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

The restrictions of the 13th 5-year economic plan, introduced in China at the start of 2016, compounded the woes of the Chinese glass industry by requiring greater focus on energy efficiency and environmental protection. This implies greater production costs for Chinese glass manufacturers and will make their products more expensive on world markets.
By way of contrast, according to Corning, the niche sector of display glass continued to show signs of growth through 2016 in the low, single digit percentages, although prices are falling.

Global demand for solar energy remained robust during 2016, with China experiencing an installation boom resulting in enormous demand for photovoltaic modules. These are likely to become cheaper as a result of the possible introduction of new materials such as perovskite as a replacement for polysilicon in PV units. A consequence of this trend will be increasing demand for low iron PV cover glass for which Maydena Sands silica flour and sand would be suitable. Further opportunities for high quality glass continue to emerge for glass substrates for semiconductor manufacturing.

China was again largely the focus of this year's marketing activities, although enquiries were also dealt with not only from other countries in East Asia, but also from India, the Middle East, US and Australia for product across a range of different applications. In the main, interest was in the supply of large volumes of lower quality, lower priced product.

TasRail freight services to northern Tasmanian ports show continuing improvements. The low global oil prices and the lower Australian dollar all benefit the Maydena Sands project. Surprisingly, the uptake by businesses and industry of the extension of the Tasmanian Freight Equalisation Scheme to assist with container transhipment costs via mainland ports is reported to be slower than expected.

The results of a laboratory trial using upward flow hydro-classification to remove organics, including carbon particles and other contaminants from a sample of "dirty" sand, did not come up to expectations. Not all of the organics were removed and the best results overall were obtained in the silica flour fraction in the underflow, yielding an end-product of 60ppm Fe_2O_3 after acid leach. These results and the reduction in other contaminants, including organics did not match results obtained last year using spirals/wet tabling and followed by acid leach.

Keywords:

Maydena; Silica flour; Silica sand; Charcoal;
Organics; Marketing;Logistics.

C O N T E N T S

1. INTRODUCTION

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

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, now reduced to 3sq.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 a recent assets review, TasRail resolved to hand over the Derwent Valley Railway line west of Boyer 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 now fully operational. 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 on various, changing 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, 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.

These included additional shallow AirCore/RC drilling, deep RC drilling, beneficiation tests, marketing and logistics monitoring.

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

- Beneficiation:

  Continuation of lab-scale investigation to remove charcoal/organics from silica flour and sand, using upward flow hydro-classification

  Acid leach tests on end products for quality upgrade.

  Comparison of relative effectiveness of spirals, wet tabling and upward flow hydroclassification to remove charcoal/organics from raw material feed.

- Market related activities:

  Ongoing market monitoring – silica sand, silica flour, quartz sand, display panels, technical glass and PV polysilicon.

  Attendance at several significant events including:

  - Semicon/FPD 2016 Exhibition – Shanghai, China
  - China Glass 2016 Exhibition – Shanghai, China
  - Glasstec 2016 Exhibition – Dusseldorf, Germany

  In addition, Contacts or Meetings with a number of companies listed in Section 4.3.4.

- Project Planning and Feasibility:

  - Discussions and update with Swire Shipping re container shipping ex Hobart to overseas destinations via mainland trans-shipment.
  - General monitoring of transport logistics.

- Community relations:

  Occasional contact with Maydena Development Association.

- Environmental

  No action required.

3.2 Statistical Summary

Test Samples Generated:

SAC Corporation – S. Korea (raw material)	:	2 x 2Kg
3 Crosses Energy – US (raw material)	:	120Kg
Shield Resources Pty Ltd - Sydney	:	3 x 0.5Kg

Test Samples Analysed:

No. of Samples Analysed	:	32
No. of Analyses	:	419

3.3 Expenditure

To Dec 2015 (RL Tenure only)	:	$1,170,423.00
Period Jan – Dec 2016		
(Including Oct – Dec 2016 Estimate)	:	$60,298.00 (approx)
Estimated Cumulative Total		
for period of RL Tenure (to Dec 2016)	:	$1,230,721.00 (approx)

3.4 Tenure

Confirmatory documentation received from MRT for the reduction of the tenement from 4sq.km to 3sq.km.

4. RESULTS

4.1 Beneficiation

4.1.1 Carbon Removal – Upward Flow Hydro-classification

Investigation of this method with potential for carbon/charcoal removal and end-product improvement was recommended by the metallurgical consultant as an alternative to the two stage wet tabling method successfully trialled last year. (Krummei, 2015). If successful this one stage method would have the added advantage of good particle size separation capability. After some delay in securing a time slot and staff, Mineral Technologies at Carrara, Queensland was contracted to hire its laboratory classification plant as a cheaper alternative to Maydena Sands constructing its own classification unit. Further delays were experienced due to the limited availability of Mineral Technologies staff to address the matter.

The raw material for this and previous investigations came from a sample collected at GDA 466601 5264052 from a charcoal-rich horizon near the top of a 4m embankment north of the Eastern Quarry and on the west side of a now disused logging haulage road.

Size bands investigated were between 53 and + 425 microns, with most of the attention paid to the 106-150 micron (coarser silica flour) fraction and finished with an acid leach.

Good particle size classification was obtained. However, although much of the charcoal/organics was removed, some fine particles of the latter material remained in the overflow and underflow end-products.

Best results were achieved in the 106-250 micron (silica flour) underflow material which, after acid leach, yielded 60ppm Fe_2O_3, still well above the desired target of 10-20 ppm Fe_2O_3 for a premium product. Accompanying this result was the significant reduction of other contaminants such as Al_2O_3, CaO, MgO, TiO_2, P_2O_5 and metallics when compared with the assays of the overflow products.

Also of interest is the high level of all contaminants in the coarse fractions of the overflow material which, in the case of O/F2, is associated with very high carbon content. This apparent relationship may also explain the high level of contaminants in the coarse fraction of sample O/F1 for which no carbon analysis was carried out. These empirical relationships underscore the concern that organics, if not removed, can be a significant source of impurities in the silica sand and flour.

Details of the procedures and results of this year's test work are provided in Appendix 1. Appendix 2 gives a summary of the Carbon Removal Programme.

In the light of all tests to-date there is now need to consider and, if possible, develop a process to optimise/maximise charcoal/organics removal from the silica sand and silica flour products.

