

Tantalum and Lithium – A Market Outlook

**David Miller – General Manager Strategic Development,
Talisson Minerals Pty Ltd**

Introduction

Tantalum and lithium are both entering interesting supply/demand phases over the next few years. Tantalum concentrate inventories are gradually depleting with the potential to be off-set by new projects or expansions within existing operations. Lithium demand in recent years has outstripped supply but this may change with the introduction of new lithium brines projects and expansions.

This paper examines the supply demand dynamics of the tantalum and lithium feedstock markets over the next five years including an overview of Talison, the new company formed from Sons of Gwalia's Advanced Minerals Division and its future role in these industries.

Tantalum Market

Background

Tantalum metal has a number of physical properties which makes it suitable for a range of applications including:

- ◆ Use in capacitors due to the metal's high capacitance to store and release energy
- ◆ An additive in superalloys in the manufacture of aircraft and land based turbine blades
- ◆ Tantalum carbide cutting tools
- ◆ Mill products for corrosive resistant piping, vessel lining and valves
- ◆ Sputtering targets
- ◆ High purity tantalum oxides and chemicals for optical lenses and anti-reflection coatings

The electronics industry is the major market for tantalum where tantalum powder for capacitors and tantalum wire for connectors represent about 50% of total tantalum consumption. However over the last few years, strong global economic growth has seen increased usage of metallurgical powder and mill products.

Talison estimates that over the last 15 years, the compound annual growth rates (CAGR) in tantalum demand has been around 5%. Growth in consumption was particularly strong during the late 1990's driven by the electronics industry especially growth in mobile phones.

Towards the end of the 1990's, it was assumed that growth in the electronics industry would continue to increase exponentially. At the same time, there were concerns of a potential shortage of tantalum feedstock supply. This resulted in the spot price for tantalum concentrate increasing from about US\$30/lb to over US\$250/lb. To secure supply, processors and manufacturers entered into long term take-or-pay contracts. However, neither the anticipated growth in demand nor the shortage in supply occurred resulting in a collapse in the market and the processors and manufactures

left to meet the take or pay contractual obligations. This has led to a build up of inventories across the supply chain that is currently still being drawn down.

Feedstock Sources

Tantalum feedstock for the last few years has been provided from a number of sources including:

- ◆ Tantalite (Ta_2O_5) concentrate from mining operations;
- ◆ Tin slags from old dumps containing low percentages of Ta_2O_5 which can be upgraded into a synthetic concentrate;
- ◆ Stockpiles such as the United States' Defense Logistics Agency (US DLA);
- ◆ Recycled and scrap; and
- ◆ Processors' and manufacturers' inventories

The US DLA's stockpile of tantalum concentrate is now depleted and the tin slags from the dumps are also expected to be exhausted in the next few years. With inventories across the supply chain moving to normal operating levels and a decreasing trend in the amount of recycled material returning to the processors from downstream manufacturing, the processors will become increasingly reliant on feedstock from current mining operations and new projects.

Current Market

Talison estimates that primary production in 2006 including tin slags was about 3.6Mlbs Ta_2O_5 . About one third of global production came from Talison's Wodgina mine with the other important supply regions being Brazil, Africa and China. Other than Talison, the industry can be characterised as highly fragmented with production coming from small 100 to 200klbpa producers or very small artisanal mining operations in Brazil and Africa.

On the other hand tantalum processing is highly concentrated with Cabot Supermetals (Cabot) and HC Starck (Starck) dominating the market. That dominance is now being challenged by Asia with the strong growth in companies such as China's Ningxia Non-Ferrous Metals and Kazakhstan's ULBA. While Cabot and Starck still monopolise the high technology end of the tantalum market such as the high capacitance powder market, their overall share is gradually being eroded in other areas by the Asian processors.

Talison estimated processor demand to be about 5.6Mlbs Ta_2O_5 in 2006 (calculated by taking processor tantalum product production, converting back to Ta_2O_5 equivalent and adjusting for recoveries, etc). After including purchases from the US DLA stockpile and scrap, processor and manufacturer inventory drawdown was estimated at about 400 to 450klbs.

