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Annual report for EL 35/2010 (Tonganah)
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Introduction

Duggans P/L is involved in exploration activities within Tasmania for high grade silica.

EL 35/2010 was taken up to investigate the potential for a high grade silica resource contained within the tailings of previous mining for kaolin.

While this is the primary objective, the tailings are also being evaluated as a potential raw material in the production of porcelain/ceramics and for use as a supplementary cementitious material in the cement/concrete construction industry.

During the past year this latter pursuit has taken precedence in research activities due to greater interest in supplementary cementitious materials for use in specialty concretes and the potential impact of the carbon tax on cement producers.

Statement of exploration philosophy and objectives

This EL has been taken up to investigate potential uses for tailings from previous mining and processing of kaolinite. The conventional exploration activities associated with a greenfield site are therefore not entirely applicable.

The 'ore bodies' are defined and exist as partly processed material.

The nature of the materials of interest are known and most of the 'exploration' activity will focus on more accurately defining the minerals present as well as their proportions and processing techniques to provide products of best value.

Two grades of tailings have been identified;

Coarse tailings consisting of silica crystals nominally 2 to 6mm in size and

Fine tailings consisting of -2mm material.

Both of these grades contain remnant kaolin and feldspar. The coarse tailings have been dumped as dry stockpiles while the fine tailings are contained within a bunded pond structure having been pumped into it as a slurry.

Any subsequent mining activity will not conform to conventional operations as it will be confined to the tailings dump areas and importantly, in the case of the fine tailings, will be conducted within an already bunded area which will prevent escape of kaolin rich run off to the wider environment.

The EL is being explored primarily for its potential to provide a resource of high grade silica although it is probable that, if processing the tailings from previous mining for kaolin is feasible from the point of view of deriving high purity silica, then a kaolin rich by-product will probably also be a saleable commodity and potentially a raw material for production of porcelain/ceramics or for the production of metakaolin (a supplementary cementitious substance of high value in the concrete industry).

The tailings are considered to be a superior source of high grade silica when compared with naturally occurring silica sand because the tailings have been mined from weathered ,or hydrothermally altered, Devonian granite in situ so that the silica component of the material dumped as tailings is composed solely of quartz crystals whereas naturally occurring sand is highly likely to be contaminated by other detrital particles included during the weathering and transport processes.

It is envisaged that any subsequent reclamation and processing of the tailings will give rise to two or more economically viable products and result in a zero waste operation.

To date work has concentrated on the potential silica resource primarily in the coarse tailings although work has taken into account the fact that the silica in the fine tailings is more likely to be present as discrete particles and therefore require little or no attrition to remove remnant kaolin.

Increased emphasis has been placed on the potential to produce metakaolin in the past 12 months as the most likely way to utilise all of the tailings material. This has resulted in a realisation that fresh sources of kaolin may need to be utilised to supplement the kaolin from the tailings due to the fact that the finer material has been extracted for paper filler. This possibility is yet to be assessed.

Site review

The site may be defined as the operational area, both mining and processing, occupied in the past by Associated Pulp and Paper Mills Limited (APPM) in the extraction and processing of kaolin for use as a paper filler.

A site review was carried out to identify the locations of the tailings dumps and pondages.

Summary of work completed

- Production of kaolin rich sub samples from fine tailings for testing directed at metakaolin production.
- Production of calcined finely ground product for testing in concrete test cylinders. (calcining and fine grinding done by others, - concrete cylinder production and testing done 'in house' by Duggans Pty Ltd)
- Review of outlying known but unmined kaolin deposits for potential use as supplemental kaolin. (May require extension of EL area.)
- Approach made through Tas Uni Professor Ross Large to Professor Jay G Sanjayan (Professor of concrete Structures) Swinburn University of Technology for possible assistance with research.

Regional exploration activities

Because of the focus of the work ie tailings dumps, there were no regional exploration activities apart from a literature review of known but unmined kaolin resources outside of the current EL area.

Prospect based activities

Prospect based activities have been confined to limited sampling of the tailings to evaluate the potential to produce metakaolin.

Metakaolin testing

The test work regime calls for :

1. The production of suitable metakaolin.
2. Incorporation of the metakaolin in a concrete mix.
3. Testing of the mix design in terms of strength over time and possibly subsequent testing to evaluate properties for use in speciality concretes, eg use in marine conditions or resistance to fire.

These three steps involve complex operations to determine what may be the best course of action in a full scale production situation. Additionally, decisions have to be made to achieve what is desired of the concrete depending on its application and its cost of production.

In step 1. Kaolin must be separated from the silica, calcined at between 650 and 800 degrees C for 150 minutes, (NOTE; calcining and intergrinding with limestone was attempted to try to increase early strength to suit application in pre-cast concrete work), cooled and then ground to give suitable reactivity. The fineness is important and must be monitored to confirm consistency. (This aspect of the work has been found to be difficult due to the difficulty in measuring the fineness of very fine material and the fact that the platyness of the kaolin particles must be broken up to achieve the best results in terms of reactivity.)

Step 2. Requires decisions on the make-up of the concrete mix including aggregate type and sizing, percentage replacement of Portland cement and water addition and use of water reducing agent. Slump and design MPa strength must also be taken into account.

