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ASX RELEASE

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FLASH JOULE HEATING SHOWS POTENTIAL TO REVOLUTIONISE LITHIUM EXTRACTION FROM ORE

Potential to eliminate or significantly enhance the most energy intensive step in hardrock lithium production – calcination

Highlights:

- Initial **FJH testing reduces calcination time of spodumene concentrate by up to 92%** over conventional processes with expected energy savings to be determined in subsequent tests.
- Metallurgical lab engaged to determine if the downstream acid leach recovery of lithium can also be improved using upfront FJH treatment, potentially delivering additional overall benefits.
- Future studies also planned to investigate if FJH technology can recover Li from spodumene waste tailings, where ultrafine particles are typically discarded due to being unrecoverable by conventional processing methods.
- Commercial discussions underway with **industrial chemicals and mining companies** to collaborate on implementing FJH.
- These promising initial test results pave the way for MTM to address other refractory mineral processing challenges, including those associated with rare earths, niobium, and gold.

MTM Critical Metals Limited (MTM or the Company) advises that initial Flash Joule Heating (FJH) tests show a 92% reduction in calcination time of spodumene concentrate from a lithium mine over conventional processing in a rotary kiln.

The objective of this study is to determine whether lithium extraction from the mineral spodumene can be made more efficient, addressing the significant energy demands of current industrial processes. Due to the refractory nature of spodumene, conventional recovery processes are very energy-intensive and involve the use of rotary kilns operating at high temperatures for extended periods. Calcination, which is essential for rendering spodumene amenable to acid leaching, is the most energy and CO_2-intensive step in producing battery-grade lithium, accounting for over 50% of the energy consumption and carbon emissions released (*Fig. 1 & 3*).

MTM Chairman, Mr John Hannaford said: *"FJH has the potential to revolutionise lithium refining by significantly enhancing or even eliminating the calcination step, which is crucial for making the mineral spodumene amenable to leaching. FJH treatment of spodumene concentrate rendered the material unrefractory in a fraction of the time required by conventional kiln calcination. While these results are preliminary and unoptimized, they present an exciting path forward for FJH to revolutionise how lithium is extracted in the future.*

"Refractory mineral processing presents a formidable challenge and financial burden for the current mining industry and these promising initial tests open the door for MTM to target other critical metals, such as rare earths & niobium. The opportunity to develop an energy efficient carbon reduced process open the door to the

onshoring of lithium processing in key markets globally and ex-China. The Company has already begun commercial discussions with several leading industrial firms in this sector, and further updates will follow in due course".

Spodumene Processing

Spodumene, the world's largest source of lithium, is highly refractory in its natural α-monoclinic form, resisting acid leaching. The conventional method to make it leachable involves calcination at over 1000°C for up to three hours in a rotary kiln, converting it to the more acid-soluble β-tetragonal form (Salakjani et al., 2016). This industry-standard process, developed over 70 years ago, consumes large amounts of fossil fuels and results in significant CO_2 emissions, as current kiln technology relies on natural gas or diesel and is thermally inefficient.

Preliminary results indicate that FJH can transform α-spodumene to β-spodumene after only a short pulse (minutes timeframe) of 'flashing' mimicking what takes 2-3 hours at high temperatures in a conventional calcination kiln (Salakjani et al. 2016). The 'flashed' material may also demonstrate enhanced downstream leaching properties compared to the conventional "calcination-sulfation-roasting" (CSR) method. Ongoing tests are being prepared to explore this further.

FJH technology offers a disruptive means of improving the process by which lithium is currently refined and the initial unoptimized tests are very encouraging. Applying energy directly to the material with FJH is conceptually more thermodynamically efficient than conventional kiln calcination, which requires heating not only the spodumene concentrate but also the kiln internals and surrounding air. The prolonged heating process of rotary kilns further increases heat dissipation and thermal losses (Boateng 2015, pp. 243-244).

