LITHIUM MINERALS

By Special Contributors

Approximately 25% of the consumption of lithium worldwide in now in the form of lithium minerals. During the past 20 years, the use of lithium minerals has replaced the use of lithium carbonate in a small number of applications but several uses for lithium minerals have been subsequently developed for which there was little or no previous use of lithium carbonate. Lithium oxide (lithia), as it occurs in lithium minerals, is a powerful flux. Lithia can also be supplied as a flux by using lithium carbonate. However, technical and economic considerations have led to the use of lithium minerals in the majority of fluxing applications.

Consumption

In 2002, the production and consumption of lithium minerals, mainly spodumene and petalite, grew by 1.8%. The worldwide estimated consumption for 2002 was 195,000 t, or 25,000 t of lithium carbonate equivalent (LCE).

The main uses of lithium minerals are as raw materials to the glass, ceramic and metallurgical industries. Thus demand for lithium minerals is closely linked to the performance of these industries. However, demand in Europe and North America was flat, reflecting depressed economies and the outlook is for only modest growth. Demand from many Asian countries continued to recover in 2002 from the depressed demand caused by the economic crises of the late 1990s. Demand in Japan was hampered by the flat economic conditions, as well as the tendency to move production facilities offshore.

Main suppliers

Over the past decade, the three major producers of lithium minerals, Sons of Gwalia Ltd in Australia, Tanco in Canada and Bikita Minerals in Zimbabwe (Table 1) have met more than 85% of worldwide demand. Sons of Gwalia owns the largest operating high-grade deposit of lithium ore (spodumene) at Greenbushes in Western Australia where the installed production capacity is nearly capable of meeting the present total demand for, sales of, lithium minerals. Bikita operates the largest known high-grade deposit of petalite.

Potential suppliers

There are several other known deposits of lithium minerals, in China, the CIS, Brazil and Canada but these are often of low-grade and are either currently uneconomic or are awaiting development funding. With existing installed capacity exceeding demand, the entry of new producers of high-grade lithium mineral concentrates is not likely to be an economic proposition in the short term.

Potential new mineral producers in the news during 2002 included Avalon Ventures in Canada which has changed its project strategy to developing a low-lithium feldspar product. Avalaon has entered into a sales and marketing agreement with Amalgamet Canada for a minimum offtake quantity of 10,000 t. Amalgamet will begin market development in 2003. To date, neither this project nor the Emerald Fields project, also in Canada, has progressed to full-scale production.

Elsewhere, a preliminary assessment of a newly-discovered petalite deposit in Finland has been initiated by the local community government, limited quantities of low-grade spodumene are being produced from a deposit in North Korea, Metallurg in Brazil has begun to produce a lithium feldspar by-product for the domestic market, and in China there have been similar developments involving low lithia-containing feldspar as a by-product, although the high fluorine content (thought to be from lepidolite) could preclude the use of the Chinese by-product in several important applications.

Uses

The most common applications of lithium minerals include: the production of heatproof cookware (freezer to oven use); glass ceramics; glass containers; pharmaceutical glass; flaconnage; fibreglass; ceramic frits and glazes; enamels; sanitaryware; and porcelain tiles. Monochrome TV tube production, which used lithium minerals, has now practically ceased.

Lithium minerals, when combined with other traditional fluxes such as feldspars and nepheline syenite, develop a eutectic mixture that increases the fluxing powers of the traditional flux batches, thereby improving product quality and plant efficiency. Some of the benefits are:

- Lithium minerals in glass – increased melting rates result from the lowering of its viscosity (giving reduced reject rate, higher output), lower melting temperature (giving energy savings), lower seed (bubble) count, lower thermal expansion coefficient and higher chemical durability. Another increasingly important benefit is the total or partial replacement of fluorine and other refining agents thus enabling reduction of toxic emissions.

- Lithium minerals in ceramics – lower firing temperature (giving energy savings), shorter firing-cycle times (giving higher output), lower thermal expansion coefficient, lower pyroplastic deformation (less rejects) and more brilliant body and glaze colours. The latter attribute can be used to develop much higher grades of products with more intense colours. However, it can also be used to maintain a certain colour intensity while reducing the use of more costly colourants.