4.2 Project Planning

4.2.1 Logistics

Road:

With the introduction of container shipping services from the Port of Hobart, road access to the latter now becomes relevant to the project as rail service to that location was recently discontinued. However, the number of truck movements for delivery and pick-up of containers would be low. This is due to low shipping frequency and the current shortage of storage space for containers, whether outgoing or incoming, on the dedicated wharf, currently limiting to three days the time for accumulation of containers prior to shipment.

Rail:

Due to cost advantages, safety, lower environmental impact and implied greater efficiency overall, rail transport remains the preferred option over road use to move containers with Maydena Sands product to port, Hobart excepted.

According to the Annual Report for 2015/2016, TasRail now has a fit-for-purpose freight network providing a critical link in the movement of freight to the State's Northern Ports following several years of investment in above and below-rail assets. Services show continued improvements, with steady annual increase in freight volumes, only one derailment in 2015 and none in 2016. This result is even more commendable in the light of a severe flood event in June 2016, which resulted in significant flooding and damage to rail infrastructure throughout the State of Tasmania, causing disruption of services for several weeks, all since restored.

However, this event raised awareness of additional risk exposure for users of TasRail services, especially on the Western and South Lines.

TasRail now has 4 freight terminals to facilitate the handling of goods: one each at Burnie, Devonport, George Town and Brighton, the latter two being of prime significance to the Maydena Sands Project.

Ports:

Due to the persistent low growth rates of the global economy, container shipping companies world-wide are experiencing the worst downturn in 30 years, resulting in the collapse of at least one major container shipping line and the merger of several others. Despite this adverse trend, DP World Australia continues advance its plans to develop a major international freight terminal at Burnie Port, with work currently expected to start towards the end of 2017.

Searoad added capacity ex Burnie. Toll continues with container shipments to Melbourne while MSC increased its shipping services from Bell Bay to mainland ports via Melbourne to twice weekly. A very recent entrant to offer services from Bell Bay is MAERSK. However, Swire Shipping, using the Port of Hobart to provide shipping services to Melbourne and other mainland ports is said to be experiencing difficult times. A limiting factor at the Port of Hobart is the inability of Berth 4, dedicated to commercial goods, to accommodate large accumulations of outgoing or incoming containers for any length of time.

Delivery of containers to the waterfront is now facilitated by a TasRail freight terminal at each of the Ports of Burnie, Devonport and George Town (Bell Bay), but not Hobart.

4.3 Marketing

The main focus remained again on TFT-LCD and other display and touch-screen glass, optical, technical and solar cell cover glass, with some attention to the low grade semi-conductor industry.

Also monitored was the PV polysilicon industry in the light of recent positive developments as a result of the growing adoption of "clean", renewable energy production. This opens up the possibility of greater demand for clear cover glass for solar cells.

4.3.1 Overview – Polysilicon

After several difficult years, optimism seems to be creeping back into the PV polysilicon industry in response to widespread uptake and installation of utility-scale solar plants as well as installations of domestic solar systems.

There are indications that the polysilicon supply deficit has been growing in 2016 and will continue through 2017, with tight supply dynamics reported to be developing in China. A turn in the polysilicon market is predicted for 2018. After record lows of about US$13/kg reached in February 2016, polysilicon spot prices have started to climb in China back to around US$20/kg towards the end of 2016.

This is despite the fact that major Chinese manufacturers of photovoltaic systems have started to add significant capacity in South East Asia, with the possibility of shuttered facilities reopening, relieving the developing tight supply position.

An eventual threat to the growth of polysilicon usage in the PV industry is emerging from new research into the use of perovskite in solar fabrication. The perovskites investigated for use in the solar industry fall into a class of synthetic materials based on the structure of the naturally occurring mineral perovskite. These can be engineered to react to different wavelengths of light. They are lower cost, higher efficiency materials compared with polysilicon. Of particular interest is the use of perovskite-silicon cells in tandem, which achieved steady-state efficiencies of 24.5%, surpassing those of silicon cells, with further improvements possible. The advantage in the use of this tandem arrangement is the fact that perovskite solar cells are good at making electricity from visible light, while normal silicon cells are more efficient at converting infrared light into electricity. This has great potential to be the cheapest photovoltaic system on the market. The downside for perovskites at the moment is that they degrade quickly when exposed to moisture and, ironically, light and cannot yet compare with the typical life span of solar panels of 25 years or more. These and several other issues need to be resolved before perovskite cells can be fully commercialised and used in traditional solar applications.

4.3.2 Overview - Display Glass

Retrospectively, in 2015, China claims to have produced 70% of all smart phones and 75% of tablets. Growth in output for cell phones was 7.8%, smart phones 11.39%, colour TV 2.5%, smart TV 14.9%. Computers registered a fall of 10.4%. Silicon flour is an essential component of all these products. Outlook in 2016 was more subdued, as the market for computers, cell phones and smart phones appears to reach maturity, leading to lower or possibly stagnant growth rates into 2017. These views are echoed by Corning, the global market leader for substrates, touch screens and tough cover glass for cell and smart phones. The latter company is recording growth rates in the demand for its products in 2016 in the low single digit percentages against falling prices. These growth rates will also be impacted in the glass industry in China generally by virtue of the introduction of the 13th 5 -Year Plan in early 2016. This new plan encourages greater energy efficiency in the glass production processes, lower energy use and also focuses on environmental considerations.

4.3.3 Other

The demand for ultra high purity quartz sand and silica flour in China continues to grow in the face of diminishing resources and growth in the solar cell sector in line with demand for polysilicon and synthetic sapphire products. This is also supported by an increase in the number of specialist companies focused on supplying quartz crucibles to grow silicon ingots for the production of computer chips, wafers for semiconductor or PV applications and sapphire ingots to produce sturdy, more durable cover glass and slabs for cell phones, watches etc. Sapphire covers are finding increasing use despite substantially higher costs compared to toughened glass and other glasses.

4.3.4 Marketing Activities

Semicon/FPD China 2016 - Shanghai

As last year, this large trade exhibition focused on showcasing the broad range of products, producers and production equipment in the semiconductor and TFT-LCD display industries. Noteworthy was the increased presence of producers of quartz crucibles using IOTA standard, ultra high purity quartz sand and flour assaying better than 99.995% $SiO2$ and free of gaseous and liquid inclusions. This ultra high purity material also finds applications in the manufacture of glass tubes for LED lighting and IR heaters. Demand is estimated to reach 160,000 tpa by 2021, with no new production capacity coming on-stream or announced.