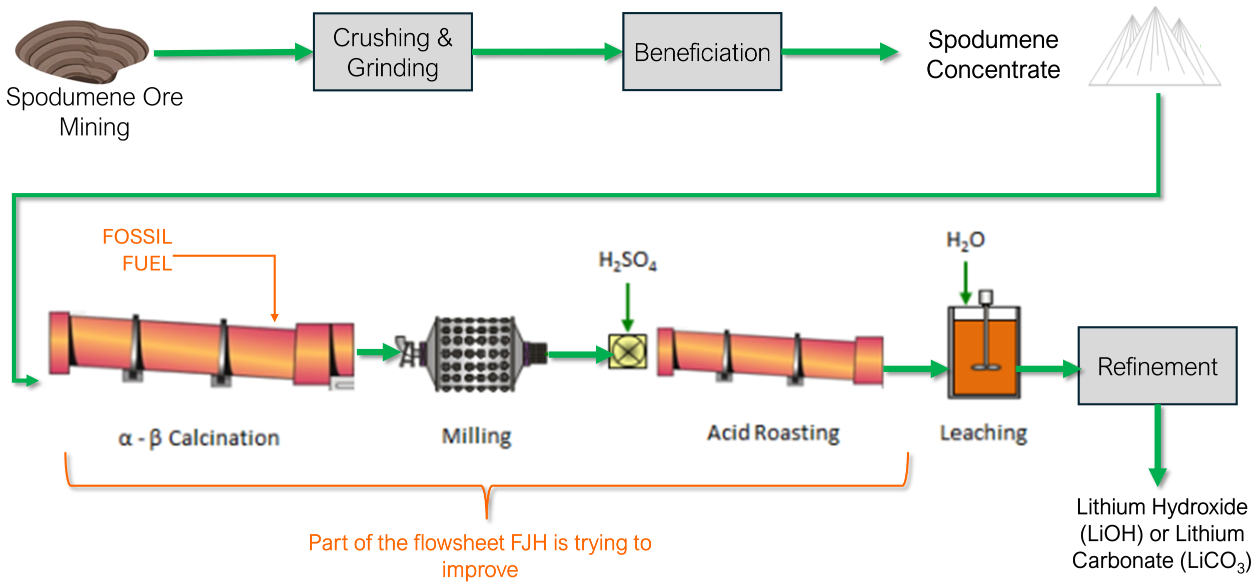

Figure 1: Simplified flowsheet for Lithium production from hardrock spodumene ore source. FJH target area shown.

Test work method and results

Samples of spodumene concentrate (~6% w/w Li_2O content) were tested utilising the Company's FJH prototype unit in Houston, Texas. Test samples were 'flashed' and assessed pre and post-flashing using semi-quantitative XRD to determine the extent of conversion of refractory α-spodumene to β. Flashing was undertaken for a variable time frame to achieve a set energy density which at this stage is unoptimized.

Results from these tests are shown in Table 1 below.

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Table 1: Test results showing the positive effect on spodumene mineral conversion using FJH technology.

Sample ID	"Conventional" Kiln Process used in industry[1]	FJH Test J1-H2001	FJH Test J2-H1001	FJH Test J3-H1001
α-β spodumene conversion (%)	90%	**74%**	41%	58%
Reaction time (minutes)	120-180	**14**	12	54
Time saving vs Industry Standard (%)	N/A	**88-92%**	90-93%	55-70%

Notes to Table 1:

- Results are **preliminary only**. There remains significant scope for further optimisation and refinement.
- The concentrate contains approximately 6% Li_2O by mass, typical of spodumene mines.
- The measurement of alpha (α) and beta (β) spodumene in the concentrate and flash residue is based on semi-quantitative XRD analysis.

Further Metallurgical Test Work

MTM, in conjunction with KnightHawk Engineering, Texas, will continue to test spodumene samples, using the data to help refine and improve the technology. MTM has also engaged with a commercial metallurgical laboratory to assess and quantify the effects of the FJH treatment on the downstream leaching of the concentrate, with objective of showing that FJH offers a benefit over the conventional calcination and acid baking process used for lithium extraction.

Further studies – can lithium be recovered from spodumene waste tailings?

Future studies will explore the potential of FJH technology to extract lithium from spodumene waste tailings. In a traditional spodumene concentrator plant, fine ore particles (sub ~20 microns) are typically discarded to tailings because conventional processing methods cannot recover them, and they are also problematic in terms of material handling within the downstream calcination and roasting kilns.

This waste stream can comprise up to 20% of the ore by mass, signifying a substantial loss of valuable metal. If the lithium in this material could be recovered by using FJH technology, this could have significant commercial implications for operating spodumene mines, where vast quantities of tailings have accumulated since production began.

Strategic Collaborations & Partnerships

MTM is in discussion with top-tier industrial firms in both the US and Australia. Additionally, the Company is exploring complementary technologies with Rice University and engaging with leading research institutions in the US and Australia to accelerate our development efforts.

[1] Salakjani et al. 2016 and Liontown Resources Ltd 2020.

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Flash Joule Heating

FJH is an advanced processing and recycling technology being developed to extract critical metals including REE, titanium, nickel, cobalt and lithium from waste material including lithium-ion batteries, e-waste, coal fly ash produced by coal-fired power stations or bauxite residue derived from alumina refining.

The FJH technology is an electro-thermal process that involves the rapid and intense heating of material to both directly recover critical metals and make materials more amenable to metal recovery through conventional acid leaching methods.

MTM has recently executed a global licence agreement over the FJH technology patents with Rice University (see MTM ASX announcement dated 31 May 2024).

This announcement has been authorised for release by the Board of Directors.