Supply/Demand Outlook

In discussion with numerous players in the industry, a wide range of growth forecasts have been predicted varying from 3% to 6% CAGR. While historical growth has been about 5% over the last 15 years, this includes anomalously high growth during the late 1990's. Talison has therefore taken a more conservative approach and has used 4% CAGR over the medium term.

Production from current operations over the next five years is forecast to increase by a net 10%. Reduction in the availability of tin slags is expected to be offset by

planned modest increases in production from a number of operations. It has also been assumed that recycled material will continue to represent about 20% of future processor plant feed, though the trend continues to show this ratio decreasing.

There are also a number of advanced tantalum projects at various stages of development. Within the five year forecast, Talison has assumed:

- ◆ The Rocha Sã project will advance to Stage II and III in the next couple of years
- ◆ Jiangxi Jinfeng to commence in 2009
- ◆ The Marropino project will eventually resolve current technical issues but this may result in the Morrua project being delayed
- ◆ Abu Dabbab project to commence in 2010

Talison believes that all other projects are currently not sufficiently advanced to be developed within the five year timeframe

Despite the additional supply from the new projects, there still remains a 300klbspa to 500klbspa gap in supply between 2008 and 2012. There is a strong possibility that this deficit will widen given that the analysis assumes no production issues at current operations and new projects can meet both project start dates and ramp up in an industry which has a poor history of project development.

Talison's idled Greenbushes tantalum operation with a capacity of 1Mlbspa is more than capable of meeting any future supply deficit. Re-commissioning of mine and plant can be achieved within a few months and at minimal capital cost.

In 2007, Talison estimates the supply gap to be about 950klbs, a function the depleted US DLA stockpile, a modest loss of production from Wodgina following Cyclone George and the commissioning issues at Noventa's Marropino project.

This deficit is being met by processor and manufacturer inventory drawdown, but Talison is of the opinion that with the large supply gap this year and also next year's deficit, inventories throughout the supply chain should be close to or at normal operating levels within the next one year to eighteen months.

Circumstantial evidence is indicating the market is in the early stages of tightening. Over the last six months Talison has started to receive an increasing number of inquiries from processors and agents to purchase the company's tantalum concentrate and it is also noticeable that the spot price has increased substantially over the same period.

Lithium Market

Background

Lithium is the lightest of all metals with an atomic number of 3. The soft silver grey metal is highly reactive at room temperature. As such, it never occurs as a pure element but rather in the form of stable minerals or salts.

Commercial lithium production comes from two sources:

- Lithium minerals containing lithia (Li_2O) such as spodumene, petalite and lepidolite which are mined using open cut and underground methods with the largest producers being Australia, China, Zimbabwe and Canada
- Lithium rich brines from salt lakes located in Chile and Argentina in the Andes and China in the Himalayas

Lithium from the brines is the main source of lithium carbonate, the raw material which is used to produce lithium compounds and metal. The largest end use for these products is in the manufacture of lithium ion batteries used to power hand held electronic equipment, re-chargeable power tools and computers. Lithium from this source is also used in a wide range of applications including greases, glass, aluminium production, air-conditioning systems, alloys, catalysts, pharmaceuticals, polymers and cements.

Lithium minerals are primarily used in the glass and ceramics industries. The addition of lithia in glass manufacturing increases the melting rate which increases production throughput and lowers the melting temperature providing energy cost savings. For ceramics, lithia's very low co-efficient of thermal expansion makes it ideal for heat-proof ovenware and ceramic cook tops to withstand the thermal shock of rapid temperature changes.

In recent years, supply of lithium carbonate from the brines operations to the chemical market has not kept up with demand. This gap is now being filled by Chinese lithium chemical producers using spodumene as their feed source.

Supply

Global brine production in 2006 was estimated at just over 60kt lithium carbonate equivalent (LCE). Production was highly concentrated with only four producers of which SQM contributed about half of the total production. Over the next couple of years brines production is expected to increase significantly with expansions of current operation and new projects including:

- ◆ Chemetall increasing output from their SCL facility in Chile by about 8ktpa LCE
- ◆ SQM planning to expand production by an additional 10ktpa LCE by the second half of 2008
- ◆ China's Qinghai CITIC commencing their 20ktpa LCE operation near Golmud this year
- ◆ Admiralty Resources commencing pilot plant trials at their Rincon project in Argentina

Lithium minerals production in 2006 was estimated at 350kt with about two thirds of the production coming from Son's of Gwalia's Greenbushes operation. As well as Greenbushes, the major producers of minerals are Tanco in Canada, Bikita in Zimbabwe and a number of small spodumene mines in China. Mineral production was significantly higher than in previous years due to increased demand from the glass/ceramics market and sales of spodumene to the Chinese chemical producers to meet the shortfall in supply in the lithium chemicals market.