Of interest in the display substrate sector is the development of large (1mX1.8m approx) OLED and AMOLED flat or curved TV screens which are now starting to replace TFT-LCD substrates. This technology is now also being adapted for smaller display screens in such appliances as GPS systems, cell phones, tablets, etc.

China Glass 2016 – Shanghai, China

Attendance at China Glass underlined the plight of the Chinese flat glass industry which is in oversupply and adversely impacted by the 13^{th} 5-Year Plan introduced at the start of 2016. However, there still seems to be on-going demand for low iron photovoltaic cover glass for which the Maydena Sands silica flour and sand is suitable. But this is now subject to competition from suppliers in China and nearby countries and disadvantaged by higher Australian production, land transport and shipping costs.

Glasstec 2016 – Dusseldorf, Germany

This is the largest trade fair for the glass industry in Europe. This year, there was significant focus on production technology, mainly for architectural and automotive glass. Raw material suppliers to the glass industry were very poorly represented. Attendance this year did not result in any significant new product enquiries or contacts.

Other

Significant contacts in progress are:

- *3 Crosses Energy Pty Ltd*

  Following expression of interest from this Company to test its new proprietary processing technology, 120kg of raw material was processed overseas. Verbal reports indicated that the results have been "extremely encouraging". Assay results are imminent and, if satisfactory, a 5 tonne bulk sample will be required. Consent to extract this sample has been obtained from MRT.

- *SAC Corporation – South Korea*

  This Company is one of the largest processors and suppliers of high purity silica sand and silica flour to the manufacturers of display panels in Asia. As requested, 1kg of raw, unprocessed silica flour in the +45-250 micron size band and 1kg of raw, unprocessed silica sand in the +250-600 micron size band was forwarded for investigation. SAC Corporation undertook more accurate sizings of the raw material supplied into the two required size bands, washed each fraction, removed iron (method unspecified) and assayed each sample after each clean-up step. Each step achieved reduction of impurities.

  Details of these results are provided in Appendix 3, where the SiO_2 results quoted were obtained by subtraction of total impurities present from 100.

  The material was judged to be "very good quality" on the basis of these results. Further discussions with representatives of this company as to the way forward are expected before year-end 2016.

- *Shield Resources Pty Ltd*

  This Sydney-based company is seeking silica materials for a Chinese customer manufacturing bench-top products using silica sand, silica flour and silica rock as production material. For these products white colour is important.

  A small sample of each of silica flour, silica sand and rock were forwarded for inspection and tests. The silica flour and silica sand passed the visual colour test. Confirmation and further comment is awaited from China.

- *Mountsharp Pty Ltd*

  Arrangements were put in place mid-year with this Brisbane based Chinese/Australian trading and marketing company to introduce the Maydena Sands project and its products to potential end users in China. Several of the latter were approached without apparent success to date.

  This marketing effort is ongoing.

The following are among other enquiries and contacts dealt with during the year. Most were for the supply of large quantities of material for Chinese end users with different size and lower chemical specifications.

- Pathen Australia Pty Ltd – Australia – Silica Sand and Flour
- Hang Fai Resource Development Limited – Australia/China
- Orient Libao Investment Co. Ltd – Australia/China
- H & A Corporation – Australia/South Korea
- Cordev – Australia – Marketing
- Crommelin Waterproofing and Sealing – Australia – Silica Flour
- Casic Pty Ltd – Australia
- Michelle Maullon – Australia – Silica Sand

- Mills Ormiston Rubber – Australia – Silica Flour
- J & H Minerals – India
- Kliss Trading Pvt Ltd - Chennai, India
- Khawaja Trade International – India
- Narang Trading Group – India
- Mantu Minerals- India
- Sahil Trading Corporation – Lebanon
- Mohammed H. Al-Rasheed Co. – Saudi Arabia
- SISME LLC – UAE – Abu Dhabi
- M K Trade Inc – USA
- Enads Construction and Power – USA – Silica Sand

Contact renewed with:

- Shanghai Dawnlite Electronics Tech.Co.Ltd – China – Silica Flour, Sand, Rock
- Innoceram Co. Ltd – China – Fused Silica & Ceramics
- Wuxi Ding Long Co. Ltd. – China – Silica Flour & Sand

4.4 Environmental

This year's activities had no environmental impacts.

4.5 Rehabilitation

No rehabilitation was necessary, including on area relinquished.

4.6 Community Relations

Occasional contacts with members of the Maydena Development Association were maintained.

5. CONCLUSIONS

- Upward flow hydroclassification resulted in good particle separation but did not successfully remove all charcoal organic particles from the feed.

- Of the three methods trialled over the last two years, wet tabling in conjunction with spirals appears to be the most effective way of removing charcoal/organic particles from the sand feed.

- Beneficiation tests by 3 Crosses Energy Pty Ltd using that company's new proprietary approach to be progressed.

- SAC Corporation's positive comments on the results of its tests on Maydena Sands raw material sand and flour are encouraging and need follow-up.

- The major fires in the North West of the State this summer added to the risk profile of operating mines and processing plants in Tasmania's more remote locations, including the Maydena area.

- Rail transport facilities in Tasmania continued to improve during the year but were seriously affected by a major flood event mid-year which highlighted another risk factor in the logistics chain to be taken into consideration.

- A further risk to operations is the possibility of a major, lengthy disruption of electricity supply to industry as shown by the recent Basslink failure.

- Encouraging is the increase in the number of container shipping services from Tasmanian Ports, of which Bell Bay and Hobart remain of greatest interest.

