

## ASX RELEASE

21 August 2024

# BREAKTHROUGH DEVELOPMENT: FLASH JOULE HEATING CONVERTS SPODUMENE DIRECTLY TO LITHIUM CHLORIDE IN ONE STEP

**MTM Critical Metals Limited (ASX:MTM) (MTM or the Company) is pleased to announce a significant breakthrough in the development of our Flash Joule Heating (FJH) technology. The Company has successfully converted SC6 spodumene concentrate directly to lithium chloride (LiCl) in a single, acid-free unit operation.**

This innovation has the potential to revolutionise lithium refining by radically simplifying the processing of spodumene, the primary source of lithium for batteries. The process promises substantial reductions in CAPEX, OPEX, and emissions, marking a significant leap forward for the industry.

### HIGHLIGHTS:

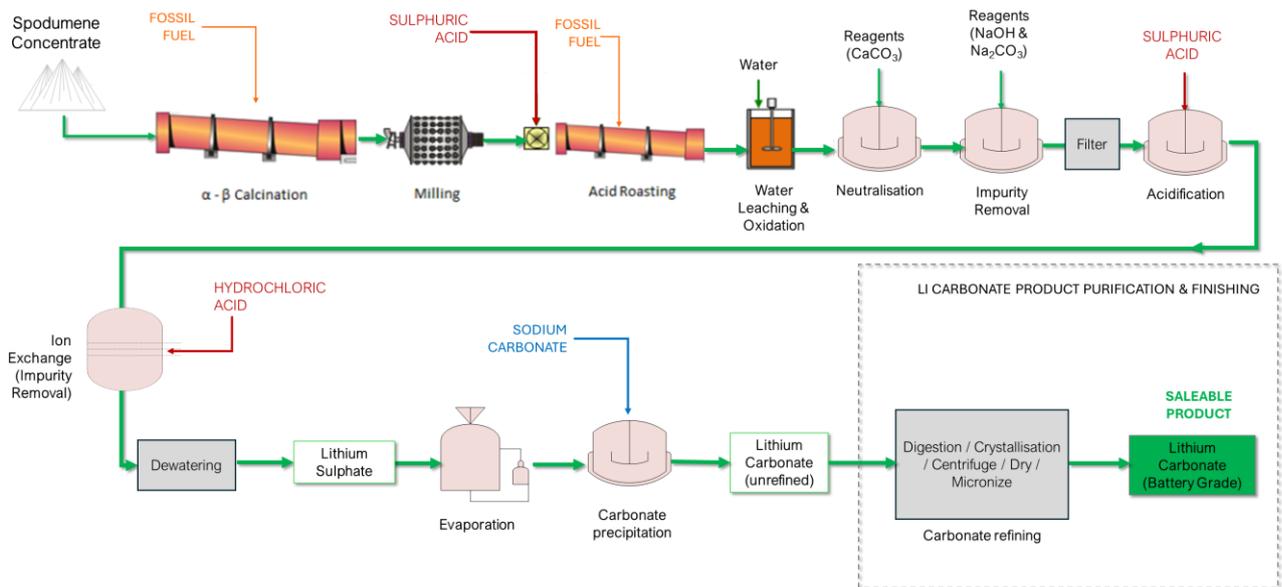
- **Single Unit Operation to Saleable Product:** Successful conversion of spodumene concentrate directly to lithium chloride in one step, **eliminating a large number of stages of conventional processing** (see *Fig. 1*).
- **No Acid (Or Strong Base) Required:** The process is entirely acid-free, reducing chemical use and associated environmental impacts.
- **Efficiency Gains:** Preliminary results indicate significant potential savings in energy, operating expenditure (OPEX), capital expenditure (CAPEX), and CO<sub>2</sub> emissions compared to traditional methods.
- **Environmental Impact:** The elimination of acid and the reduction of emissions & water consumption underscore the process's superior environmental footprint.
- **Game-Changing Potential for the Li Industry:** Validates the disruptive potential of FJH technology for refractory mineral processing, positioning MTM at the forefront of innovation in the industry.
- **Strategic Discussions:** MTM is currently in discussions with major chemical and mining companies regarding potential collaborations to test this technology.
- **Market Opportunity:** The global lithium-ion battery market is projected to reach over US\$150 billion by 2030<sup>1</sup> which represents a major commercial opportunity for MTM.
- **Accelerated and Localised Production:** The single-step process significantly reduces production time, enabling rapid conversion from raw spodumene concentrate to market-ready lithium chloride (LiCl). This approach offers substantial profit potential, particularly in a challenging market for other lithium products.

