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Lithium Australia converts waste into high-performance lithium-ion battery cathodes

HIGHLIGHTS

- High-performance battery cells produced using lithium recovered from mine waste and spent lithium-ion batteries ('LIBs').
- Low-cost lithium used for battery cell production recovered as lithium phosphate ('LP') via proprietary Company technology.
- Testing of cells achieved results in excess of the capacity specifications of commercial battery-cell manufacturers.
- There is potential for Australia to become more competitive in terms of battery production.

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Background

Lithium Australia NL (ASX: LIT, 'the Company') announced on [3 August 2020](#) that its wholly owned subsidiary VSPC Ltd ('VSPC') was evaluating low-cost raw-material options for the manufacture of lithium ferro phosphate ('LFP') cathode material using VSPC's proprietary reduced-cost (i.e. VSPC-RC) process (Figure 1). The LFP material produced was used to create battery cells for subsequent electrochemical testing. That testing revealed that the cells achieved capacities of up to 161 milliampere hours per gram ('mAh/g') at a 0.1C discharge rate¹, which is equivalent to or exceeds that of the best LFP cathode materials currently on the market.

VSPC has achieved similar results with cathode material for test cells created from LP recovered during the application of Company processing technology to mixed metal dust ('MMD'); the MMD was derived from the recycling of spent LIBs by Company subsidiary Envirostream Australia Pty Ltd ('Envirostream').



Figure 1. LFP cathode material sourced from LieNA® LP.

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VSPC test results

Test results for all the cell samples VSPC produced using low-cost materials were excellent, exceeding the capacity specifications of commercial cell manufacturers, which is generally 158 mAh/g.

- The LFP produced by VSPC from LP recovered from MMD (spent LIBs) achieved a capacity of 159 mAh/g¹.
- The LFP produced by VSPC from LP recovered through application of the Company's proprietary LieNA[®] process to fine or low-grade spodumene discarded during the production of commercial lithium concentrates achieved a capacity of 161 mAh/g¹.
- The LFP produced by VSPC from LP recovered through application of the Company's proprietary SiLeach[®] process to lepidolite (mine waste) also achieved a capacity of 161 mAh/g¹.

All the LFP produced by VSPC from these low-cost feed options demonstrated physical properties that facilitated efficient cathode production, as well as good retention of capacity at higher discharge rates.

¹ Specific energy capacity for cathode material is determined in coin cells at a 0.1C discharge rate (i.e. the discharge current will discharge the entire battery in 10 hours). Typically, manufacturers using advanced LFP cathode materials to create battery cells seek a capacity exceeding 158 mAh/g, good retention of capacity at higher discharge rates and physical properties amenable to the electrode manufacturing process.

Choice of raw materials

VSPC's uniformly excellent results confirm the flexibility of its process for creating high-quality cathode material from LP recovered from mineral waste and recycled LIBs. The ability to extract and refine lithium from such low-cost sources for use in battery manufacture could lead to significant savings and greater sustainability for the relevant manufacturing and mining industries.

In addition to evaluating low-cost lithium and phosphorous sources in the creation of cathode materials, VSPC is investigating alternatives for iron reagents.

The benefits of embracing 'waste'

Worldwide, the popularity of portable electronic devices continues unabated. Also, many countries are now embracing electric vehicles ('EVs') powered by battery packs as an alternative to internal combustion engines powered by fossil fuels. And that means e-waste is accumulating. Indeed, it's estimated that the volume of spent LIBs worldwide will grow to around 7 million tonnes per annum within the next 20 years. To avoid the mountains of toxic waste this could create, the recycling of spent LIBs is not just an option, it's an imperative.

The advantages of processing waste from mining are also obvious, in that the materials recovered often have a lower environmental footprint than those created from virgin natural resources.

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It's obvious, then, that manufacturing batteries using lithium derived from secondary resources such as mine waste and spent LIBs will enhance the environmental credentials of both EVs and the resources industry.

The market for LFP

VSPC continues to liaise with battery-cell manufacturers in China and Japan and is progressing to the next stage of product qualification, with further samples sent for evaluation in larger-scale cells.

In June 2020, Roskill published a white paper that discusses renewed Chinese interest in LFP as a cathode material in LIB power packs for EVs, as well as the probability that, in the next few years, European and North American automakers will consider using LFP for some sectors of their EV fleets. The market for LFP is forecast to increase more than fivefold by 2030, due to the growing demand for EVs, as well as for residential and commercial energy storage, where LFP batteries are preferred for their safety, long cycle life and low-cost characteristics.

In North America, Europe and China, legislation mandating fire protection systems in EVs powered by nickel cobalt manganese (i.e. NCM) and nickel cobalt aluminium (i.e. NCA) battery chemistries is pending, and it will by necessity reduce battery energy density at a pack level. The use of LFP batteries (which are not susceptible to thermal runaway and subsequent fire risk so no fire protection is required), would provide more competitive energy density at a pack level.

As a result of the safety and cost benefits, LFP is the battery chemistry of choice in the Chinese-produced Tesla Model 3, and there is a strong resurgence of LFP for use in light vehicles and passenger transport.

Comment from Lithium Australia MD Adrian Griffin

"The availability of low-cost reagents for battery production varies from jurisdiction to jurisdiction. Our work may well result in Australia, and Western Australia in particular, becoming a more competitive environment for battery production.

"The use of recycled materials can improve sustainability, reduce the industry's reliance on conflict metals and help protect fragile ecosystems from the impacts of mining. We're aiming for more ethical and environmentally acceptable outcomes for the battery industry as a whole."

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Authorised for release by the Board.

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About Lithium Australia NL

By uniting resources and innovation, Lithium Australia seeks to vertically integrate lithium extraction, processing and recycling, in order to ensure an ethical and sustainable supply of energy metals to the battery industry (enhancing energy security in the process) and create a circular battery economy. Recycling spent batteries is intrinsic to this plan. While rationalising its lithium exploration portfolio, the Company continues R&D on its processes for the conversion of *all* lithium silicates (including mine waste), as well as unused spodumene fines, to lithium chemicals. From these, Lithium Australia plans to produce advanced battery components for the battery industry as a whole.

Forward-looking statements

This announcement contains forward-looking statements. Forward-looking statements are subject to a variety of risks and uncertainties that it is beyond the Company's ability to control or predict and which could cause actual events or results to differ materially from those anticipated in such forward-looking statements.

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