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About MTM Critical Metals Limited

MTM Critical Metals Limited is an exploration company which is focused on searching for niobium (Nb) and rare earth elements (REE) in Western Australia and Québec. Additionally, the Company has acquired the licencing rights to an early-stage processing technology for REE and precious metals known as Flash Joule Heating, which has been developed by researchers at Rice University, USA. MTM's West Arunta Nb-REE licences lie within one of Australia's critical metal exploration hotspots where over $60m in exploration expenditure has been collectively invested in the district by a number of ASX companies including WA1 Resources Limited (ASX:WA1), Encounter Resources Limited (ASX:ENR), Rio Tinto Limited (JV with Tali Resources Pty Ltd) (ASX:RIO), CGN Resources Limited (ASX:CGR), and IGO Limited (ASX:IGO). The Company also holds tenements in other prolific and highly prospective mineral regions in Western Australia. The Mukinbudin Nb-REE Project comprises two exploration licences located 250km northeast of Perth in the South West Mineral Field of Western Australia. The East Laverton Projects is made up of a regionally extensive package of underexplored tenements prospective for REE, gold and base metals. The Mt Monger Gold Project comprises an area containing known gold deposits and occurrences in the Mt Monger area, located ~70km SE of Kalgoorlie and immediately adjacent to the Randalls gold mill operated by Silver Lake Resources Limited. In Québec, the Pomme Project is a known carbonatite intrusion that is enriched in REE and niobium and is considered to be an extremely prospective exploration target adjacent to a world class REE resource (Montviel deposit). The Company has an experienced Board and management team which is focused on discovery to increase value for shareholders.

About KnightHawk Engineering

KnightHawk was founded in 1991 and specializes in identifying high technology solutions in a short timeframe. They have executed projects throughout the United States, Europe, and Asia. Their clients range from individual entrepreneurs to the large industrial organisations such as Shell, Exxon Mobil, Chevron and NASA. They have a depth of experience and expertise and are leaders in design, failure analysis and troubleshooting across a range of engineering disciplines. KnightHawk was selected for its expertise across a wide range of disciplines and their focus on ensuring outcomes in a timely manner.

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Previous Disclosure

The information in this announcement is based on the following MTM Critical Metals Limited ASX announcements, which are all available from the MTM Critical Metals Limited website www.mtmcriticalmetals.com.au and the ASX website www.asx.com.au.

Date	Description
3 April 2024	Flash Joule Heating Prototype Complete, Testing Commenced
6 May 2024	Flash Joule Heating Prototype Test Increases REE Recovery
31 May 2024	Global Licence Agreement Secured for Flash Joule Heating Technology with Rice University
24 June 2024	Positive Advances with Metal Recovery Test Work

The Company confirms that it is not aware of any new information or data that materially affects the information included in the original ASX announcements and that all material assumptions and technical parameters underpinning the relevant ASX announcements continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are represented have not been materially modified from the original ASX announcements.

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MTM CRITICAL METALS

Appendix 1 Conversion of alpha-spodumene to beta-spodumene through a calcination process

The conventional processing of spodumene ore is highly energy intensive as it relies on calcination or 'decrepitation' to convert the monoclinic structure of the natural α-spodumene molecule to its tetragonal equivalent (β-spodumene) which is less dense. The resulting 'open' structure renders the mineral amenable to leaching. Naturally occurring α-spodumene is highly resistant to chemical leaching and until the calcination process was developed in the 1950s, no other means of lithium extraction from spodumene was economically feasible (Nazir et al. 2023).

Spodumene - Mineral and Properties

Spodumene, a lithium alumina silicate mineral, exists in two main crystal forms: alpha (α) and beta (β). Alpha-spodumene is the low-temperature monoclinic phase stable below approximately 1100 – 1200°C, while beta-spodumene is the high-temperature tetragonal phase stable above this temperature threshold. The transformation from alpha to beta spodumene is driven by calcination, a controlled heating process that induces crystallographic changes in the mineral structure.

Calcination Process

Calcination involves heating crushed spodumene concentrate to temperatures typically ranging from 1100 – 1200°C in a controlled atmosphere. The process is conducted in kilns or rotary furnaces where precise temperature control and atmosphere conditions are maintained. The primary goal of calcination is to convert alpha-spodumene into the more desirable beta-spodumene phase which is amenable to chemical leaching.