6. PROPOSED FUTURE ACTIVITIES

- Undertake preliminary tests to gauge the possibility of beneficiating silica powder (-45 microns), currently deemed to be waste, to a saleable product.
- Continue engagement with 3 Crosses Energy Pty Ltd and its investigations into a new processing method to upgrade the raw material sand and flour.
- Continue engagement with SAC Corporation of S. Korea.
- Continue engagement with Shield Resources Pty. Ltd. re silica sand and flour for bench top products.
- Progress revised flow sheet design and capex/opex estimates including silica flour and silica sand product and possibly also silica powder.
- Continue work towards determining a reliable mine gate FOB and CIF product price for silica flour and silica sand.
- Follow-up activities on 2016 market contacts, enquiries and opportunities.
- Continue with product awareness and marketing activities, including attendance at Semicon/FPD China 2017 and China Glass 2017 Trade Shows.
- Continue monitoring developments in logistics support systems in Tasmania, including road, rail and shipping.
- Maintain contact with State and Local Regulatory Authorities, and other relevant parties on project related matters.

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Wrigley, P.K. 1992 Surface Exploration of the Limestone Resource at Roberts Hill, Maydena. Tas. Dept. of Mines Report 1992/32.

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APPENDIX 1

HYDRO-CLASSIFICATION TRIAL

MAYDENA SANDS PTY LTD

HYDRO-CLASSIFICATION TRIAL

C.J. BROWNE

December 2016

HYDRO-CLASSIFICATION TRIAL

This report describes a test conducted by Mineral Technologies at their Carrara (Qld) laboratory to establish the effectiveness of Upward Flow Hydro-classification in both sizing and removal of troublesome organic matter, including carbon particles, from a sample of raw silica obtained from the Maydena Sands deposit.

1. Background

Previous test work had identified this organic matter as both having an undesirable visual effect and being a source of considerable iron contamination when producing various commercially desirable products from this material.

A series of tests were conducted using standard spiral separators and coal spiral separators in an attempt to overcome this problem. Although these tests showed that efficient product sizing was obtained in both cases along with considerable extraction of organic matter, neither of these separators was successful in producing a product fully free of organic matter.

Further test work then demonstrated that it was possible to produce a size fraction of commercial interest (106-450 micron) essentially free or organic matter, by wet tabling the concentrate fraction produced from the coal spiral test work.

The purpose of the current test was to establish whether this result could be achieved in a single step, using upward flow classification.

2. Description of Test

A 5 kg sample of heavily contaminated feed identical to that used in the previous test work described above was screened to remove the coarse + 2000 micron fraction, which was rejected.

The sample was then fed into the centre of a 10 litre capacity laboratory upward flow hydro-classifier (see Diagram 1 below) over a 5 minute period, whilst maintaining an upward flow of water at a rate of 6 litres/minute.

Solids overflow was collected via the overflow launder, whilst solids underflow was allowed to accumulate in the base of the classifier, above the perforated plate.

An initial weight of 667 g of overflow solids was collected, followed by a second quantity of 1914 g, after which solids overflow ceased.

The final underflow solid was then discharged from the base of the classifier,

All fractions were then dried and weighed and each fraction was then sized by dry screening as follows:-

+425µ, 250-425µ, 150-250µ, 106-150µ, 53-106µ, -53µ

From this data a mass balance was calculated, showing the weight and size distribution for each product and the distribution of each size fraction among the products and is shown below as Diagram 2.

This mass balance indicates that Overflow 1 was predominantly 106-150 micron material, representing almost one third of this size fraction present in the feed. Some 53-106 material was also present, representing almost half of that size fraction present in the feed.

Overflow 2 contained mainly 106-250 micron material, along with smaller quantities of 53-106 micron and -53 micron material, representing respectively half and almost all of that present in the feed.

The Underflow ranged in size mainly from +106 to + 425 micron and contained very little -106 micron material.

3. Further Tests and Analysis of Products

3.1. Overflow 1

The 106-150 micron fraction was passed over a dry roll magnetic separator at 1100 gauss and the magnetic and non-magnetic fractions were recovered. A sample of the non magnetic fraction was then leached at 20% solids with 20% citric acid solution. This test was repeated using oxalic acid.
The dried leached products and both the magnetic and non-magnetic products of the 106-150 micron fraction, along with the +150 and 53-106 micron fractions, were then analysed for Al_2O_3, CaO, Cr_2O, MgO, MnO, TiO_2, V_2O_5, Na_2O, K_2O, P_2O_5, Cu, Pb, Zn, Li and Ni.

3.2. Overflow 2

The 106-150 micron fraction was again passed over a dry roll magnetic separator at 1100 gauss and the magnetic and non-magnetic fractions were recovered. A sample of the non magnetic fraction was then leached at 20% solids with 20% citric acid solution. This test was repeated using oxalic acid.
The dried leached products and both the magnetic and non-magnetic products of the 106-150 micron fraction, along with the +150 and 53-106 micron fractions, were then analysed for Al_2O_3, CaO, Cr_2O, MgO, MnO, TiO_2, V_2O_5, Na_2O, K_2O, P_2O_5, Cu, Pb, Zn, Li and Ni.
The 150-250 size fraction found in Overflow 2 appeared to contain considerable organic material and was therefore additionally analysed for carbon.

3.3. Underflow

The 250-425 micron fraction was magnetically separated and a sample of the resultant non-magnetic fraction was leached at 20% solids with 20% citric acid solution. The 106-250 micron fraction was also magnetically separated and a sample of the resultant non-magnetic fraction was leached at 20% solids with 20% citric acid solution. This test was repeated using oxalic acid.
The magnetic and non-magnetic fractions of each of these size fractions, along with the leached solids obtained from each fraction, and the +425 fraction, were analysed for Al_2O_3, CaO, Cr_2O, MgO, MnO, TiO_2, V_2O_5, Na_2O, K_2O, P_2O_5, Cu, Pb, Zn, Li and Ni.

3.4. Feed

A bulk sample of the feed used in the test was also analysed for Al_2O_3, CaO, Cr_2O, MgO, MnO, TiO_2, V_2O_5, Na_2O, K_2O, P_2O_5, Cu, Pb, Zn, Li and Ni.
The analytical results from this work are attached as Table 1.

4. Discussion of Results

The results indicate that a large proportion of the iron contamination appears to be removable as the +150 micron fraction of the overflow products.
This would then allow a range of products to be produced using this technology, depending on the size fraction chosen and whether acid leaching, using either oxalic or citric acid, is used.
In particular 48.5% of the feed appears likely to be extractable as a premium low iron product by leaching of the underflow fraction.