Lithium Carbonate

Until about 1995, the major feedstock for specialty lithium chemicals was spodumene ore converted to lithium carbonate. However, most lithium carbonate is now sourced from salars in North and South America. These salars are considered by many to be a cheaper source of producing lithium carbonate when they are of suitable grade. Brine deposits in China have long been under investigations for development. However, they have significant technical and economic problems to overcome.

As in the lithium minerals sector, the technical grade lithium carbonate sector is also serviced by only a handful of major producers:

- SQM Chemicals recovers lithium carbonate from brines in Chile. It has a capacity of 28,000 t/y of LCE and is now the world's largest producer and supplier of lithium carbonate.

- Chemetall Foote Corp.'s SCL-owned brine operations in Chile and Nevada have a total capacity of 16,000 t/y of LCE. (It was previously owned by Cyprus Foote Minerals before the latter's take-over by Chemetall.)

- FMC of the US has shut down lithium carbonate production from its brine operations in Argentina but is believed to continue to supply lithium carbonate from carbonate supplied by SQM under contract. FMC also continues to produce lithium chloride and derivatives from its brine deposit.

Other smaller producers of lithium carbonate operate in China and Brazil.

The main bulk applications of technical-grade lithium carbonate are as an additive in the aluminium smelting industry and as a feedstock for the manufacture of lithium chemicals and lithium metal.

Competition between minerals and carbonate
For high-grade optical special glasses and applications where decolouration from Fe_2O_3 are an issue, lithium carbonate is generally preferred to lithium minerals. Otherwise, lithium carbonate is rarely used in applications that normally use lithium minerals unless it is available at the special discounted prices of the late 1990s. However, even then, lithium minerals are the typical choice because they generally offer superior technical performance for these applications.

The consumption and pricing of lithium minerals was scarcely affected by the turmoil in the lithium carbonate industry, and the market for lithium minerals has continued to increase. The major producers increased the price of lithium carbonate in 2002 by 5%. Higher production costs due to fuel and energy price increases have made increases in the carbonate price more pressing. Consequently, the economic case to use lithium minerals will continue to strengthen in common applications.

The focus for growth in demand for carbonate is more likely to be as a feedstock in the manufacture of lithium chemicals, such as for use in the production of lithium ion and lithium polymer batteries. This is potentially the largest growth sector in the lithium industry.

Pricing

A price comparison of lithium minerals and lithium carbonate is shown in Table 2. The unit cost of lithia (Li_2O) from carbonate is forecast to increase further in the future. Mineral prices, by comparison, have remained relatively stable for the past five years. Marginal increases due to higher fuel, energy and freight costs may arise.

Conclusion

Overall, the market for lithium minerals is expected to remain stable and to experience moderate growth, with the commercialisation of new applications and the increased recognition of the benefits of lithium minerals by numerous producers in the glass, ceramics and metallurgical industries. It is generally recognised that the combined fluxing properties of the lithium minerals are superior to that of lithium carbonate in mineral batches. The added alumina and silica present in the mineral composition enhance batch cost savings, melting properties and production efficiency.

Table 1: Sales and Production Figures for 2002 – All types of Lithium Minerals

	Production Capacity (t)	**Production LCE**(t)**	**Sales (t)**	**Li_2O Content in Ore**
Sons of Gwalia, Australia	150,000	22,500	93,000	4.0%
Tanco, Canada	21,000	3,150	12,000	2.6%
Bikita, Zimbabwe*	60,000	11,000	34,000	2.1%
Brazil (estimated)	6,000	900	6,000	n.a.
Others	65,000	1,250	50,000	n.a.
Total	302,000	38,800	195,000	

* includes spodumene, petalite, etc.
** LCE: Lithium Carbonate Equivalent.

Table 2: Market Prices in 2002

Material	**% Li_2O**	**Approx. Price**	**Price/kg Li_2O**
Lithium Carbonate	40.4	US$1,800 - 2,600 / Mt bag or drum	US$4.50 – 6.53
Spodumene Concentrates	6.9 – 7.5	US$365 – 395 / Mt ex seller's warehouse	US$4.84 - 5.27
Glass Grade Spodumene	4.8 – 5.0	US$215 - 230 / Mt ex seller's warehouse	US$4.48 – 4.60
Petalite	4.3	US$180 – 270 / Mt fob Durban*	US$4.18 – 6.28

*Depends on packaging and particle size.