Mineral production has increased further this year as demand in all markets continues to rise. Most spodumene producers are at or close to capacity with only a modest increase in supply coming from Greenbushes to service both the

glass/ceramics and chemicals markets and a small increase in production expected from China from new projects and current operations

Demand

Talison estimated that total demand for lithium brines and minerals in 2006 to be between 105kt to 110kt LCE. The market has seen unprecedented growth since 2004 mainly driven by the primary and secondary lithium battery market. Talison has also seen significant growth over the last couple of years in the glass/ceramics market particularly in China.

Talison forecasts continuing strong growth over the short to medium term mainly driven by demand from the lithium battery market. In preparing the forecast, no consideration has been included to account for the impact of hybrid electric or electric vehicles on demand for lithium given the uncertainty as to the timing and quantity of lithium required to meet this potential demand. At this stage Talison does not see any significant growth in this market until around 2011 but sees a significant market upside if lithium derivative batteries are used in these vehicles.

The non-chemical sector of the industry outlook is also positive despite the short term slowing of the Chinese glass/ceramics market. Growth in other regions for lithium minerals continues to be positive, not only in current markets but in the continuing development of new applications.

Lithium Market Outlook

The last couple of years have seen a significant shortfall in supply of lithium minerals and brines to the market. This has been reflected in record prices for lithium products.

Talison estimates the shortfall in 2006 to have been between 5kt to 10kt LCE. As well as collating the data from producers and consumers to calculate the supply gap, these numbers were confirmed by the fact that had Talison produced additional product in 2006, it would have been able to place an extra 5kt LCE with existing and new customers.

Talison expects to see the market to move towards a balanced position by the end of the year as additional production from the chemical market in China, the expansion of brine production from SCL and the commissioning of the Qinghai CITIC brines project starts to meet demand. Likewise in the glass/ceramics market, Talison has marginally increase production of its high grade products to meet demand in this market sector.

The next few years are a little less clear. It is assumed in preparing the forecast that no catastrophic global event will occur and that demand for lithium products will continue its strong trend. A significant quantity of lithium feedstock is planned to come on-stream over this period, which, if all the producers met announced production forecasts would drive the market into oversupply. However, reality is that not all will achieve their forecast targets and one needs to also account for throughput issues and/or declining production profiles from existing operations. Talison has assessed a number of scenarios and sees that in the most likely cases the market being in balance to a mild oversupply in 2008 and 2009. Beyond 2009, the outlook remains positive as growth in demand absorbs the additional supply.

Talison Minerals Pty Ltd

Introduction

On 27 August this year, the assets of Sons of Gwalia's Advanced Minerals Division were sold to a consortium of five private equity funds. The new company, Talison Minerals Pty Ltd comprises of:

- ◆ The Greenbushes lithium, tantalum and tin mine
- ◆ The Wodgina tantalum mine
- ◆ Exploration leases including Mt Francisco and Pilgangoora tantalum prospects near Wodgina
- ◆ Head office in Perth

Both the mining operations and the Sons of Gwalia company have had a long and illustrious history in Western Australia. Greenbushes was discovered in 1886 with mining commencing in 1888, making the operation the oldest continually operating mine in Western Australia. Tin has been mined at Wodgina as early as 1904. The first Sons of Gwalia company commenced gold mining operations north of Kalgoorlie in 1896.

Wodgina (Ta)

Located 120km south of Port Hedland, the deposits have a combined mineral resource of 135Mt. Ore is extracted using conventional drill and blast, truck and excavator open pit mining methods. The crushed ore is fed into a recently upgraded 3.2Mtpa processing plant where it is milled before a variety of gravity separation processes and flotation are used to produce a primary concentrate grading between 8% and 10% Ta₂O₅.