DIAGRAM 1
UPWARD FLOW HYDRO-CLASSIFIER

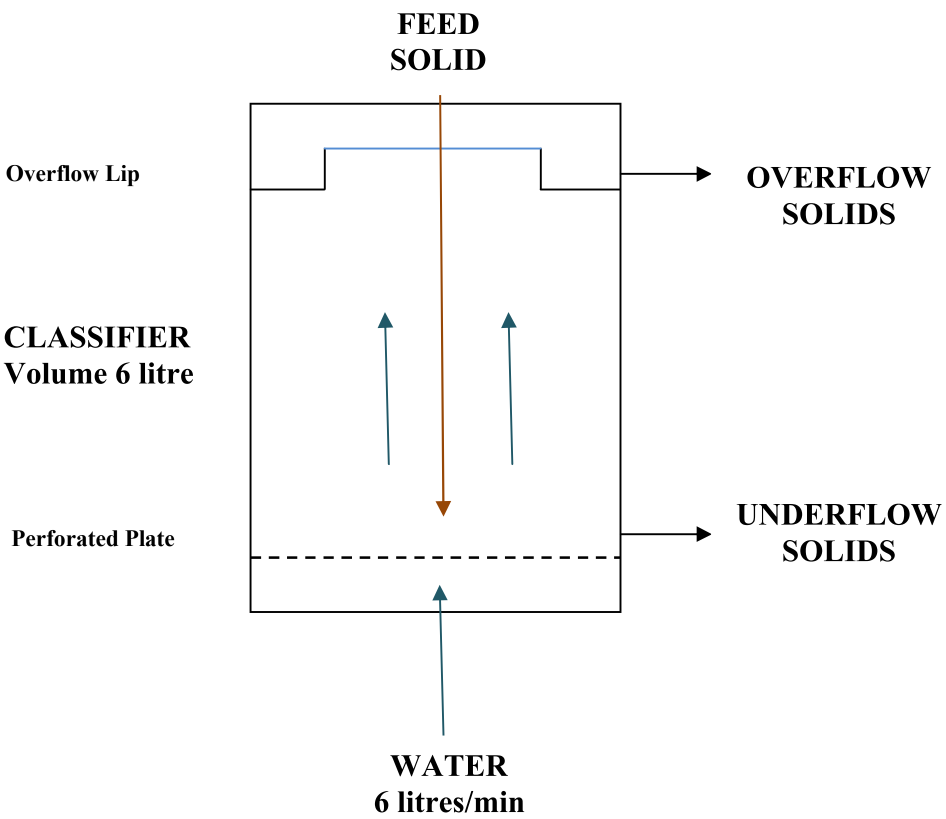


DIAGRAM 2
MASS BALANCED CIRCUIT

RAW FEED

SCREEN (2000µ)

O/S Reject 40g

FEED (5010 g)			
Size	Weight (g)	Content (%)	Dist. (%)
+425	648.5	12.9	100.0
250-425	549.0	11.0	100.0
150-250	1631.7	32.6	100.0
106-150	1719.5	34.3	100.0
53-106	308.0	6.1	100.0
-53	153.3	3.1	100.0
Total	5010.0	100.0	100.0

U/F CLASSIFIER

Water 6 l/min

OVERFLOW 1 (667 g)			
Size	Weight (g)	Content (%)	Dist. (%)
+425	0	0	0
250-425	0	0	0
150-250	42.0	6.3	2.6
106-150	494.3	74.1	28.7
53-106	130.7	19.6	42.4
-53	0	0	0
Total	677.0	100.0	

OVERFLOW 2 (1914 g)			
Size	Weight (g)	Content (%)	Dist. (%)
+425	0	0	0
250-425	0	0	0
150-250	780.9	40.8	47.8
106-150	826.8	43.2	48.1
53-106	162.7	8.5	52.8
-53	143.6	7.5	93.6
Total	1914.0	100.0	

UNDERFLOW (2429 g)			
Size	Weight (g)	Content (%)	Dist. (%)
+425	648.5	26.7	100.0
250-425	549.0	22.6	100.0
150-250	808,9	33.3	49.6
106-150	398.4	16.4	23.2
53-106	14.6	0.6	4.7
-53	9.7	0.4	6.3

TABLE 1

CHEMICAL ANALYSIS OF SIZE FRACTIONS

PRODUCT	SIZE FRACTION	ANALYSIS																
		Al_2O_3 (%)	CaO (%)	Cr_2O_3 (ppm)	Fe_2O_3 (%)	MgO (%)	MnO (%)	TiO_2 (%)	V_2O_5 (%)	Na_2O (%)	K_2O (%)	P_2O_5 (%)	Cu (ppm)	Pb (ppm)	Zn (ppm)	Li (ppm)	N (ppm)i	C (%)
FEED	Total	0.028	0.018	8	0.026	0.007	0.001	0.043	0.001	0.006	0.004	0.003	1	1	2	2	2	
O/F 1	+150	0.108	0.244	22	1.395	0.143	0.021	1.050	0.002	0.108	0.017	0.013	14	2	31	2	9	
	106-150 Mag	0.038	0.069	9	0.060	0.030	0.001	0.090	0.001	0.050	0.008	0.004	4	1	4	2	2	
	106-150 N/M	0.030	0.068	5	0.019	0.027	0.001	0.037	0.001	0.050	0.008	0.004	4	1	4	2	2	
	106-150 N/M L (citric)	0.026	0.073	4	0.014	0.032	0.001	0.033	0.001	0.072	0.010	0.003	4	1	2	2	1	
	106-150 N/M L (oxalic)	0.026	0.060	4	0.010	0.027	0.001	0.032	0.001	0.059	0.008	0.003	2	<1	<2	2	1	
	53-106	0.034	0.081	8	0.030	0.033	0.001	0.040	0.001	0.070	0.011	0.003	2	1	4	2	2	
O/F 2	150-250	0.608	1.925	138	3.3	0.927	0.040	1.925	0.006	0.852	0.118	0.062	46	34	201	1	96	**41.3**
	106-150 Mag	0.042	0.042	16	0.054	0.015	0.001	0.093	0.001	0.011	0.006	0.004	2	2	3	2	3	
	106-150 N/M	0.026	0.028	5	0.017	0.008	0.001	0.037	0.001	0.008	0.004	0.003	1	1	2	2	1	
	106-150 N/M L (citric)	0.026	0.026	4	0.011	0.008	0.001	0.035	0.001	0.009	0.005	0.003	2	2	<2	2	1	
	106-150 N/M L (oxalic)	0.025	0.033	4	0.016	0.008	0.001	0.037	0.001	0.009	0.005	0.003	2	2	<2	2	1	
	53-106	0.034	0.040	10	0.030	0.010	0.001	0.043	0.001	0.009	0.006	0.004	2	1	3	2	2	
	-53	0.047	0.042	19	0.073	0.017	0.001	0.150	0.001	0.012	0.008	0.006	2	2	4	3	5	
U/F	+425	0.015	0.006	2	0.016	0.002	0.001	0.007	0.001	0.004	0.002	0.001	<1	1	<2	1	1	
	250-425 Mag	0.021	0.008	10	0.041	0.005	0.001	0.023	0.001	0.004	0.002	0.001	1	2	2	1	2	
	250-425 N/M	0.021	0.006	2	0.007	0.003	0.001	0.007	0.001	0.007	0.004	0.001	1	<1	<2	1	1	
	250-425 N/M L (citric)	0.030	0.005	3	0.009	0.002	0.001	0.005	0.001	0.004	0.002	0.001	1	1	<2	1	1	
	106-250 Mag	0.021	0.008	10	0.041	0.005	0.001	0.023	0.001	0.004	0.002	0.001	1	2	2	1	2	
	106-250 N/M	0.021	0.006	2	0.007	0.003	0.001	0.007	0.001	0.007	0.004	0.001	1	<1	<2	1	1	
	106-250 N/M L (oxalic)	0.019	0.006	2	0.007	0.003	0.001	0.010	0.001	0.005	0.004	0.001	1	1	<2	1	<1	
	106-250 N/M L (citric)	0.019	0.006	2	0.006	0.003	0.001	0.007	0.001	0.007	0.004	0.001	1	1	5	1	<1	