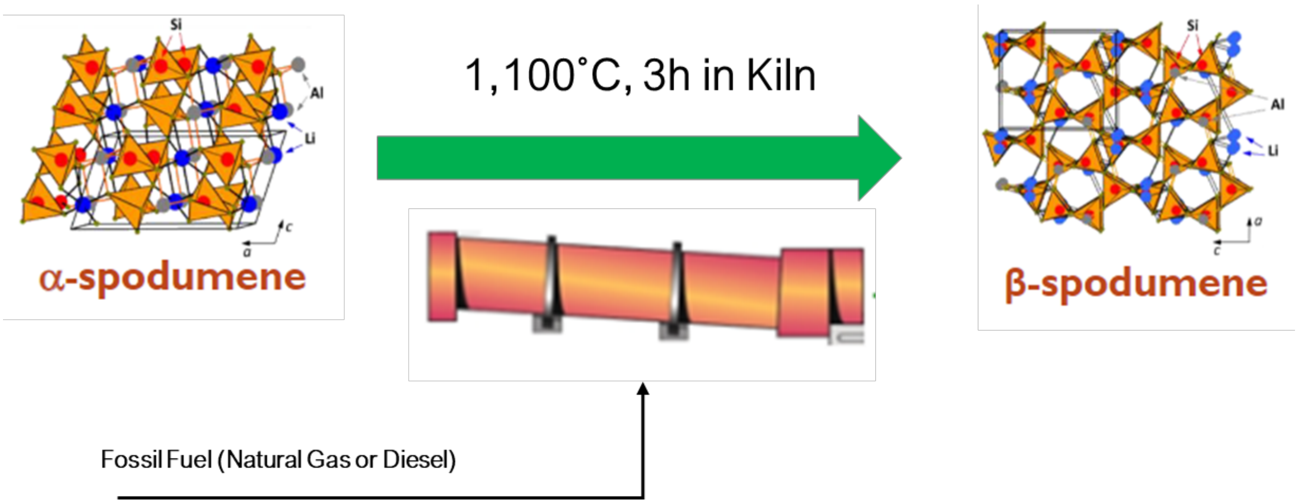

Figure 2: Simplified schematic of spodumene calcination transforming it from α to β polymorph

Conclusion

The calcination of spodumene from alpha to beta form is a fundamental process in lithium production for the current lithium-ion battery industry. This transformation alters the mineral's crystal structure, enhancing its chemical reactivity and suitability for subsequent lithium extraction processes. An improvement of the current process could potentially make lithium extraction from spodumene more efficient and environmentally friendly, addressing the significant energy and sustainability demands of current industrial processes.

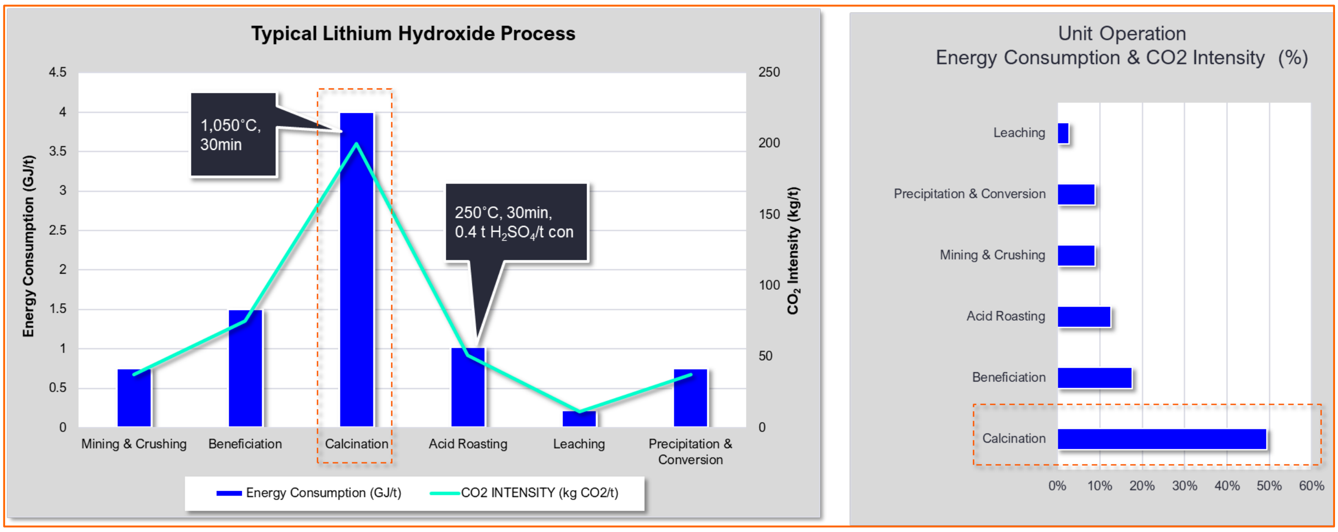

Figure 3: **Estimated energy consumption & CO_2 intensity for each major unit operation of the conventional lithium hydroxide manufacturing process. As shown, Calcination is the largest energy consumer and CO_2 emitter (Habashi 1997, Fosu et. al 2020).**

Figure 4: **Typical natural-gas fired calcination kiln used in the lithium refinery process. Source: Sichuan Calciner Technology Pty Ltd**