**Why This Breakthrough Matters:** MTM's FJH technology has demonstrated the ability to replace traditional, multi-step lithium extraction processes, which typically involve high-temperature calcination, acid roasting, and multiple stages of purification. **The FJH process simplifies this to a single step, directly converting spodumene to lithium chloride (LiCl) without the use of acids. LiCl is a valuable product on its own and can be easily converted into 'battery grade' Li carbonate or hydroxide, the essential components for battery manufacturing.**

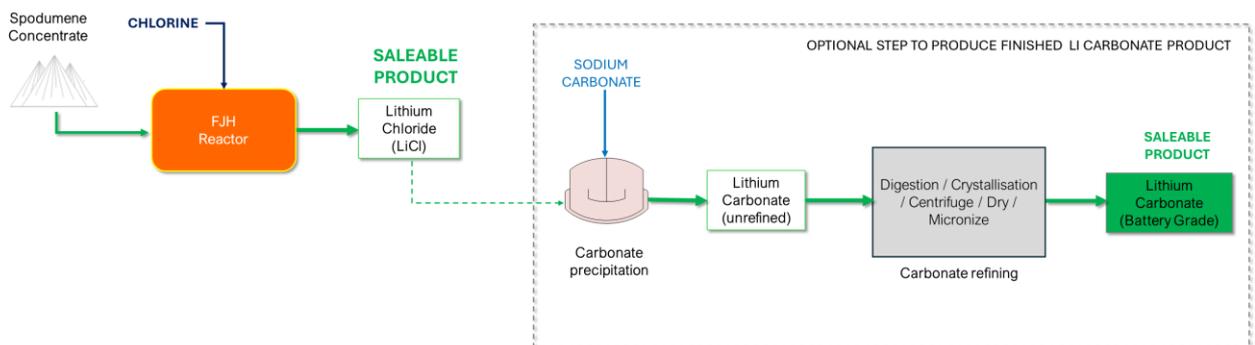
<sup>1</sup> InsightAce Analytic Pvt. Ltd 2023, <https://www.insightaceanalytic.com/report/lithium-ion-battery-market/1655>.

**MTM CEO, Michael Walshe added** *“This breakthrough validates the disruptive potential of our Flash Joule Heating technology. The ability to convert spodumene, a highly refractory mineral, directly to lithium chloride in a single step, without the use of acids, is a game-changer for the industry. By eliminating two major fossil-fuel-dependent kiln processes and removing the need for significant acids and chemical reagents, we are fundamentally disrupting the status quo in lithium production. The preliminary results are highly encouraging and point to significant cost, capital equipment, energy, and environmental benefits. We are excited about the commercial opportunities this presents and are actively engaging with major industry players to explore collaboration opportunities”.*

**A. CONVENTIONAL FLOWSHEET FOR LITHIUM CARBONATE MANUFACTURE**



**B. FJH CONCEPTUAL FLOWSHEET FOR LITHIUM CHLORIDE OR CARBONATE MANUFACTURE**



**Figure 1:** **A. Simplified flowsheet for conventional  $\text{Li}_2\text{CO}_3$  production from hardrock spodumene ore source.**  
**B. FJH single step process to produce saleable Lithium Chloride with optional further steps to  $\text{Li}_2\text{CO}_3$**

**Commercial Potential:**

The lithium market is poised for continued growth, driven by the electric vehicle (EV) revolution, energy storage and the global energy transition. With the global market for lithium-ion battery compounds projected to exceed US\$150 billion by 2030, MTM’s innovative technology opens up significant revenue potential. By streamlining the extraction process while cutting costs and emissions, the Company is strategically positioned to explore multiple commercial opportunities, including technology licensing, revenue-sharing agreements, and joint ventures with industry leaders.