APPENDIX 2

SUMMARY

CARBON REMOVAL PROGRAM

MAYDENA SANDS PTY LTD

CARBON REMOVAL PROGRAM
2014-2016

C.J. BROWNE

December 2016

1. SUMMARY

A series of tests have been conducted at Mineral Technologies Carrara (Qld) laboratories under my supervision, with the objective of using gravity separation as a means of removal of carbon particles from samples of silica drawn from the Maydena Sands deposit in Tasmania.

Previous test work on this material had indicated that magnetic separation and subsequent oxalic leaching was able to reduce the residual iron levels in typical samples to less than 70 ppm, whereas a desirable final iron content of less than 10 ppm was sought, from a marketing viewpoint.

It was established that carbon particles were present throughout the deposit and that these particles may contain elevated levels of iron and therefore may have been a contributing cause of the higher than expected iron levels in final samples from these tests, as well as having an undesirable visual effect on the products obtained.

2014 Program
An initial series of tests were conducted in 2014, based on heavily contaminated sample, using 4-turn and 7-turtn coal spirals as a means of carbon removal. The results of these tests, reported as "Carbon Removal – Coal Spiral Tests – LD7 Spirals – 25/11/14", showed a moderate effectiveness in carbon removal.

The effectiveness of the equipment may have been hindered by relatively high levels of slimes in the feed. There was no doubt that better results can be obtained using the 7-turn spirals, which provided more opportunity for gravity definition, however it was obvious that more than 1 pass would be required to achieve a satisfactory separation.

2015 Program
A further series of tests were then conducted in 2015 and reported as "Carbon Removal – Further Investigations – 15/11/15", initially involving a repeat of the 7-turn spiral test using the same sample, but involving a prior desliming test.

Although some improvement was noted, carbon removal was still less than satisfactory.
It was then decided to pass the concentrate fraction from this test over a wet table, where it was noted that the remaining carbon particles in this material appeared to be swept down the table into the tailings fraction along with the coarser +200 micron particles and all remaining slime. The table product, consisting of 45% of the original sample, was subjected to magnetic separation and the non magnetic fraction was found to contain 70 ppm iron. Subsequent oxalic acid leaching resulted in a further reduction to 60 ppm.

The wet tabling method was then applied to a 45-250 micron sample of relatively high grade product extracted from a previous test program on samples from the Maydena deposit and containing 50 ppm iron.

In this case it was found that the non magnetic fraction of the table concentrate, representing 85% of the total sample, contained only 30 ppm iron and that this could be further reduced to 10 ppm by either oxalic or citric acid leaching.

Subsequent leach tests confirmed that citric acid is equally as effective as oxalic acid, in removal of iron from Maydena Sands products. This is an important discovery, as citric acid is a non-hazardous reagent (lemon juice) and thus presents no effluent disposal problems.

2016 Program

A further series of test was carried out recently and described in the attached report. The aim of this test work was to gauge the effectiveness of Upward Flow Hydro-classification in removal of carbon particles from the same heavily contaminated sample used for spiral and wet tabling tests in both of the previous programs.

The results indicated that the composition and weight proportion of the underflow product obtainable by hydro-classification was similar to that of the concentrate produced in the 7-turn spiral tests.

It could therefore be assumed that wet tabling of the underflow from this test would result in a similar upgrading to that obtained when wet tabling the concentrate fraction from the 7-turn spiral tests.

2. CONCLUSIONS

It has clearly been established that in order to produce a saleable premium grade product from raw silica recovered from this deposit will involve de-sliming to both remove the bulk of contaminants and render the balance of the material amenable to conventional metallurgical treatment, which would include a combination of gravity concentration, size separation and magnetic separation to remove undesirable organic and inorganic impurities and to produce suitably sized product.

The results generated by this program, when combined with the results obtained from the large volume of tests carried out previously can now be used to develop a suitable practical plant design from which capital and production costs can be estimated with some precision.

