed in. This material is all very high carbon, and would carry very low levels of potential contaminating elements. It is conceivable that the charcoal might have something worrying sorbed to it, but one would be asking where that contaminant came from.

I don't know the geology and geochemistry, but I might be more concerned about then discoloured bits of rock.

Dr. Greg Jordan
UTAS

March 2013

ILLUSTRATIONS



MAYDENA SANDS PTY.LTD.

MAYDENA SANDS PROJECT

LOCATION MAP

RETENTION LICENCE 2/2003

Scale: 1:100,000	12/04, 12/05,	FIG. 1