Step 3. Requires crush testing of standard concrete cylinders at various ages to determine the strength and characteristics of the concrete against a Control cylinder made at the same time but with no metakaolin addition. (This is a time consuming business with testing typically stretching out to 56 days which means that for one test there needs to be at least 6 cylinders made including the control.)

Results of this test work to date are summarised in the appendix.

Environmental considerations

Both the mining and production areas of the past operations of APPM have been rehabilitated at great expense and most of the area is now reminiscent of park land with regenerated land forms, drainage control and individually planted seedlings providing the now mature vegetation cover.

The focus of Duggan's activity is solely the tailings dumps and there is no intention of disturbing any of the rehabilitation away from these dumps.

Initial small scale sampling of these dumps has been undertaken in sympathy with the rehabilitation and the surface restored to present levels.

If there is a future larger scale sampling regime required, similar protocols will apply and if eventually a mining operation is proven viable then the mining will be confined to the tailings dumps and will proceed under the Development Proposal and Environmental Management Plan approved for the mining lease.

Conclusions

Results of work to date continue to support the probability that a high grade, consistent quality silica concentrate could be produced from the tailings. The achievement of this is more dependent on the mineral separation technology employed rather than the quality of the silica itself. Various analytical results show the silica grains to be relatively free of impurities of consequence.

The potential for portions of the tailings to be utilised as the basis for the production of ceramics is still recognised while the potential for the remnant kaolin to be used, after calcining, as a supplementary cementitious material is currently being assessed. Results of the metakaolin testing are encouraging but it is proving difficult to duplicate results with any certainty due mainly to the number of variables at play.

Proposed work for the next 12 months:

As explained above the conventional progression from exploration to mining has been short circuited in this case. The nature of the 'ore' is known as are approximate reserves and target markets for any products produced.

Further work will seek to establish more accurate market values for the potential products and, depending on the results of this, prioritise product development. Production processes for selected products will be developed at laboratory scale and end products tested for quality. This is especially necessary in the case of metakaolin and ceramic raw materials involving the use of kilns and subsequent testing at laboratory scale in the concrete and ceramics industries.

In the case of the ceramics industry the primary aim is to produce ceramic grinding media.

In the case of the concrete industry the primary aim is to produce standard test cylinders incorporating various proportions of metakaolin to test for various properties of high strength, high resistance concrete.

This work has been identified as a priority and is currently in progress. The test regime is proving to take up a lot of time due to the fact that duplicate test cylinders must be made and kept to enable strength testing at 2, 7, 28 and possibly 56 day time periods before the nature of the concrete can be assessed.

It is proposed to continue this work in the next twelve months.

It is further proposed to engage the assistance of an expert in the field to provide guidance and assist in the work program.

Given further encouraging results in this work it is likely that an extension to the EL will be applied for to incorporate areas of kaolinite already identified but as yet unmined.

Appendix Summary of metakaolin test results



MetaKaolin Trial		
Job Name		
Job No.		

Sample No.	Date	Day 2	Day 3	Day 7	Day 28	Day 56	Slump	Density	Water/m	Comments
7116	13-Jul-12	12.5		31	44.5		205	2440	198	Meta Kaolin + Limestone + GP
7117	13-Jul-12	11.5		28.5	42.5		160	2420	198	Meta Kaolin + GP
7118	13-Jul-12	19.5		41.5	53.5		240	2500	160	GP
7127	20-Jul-12		25	39	52	55	240	2480	175	MK + Limestone + GP
7128	20-Jul-12		24.5	35.5	51.5	56	185	2460	185	MK + Garden Lime + GP
7141	03-Aug-12		25.5	37	52.5	54	230	2480	185	MK + Limestone + GP
7142	03-Aug-12		22.5	32.5	47.5	50	220	2460	200	MK + Garden Lime + GP
7181	05-Sep-12	17		38	47	49.5	110	2460	200	Meta Kaolin + Limestone + GP
7182	05-Sep-12	16.5		44	53	55.5	110	2480	210	Meta Kaolin + GP
7183	05-Sep-12	16.5		36	41.5	45.5	120	2520	170	GP
7272	21-Nov-12	3.5		10.5	16	19.5	140	2380	266	75micron Kaolinite
7273	21-Nov-12	3		13	21.5	26.5	170	2400	266	75micron MetaKaolin
7313	15-Jan-13	12.5		29.5	38.5	41.5	85	2440	263	Sub 75 micron MK
7314	15-Jan-13	12.5		28	39	42	120	2440	263	Sub 75 micron MK + Limestone
7315	15-Jan-13	20.5		36	45	47	85	2500	188	Control - N40 GP @ 80%
7402	22-Apr-13	22.5		43.5	54.5		210	2500	210	Control - N40 GP @ 100%
7403	22-Apr-13	13.5		34	48.5		25	2460	210	Virgin MK + GP
7404	22-Apr-13	14		34.5	50.5		35	2460	210	Tailings MK + GP
Average				32.89	44.39		149.44	2460.00		
Standard Deviation				9.00	10.60		67.84	36.30		