APPENDIX 3

SAC CORPORATION

TEST SAMPLE ASSAY RESULTS

SAC PURE SILICA & FELDSPAR

SAC Corporation

Pure Silica & Feldspar

Certificate Of Analysis

Pure Silica

Item	ATS 45~250μm
Analysis Date	2016-11-21

Sieve shaker				TYPICAL CHEMICAL ANALYSIS (ICP) , %	
Mesh	mm	SIEVE Wt %	PASS Wt %	CHEMICAL COMPONENT	Result
10(2mm)	2.00	0	100.00	SiO2	99.93
20(850)	0.85	0	100.00	Al2O3	0.0080
30(600)	0.60	0	100.00	CaO	0.0370
40(425)	0.42	0	99.99	Fe2O3	0.0050
50(300)	0.30	0	99.97	TiO2	0.0100
60(250)	0.25	0.14	99.83	K2O	0.0005
70(212)	0.21	2.13	97.70	Na2O	0.0019
80(180)	0.18	4.57	93.13	Cr2O3	0.0000
100(150)	0.15	8.05	85.08	Co3O4	0.0000
120(125)	0.13	6.15	78.93	CuO	0.0000
140(106)	0.11	7.22	71.71	Li2O	0.0005
200(75)	0.08	17.42	54.29	MgO	0.0091
PAN		54.29	0.00	MnO2	0.0000
D50		71.10		NiO	0.0000
				V2O5	0.0000

Remarks : This COA is restricted to use for other purpose except certification of analysis.

21-Nov-16

R&D Center Manager / SAC Corporation

384 DAEJONG-RI ONSAN-EUP, ULJU-GUN ULSAN 689-892, KOREA

Certificate Of Analysis

SAC Corporation
Pure Silica & Feldspar

Pure Silica

Item	ATS 250~600μm
Analysis Date	2016-11-21

Sieve shaker			
Mesh	mm	SIEVE Wt %	PASS Wt %
10(2mm)	2.00	0	100.00
20(850)	0.85	0	100.00
30(600)	0.60	2	98.05
40(425)	0.42	32	66.51
50(300)	0.30	35	31.94
60(250)	0.25	6.63	25.31
70(212)	0.21	4.45	20.86
80(180)	0.18	3.87	16.99
100(150)	0.15	2.99	14.00
120(125)	0.13	2.63	11.37
140(106)	0.11	1.58	9.79
200(75)	0.08	2.89	6.90
PAN		6.90	0.00
D50		359.87	

TYPICAL CHEMICAL ANALYSIS (ICP) , %	
CHEMICAL COMPONENT	Result
SiO2	99.93
Al2O3	0.0100
CaO	0.0144
Fe2O3	0.0060
TiO2	0.0080
K2O	0.0008
Na2O	0.0026
Cr2O3	0.0000
Co3O4	0.0000
CuO	0.0000
Li2O	0.0005
MgO	0.0060
MnO2	0.0000
NiO	0.0000
V2O5	0.0000

Remarks : This COA is restricted to use for other purpose except certification of analysis.