**This advancement offers the following potential advantages:**

- **Steps Removed:** Conventional processing involves at least five major steps (calcination, acid roasting, leaching, purification, and sulphation). The FJH route reduces this to just one step to obtain a saleable product.
- **Energy Savings:** Preliminary estimates suggest a potential reduction in energy consumption of up to 75% compared to traditional methods and will be validated in future testing.
- **OPEX Reduction:** Operational costs are expected to be significantly reduced versus conventional methods by eliminating multiple stages and the need for expensive reagents like sulfuric acid.
- **CAPEX Savings:** Simplifying the process reduces the need for complex and costly infrastructure, with potential substantial CAPEX savings.
- **CO<sub>2</sub> Emissions & Water Consumption:** The process's lower energy requirements and absence of acid significantly reduce CO<sub>2</sub> emissions, whilst also requiring significantly less water and generating less water-based tailings.
- **Environmental Footprint:** With no acid used and lower emissions, the environmental footprint is markedly reduced, aligning with global sustainability goals.

**Next Steps:**

The Company will continue its test work to demonstrate the scalability and effectiveness of the FJH & chlorination-enhanced FJH technology with a focus on maximising lithium recovery and minimising energy consumption. Discussions with industry partners, academia and government agencies are ongoing to support the development and commercial deployment of this revolutionary technology.

Additionally, test work is completed, underway or planned on a range of additional sample streams including: **refractory minerals** such as spodumene (lithium), monazite (rare earths), & pyrochlore (niobium); **precious metal recovery** from e-waste; **gallium** from semiconductor scrap, and **alumina recycling** from 'red mud'.

**What is Flash Joule Heating (FJH) In a Chlorinated or Carbo-chlorinated Atmosphere?**

MTM holds a global license for Flash Joule Heating technology, enabling the treatment of metals and ores, including operations within chlorinated or carbon-chlorinated environments<sup>2</sup>.

Flash Joule heating in a chlorinated or carbo-chlorinated atmosphere is an advanced metal processing technique that involves rapidly heating a material using an electric current in the presence of chlorine gas (chlorinated atmosphere) or a carbon-chlorine mixture (carbo-chlorinated atmosphere) (*see Figure 2*).

Flash Joule Heating (FJH):

- **Rapid Heating:** FJH involves passing a high-intensity electric current through a material, causing it to heat up very quickly—often within milliseconds. This rapid heating can reach temperatures of several thousand degrees Celsius.
- **Controlled Environment:** The process occurs in a controlled atmosphere, such as a vacuum or a specific gas environment, to influence the reactions that occur during heating.

