

Lithium & Battery Technology Keynote Address

TRENDS AND DEVELOPMENTS IN LITHIUM PROCESSING

By

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ABSTRACT

The sales of EVs (Electric Vehicles) have continued to grow over the last years even while there was a short term oversupply of both spodumene and lithium battery chemicals. The result of the oversupply was that prices of both spodumene concentrate and lithium chemicals fell but now that prices have risen sharply the momentum to build lithium conversion plants is intensifying.

Spodumene is used to produce roughly 55% of the world's lithium and is largely supplied from Western Australia. The focus of this keynote is to discuss the trends and development in lithium processing of spodumene as this is more relevant to this conference.

The four trends that appear to be common to the more advanced projects are:

- Trend 1. The project proponent's ability to address ESG (Environmental, Social & Governance) issues are becoming significant in order to get finance and governmental approvals. This has seen the rise of phrases such as zero carbon lithium, carbon footprint reduction and the battery value chain traceability. The ability to sell, reuse, or modify by-products and wastes is becoming more of a challenge than the processing of the spodumene and is influencing plant flowsheets.
- Trend 2. With the desire to produce batteries and battery precursors in Europe, consideration is being given to the possibility of producing lithium intermediates such as lithium sulphate. The drivers include minimizing the transport volume and cost as well as the need to dispose of aluminosilicate waste.
- Trend 3. The newer mines and proposed new mines in general have a lower grade spodumene than Talison which has dominated the global supply of spodumene. Also, the grain size of these spodumenes is typically smaller and requires finer grinding to liberate the spodumene. The combination of finer spodumene concentrate and the presence of different gangue minerals will pose significant challenges to process.
- Trend 4. The growth of the battery market is driving the demand not only for more lithium chemicals but also for tighter product specifications to produce better batteries. Predictions are that the specifications will continue to tighten and impurities in battery grade material will continue to fall.

With the rapid growth of the lithium industry there has been a similar rise in the research and development of new technologies and flowsheets. Currently all the spodumene conversion uses variations of the original sulphation technology patented in 1950. The most advanced alternative is the sodium carbonate pressure leach.



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Trends and Developments in Lithium Processing

Presenter

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Have we made any significant changes over the
past few decades, or have we simply enhanced
old technologies?

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Greenbushes circa 1919

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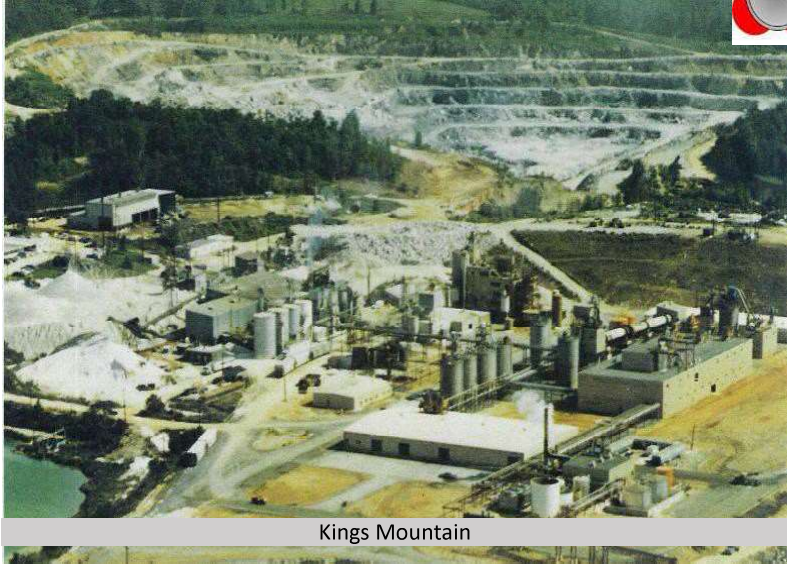
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Greenbushes Mine Currently

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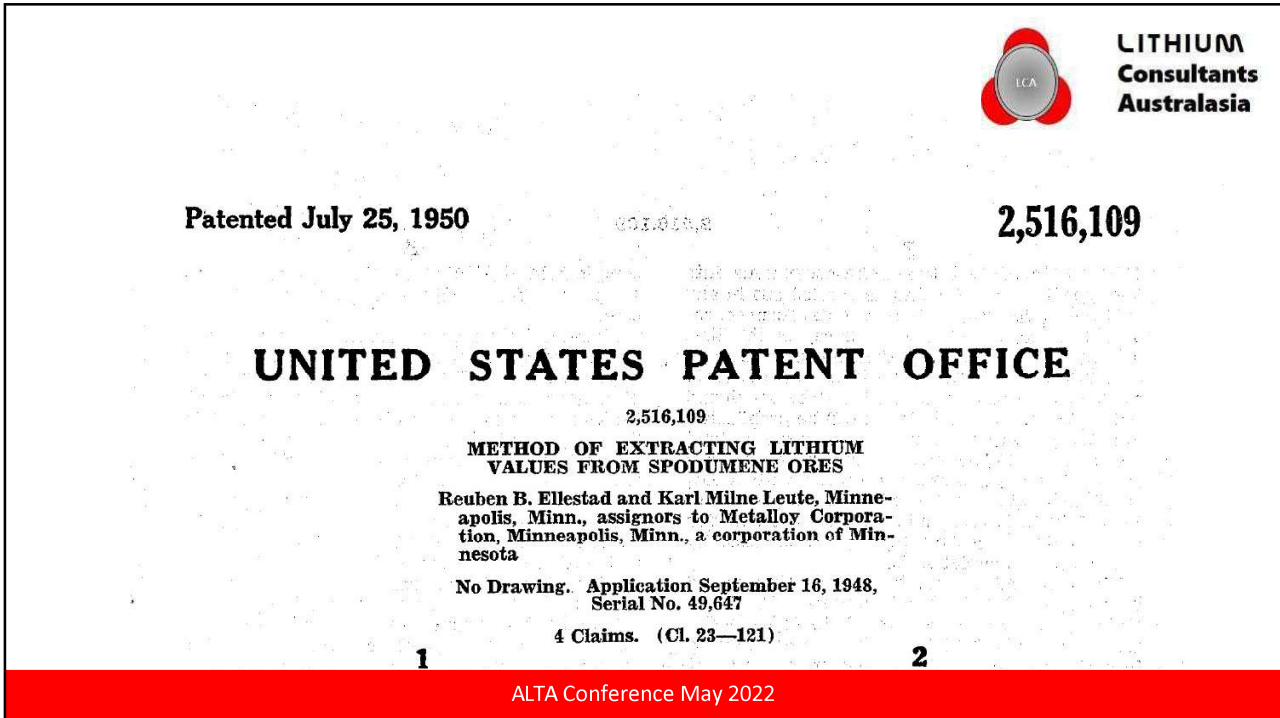
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Kings Mountain