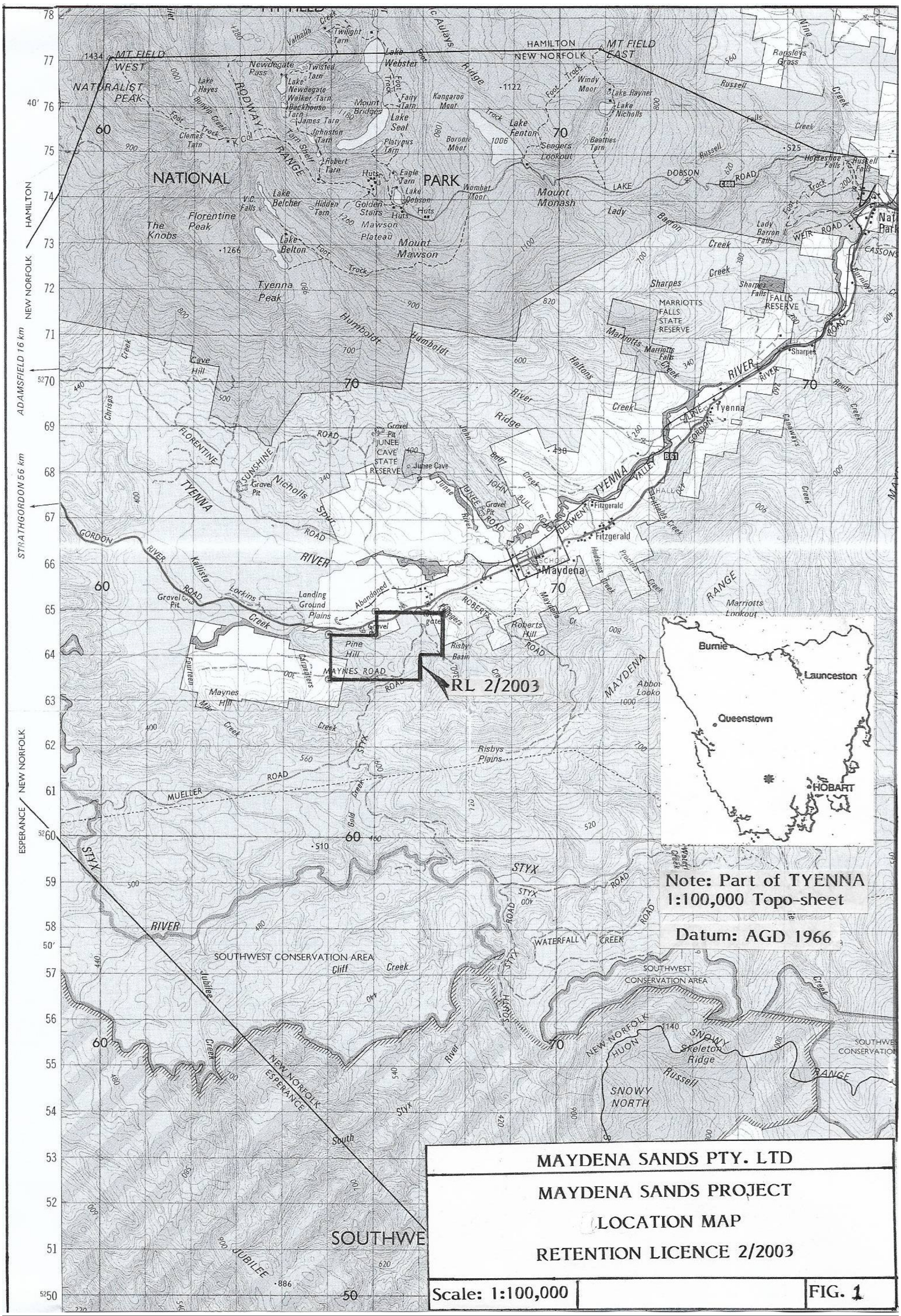
21-Nov-16

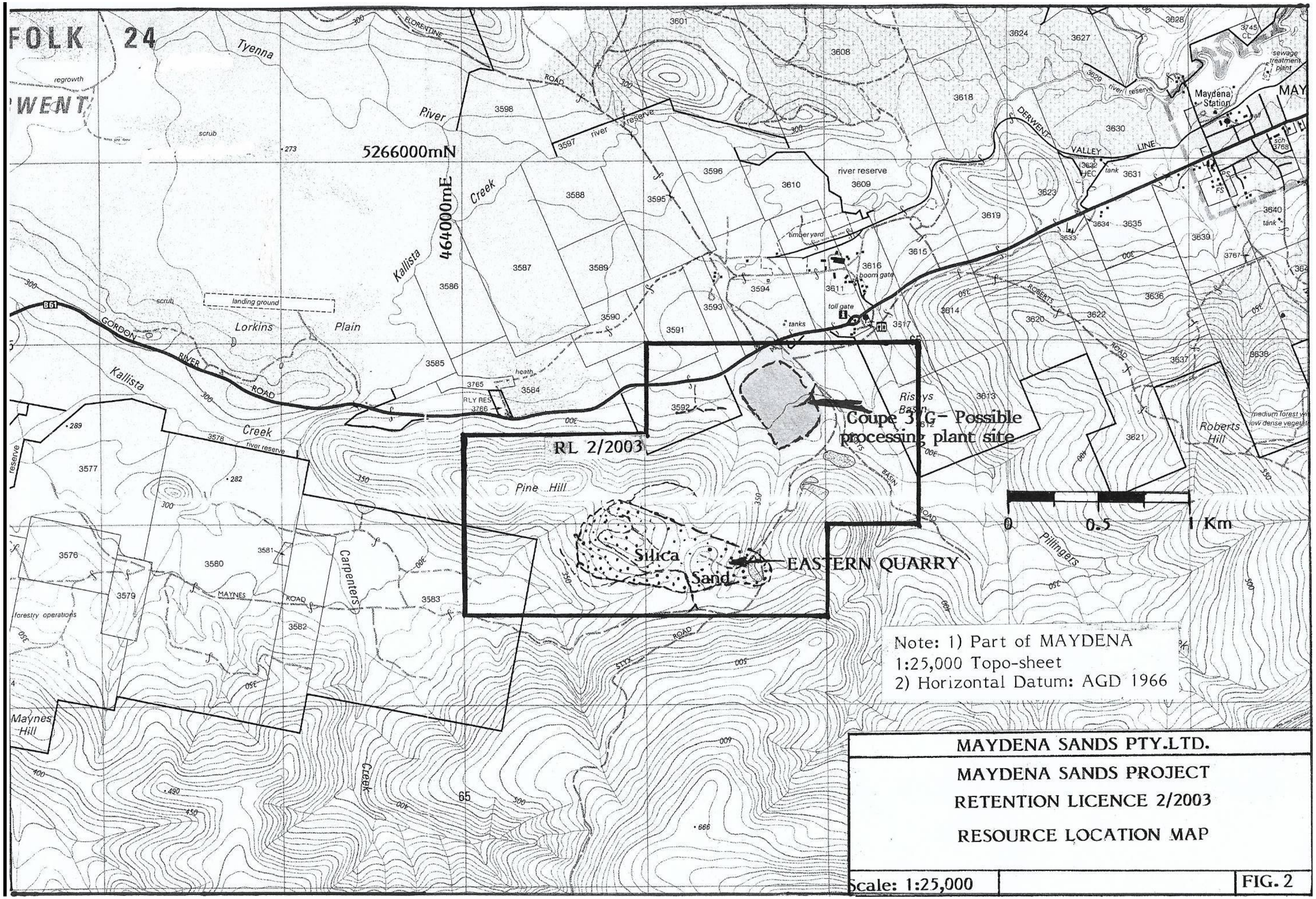
R&D Center Manager / SAC Corporation

384 DAEJONG-RI ONSAN-EUP, ULJU-GUN ULSAN 689-892, KOREA

Typical Chemical Analysis (ICP), (%)						
Chemical	Tasmania					
	ATS 45~250μm			ATS 250~600μm		
	Raw material	Washing	Iron removed	Raw material	Washing	Iron removed
SiO2	99.93	99.94	99.94	99.95	99.96	99.96
Al2O3	0.0080	0.0070	0.0065	0.0100	0.0070	0.0065
CaO	0.0370	0.0350	0.0331	0.0144	0.0130	0.0128
Fe2O3	0.0050 →	0.0040 →	0.0035	0.0060 →	0.0050 →	0.0045
TiO2	0.0100 →	0.0060 →	0.0040	0.0080 →	0.0050 →	0.0045
K2O	0.0005	0.0005	0.0005	0.0008	0.0006	0.0005
Na2O	0.0019	0.0018	0.0015	0.0026	0.0023	0.0020
Cr2O3	0.0000 →	0.0000 →	0.0000	0.0000 →	0.0000 →	0.0000
Co3O4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CuO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Li2O	-	-	-	-	-	-
MgO	0.0091	0.0086	0.0084	0.0060	0.0056	0.0052
MnO2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NiO	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
V2O5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

ILLUSTRATIONS


MAYDENA SANDS PTY. LTD
MAYDENA SANDS PROJECT
LOCATION MAP
RETENTION LICENCE 2/2003
Scale: 1:100,000
FIG. 1
Note: Part of TYENNA 1:100,000 Topo-sheet
Datum: AGD 1966
RL 2/2003
Burnie
Launceston
Queenstown
HOBART
NATIONAL PARK
MT FIELD WEST
MT FIELD EAST
Maydena
Tyenna
Fitzgerald
Sharpes
Pine Hill
MAYNES ROAD
Maynes Hill
TYENNA RIVER
GORDON RIVER ROAD
SOUTHWEST CONSERVATION AREA
STYX RIVER
ADAMSFIELD 16 km
STRATHGORDON 56 km
HAMILTON
NEW NORFOLK
ESPERANCE



MAYDENA SANDS PTY.LTD.

MAYDENA SANDS PROJECT

RETENTION LICENCE 2/2003

RESOURCE LOCATION MAP

Scale: 1:25,000

FIG. 2