The concentrate is then bagged and transported 1,700km by road train to the Greenbushes operation for secondary processing. The secondary plant uses a variety of gravity, magnetic and electrostatic separation, roasting and smelting metallurgical processes to produce a final product. Annual production is between 1.3 to 1.4Mlbs Ta₂O₅.

Extraction of tantalum into a saleable Ta₂O₅ concentrate product is not easy as witnesses by the difficulty new operations have experienced during start-up. The processing route is multi-staged using a wide range of metallurgical techniques. Talison's competitive advantage is in the wealth of experience developed over the years to maximise Ta₂O₅ recover over a range of tantalum bearing ores.

Greenbushes Mine (Ta, Li, Sn)

The mine is located 210km south of Perth. The massive pegmatite that hosts the mineralisation has a mine life of at least 15 years. The operation comprises open pit and underground mines, a primary and secondary tantalum processing plant and a lithium plant.

The operation is presently only producing spodumene from the open pit operations as well as processing the Wodgina primary concentrate. The tantalum section including the underground mine is currently placed on care and maintenance until tantalum market conditions change. Once re-commissioned, the operation can produce about 1Mlbspa Ta₂O₅. Combined with intermittently treating spodumene ore

through the tantalum plant to meet market demand, the operation produces about 300,000tpa of spodumene products in a variety of grades.

Talison's competitive advantage in the lithium market is the dominate position it holds in minerals, its long life, secure resources and ability to produce a broad range of products to meet the needs of both the glass/ceramics and lithium chemicals markets.

Growth Opportunities

Having been in Administration for the last three years, Sons of Gwalia's Advanced Minerals Business has been limited in its ability to grow. Exiting Administration will now allow Talison to realise its full potential through a number of internal and external opportunities.

Excellent opportunities exist to increase the resources at both operations through exploration. Near mine extensions and repetitions of the current orebodies at Wodgina have yet to be tested and the orebody at Greenbushes remains open along strike and at depth. Of particular interest are the Mt Francisco and Pilgangoora projects located close to the Wodgina mine where exciting results have been achieved from preliminary exploration work. Both have the potential to provide future high grade ore to the Wodgina operation

Tantalum and lithium production can easily be expanded. The Greenbushes tantalum operation can produce 1Mlbpa Ta_2O_5 when re-commissioned and lithium minerals production can be increased either via the tantalum plant or modifications to the lithium plant. These expansions can be achieved relatively easily, quickly and for minimal capital cost. Despite the latent capacity within its operations, Talison has taken a disciplined approach when expanding production to ensure markets remain balanced.

Our Research and Development Group are undertaking a number of projects to add value to the resource including:

- ◆ Product upgrading
- ◆ Downstream value adding
- ◆ New product application

Acquisition opportunities are also now being assessed. This is not limited to the tantalum and lithium industries but includes other Advanced Materials

Conclusions

There has been positive growth in tantalum industry over the last 15 years, but the market has been in oversupply for the last five years due to the events 1999 to 2001. As other sources of processor feedstock are depleted, primary production will become increasingly important. Other than Talison, current operations are generally small and fragmented, with many located in less politically stable regions. The processor market remains concentrated but the two main Western processors that have historically dominated the market are now being challenged by Asian producers. Inventory levels are returning to normal levels and the first indications of the market starting to tighten are appearing. Even assuming a number of advanced projects as developed over the next five years, there is a supply gap which could expand further if the projects to not deliver on announced start-up and production capacity.

In lithium, strong market demand led by the primary and secondary battery market has resulted in a supply deficit. The glass/ceramics market has also shown strong growth both with current products and new applications. Expansion of brine production over the coming years will see the supply gap reduce in the chemicals market but limited supply growth is available in low iron spodumene for the glass/ceramics markets.

Talison is the world's largest supplier of tantalum concentrate and lithium minerals. The company has long life resources, established operations and is located in a politically stable environment. For our customers this means long term supply, consistency of quality and surety of delivery on contracts.

Exiting Administration provides Talison with the opportunities to grow and develop the business not previously available during the three years of Administration. Given the future outlook for both the lithium and tantalum industries, Talison is now well positioned to further leverage its role as one of the leading players in these markets.