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**LITHIUM
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Patented July 25, 1950

2,516,109

UNITED STATES PATENT OFFICE

2,516,109

**METHOD OF EXTRACTING LITHIUM
VALUES FROM SPODUMENE ORES**

Reuben B. Ellestad and Karl Milne Leute, Minne-
apolis, Minn., assignors to Metalloy Corpora-
tion, Minneapolis, Minn., a corporation of Min-
nesota

No Drawing. Application September 16, 1948,
Serial No. 49,647

4 Claims. (Cl. 23—121)

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Key Trend 1



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- The rise of ESG
- Options to produce a lithium intermediate
- Increasingly difficult ore to treat

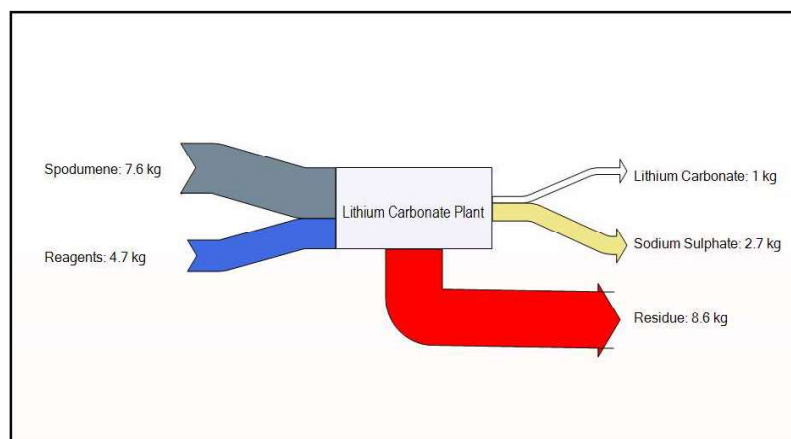
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Trend 1 – ESG Considerations



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Typical Mass Balance for a Spodumene Sulphation Plant

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Trend 2 – Lithium Intermediates



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	Lithium Content	Storage life	Market Size	Ease of Production
Lithium sulphate	10.4%	> 1 year	Small	Easy
Lithium carbonate	18.9%	> 1 year	Large	Moderate
Lithium hydroxide	16.7%	< 6 months	Growing rapidly	Difficult
Lithium phosphate	18.1%	> 1 year	Small	Easy

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Trend 3 – Falling Grades



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Freeman Resources, Plumbago North, Maine, USA

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Trend 3 – Falling Grades

Spodumene Colour	Fe ₂ O ₃ Content
White	0.02-0.1%
Pink/ Gray	0.15%
Green	0.3-0.5%



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Concerning Trends

- A reluctance to join the FBI CRC and create technologies for all because there is no intention of sharing
- Rushing to lodge provisional patents to stake intellectual claims to fence off technology to limit others
- Using the ASX, TSX and social media platforms to make announcements



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New Developments



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- Different type of crushing equipment
- Alternatives to rotary kiln calcination
- DLE (Direct Lithium Extraction)

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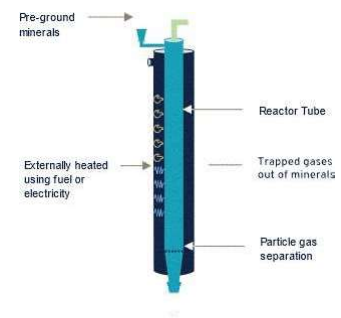
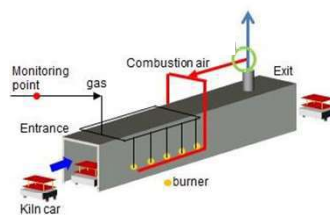
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New Developments - Calcination



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- Calix
- Tunnel Kiln



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DLE –Direct Lithium Extraction



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The three main types of DLE are:

- Absorbents
- Ion Exchange
- Solvent extraction

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DLE –Lithium Ion Sieves (LISs)



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- Lithium Aluminates
- Lithium Manganese Oxide (LMO)
- Lithium Titanium Oxide (LTO)

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Summary



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Have we made any significant changes over the past few decades, or have we simply enhanced old technologies?

- Technology has been slowly progressed
- There are great opportunities to work together to commercialise new technologies
- Our challenge is to collectively meet the growing demand for lithium to power the world

I wish all participants at the conference and online a productive conference.

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Thank You

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