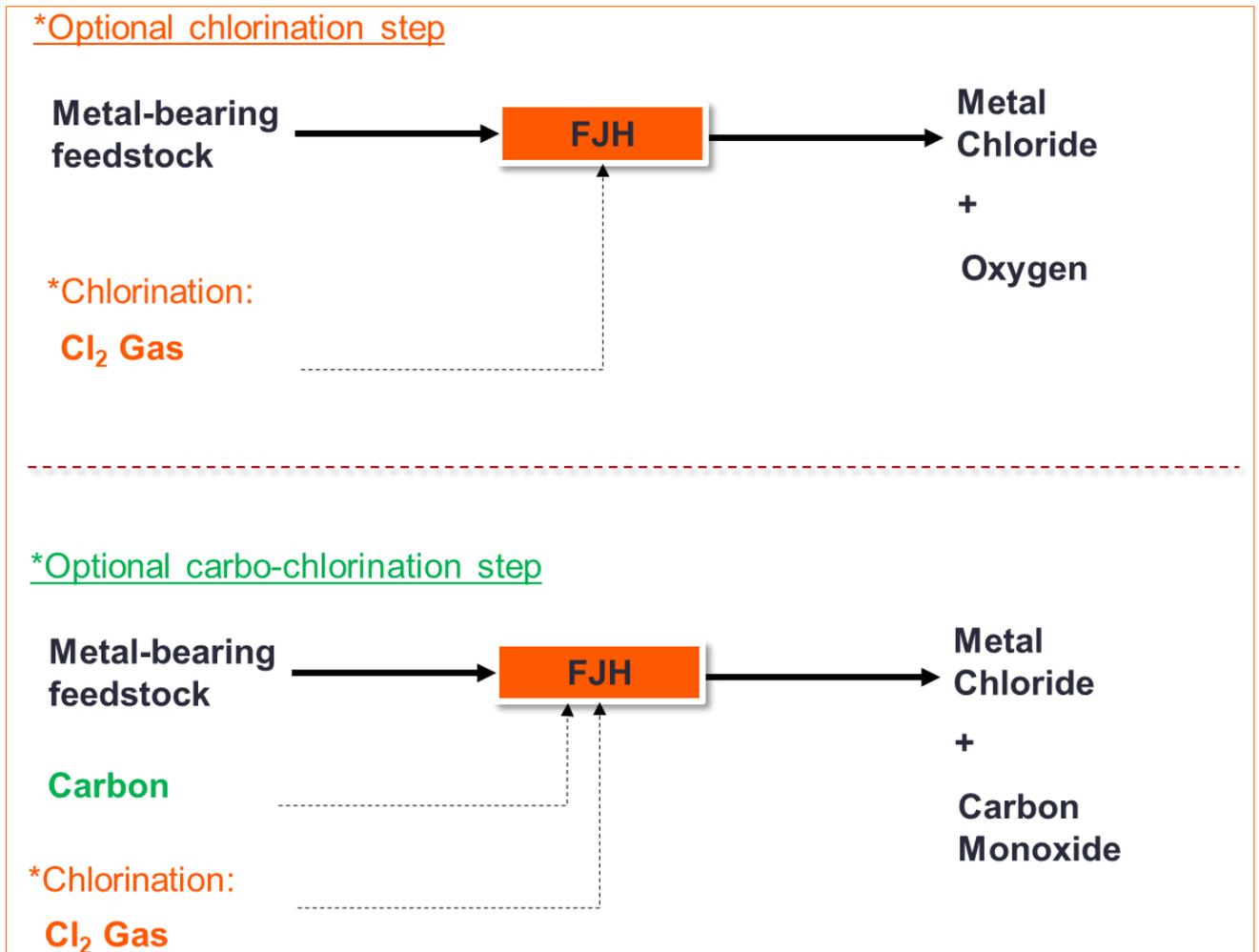
<sup>2</sup> Reference: ASX:MTM Announcement dated 13/08/2024 'Addition of Chlorination enhancement to FJH Licence'.

FJH In a Chlorinated or Carbo-Chlorinated Atmosphere:

- **Chlorinated Atmosphere:** In a chlorinated atmosphere, chlorine gas ( $\text{Cl}_2$ ) is present. When the material is rapidly heated, the chlorine reacts with the material, often leading to the formation of metal chlorides. This can be useful in processes such as refining or extracting metals.
- **Carbo-Chlorinated Atmosphere:** In a carbo-chlorinated atmosphere, both carbon (C) and chlorine ( $\text{Cl}_2$ ) are present. The carbon can react with oxygen to form carbon monoxide (CO), while chlorine reacts with metals to form metal chlorides. This environment is often used to enhance the removal of metals that won't readily extract using conventional methods, from ores or to refine materials by converting them into metal chlorides, which can then be separated from their host feedstock.

Applications:

- **Material Extraction and Refining:** FJH in a chlorinated or carbo-chlorinated atmosphere can be used to extract or refine metals from ores, such as lithium from spodumene ore. The rapid heating and reactive environment help in breaking down refractory materials and selectively removing valuable components. Refractory minerals such as spodumene (lithium), monazite (rare earths), and pyrochlore (niobium) are either currently being tested or are planned for future testing by the Company.
- **Environmental & Economic Benefits:** This process can potentially reduce energy consumption, reagent usage and waste compared to traditional methods, making it potentially more economical and environmentally friendly.



**Figure 2:** Schematic summary of the chlorination & carbo-chlorination FJH processes

**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.

### **Cautionary Statement Regarding Values & Forward-Looking Information**

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