ASX Announcement (ASX:**AXE**) 8 August 2019

Campoona derived spherical graphite ready for Li-ion battery optimisation

Highlights

- Spherical graphite derived from Archer's wholly-owned Campoona Graphite Resource has been successfully tested in lithium-ion (Li-ion) battery configurations.
- Testing confirmed that Campoona graphite is suitable for next-stage optimisation in lithium-ion battery manufacturing processes with potential off-take partners.
- Archer to request a 12-month extension for the submission of a Program for Environmental Protection and Rehabilitation (PEPR) for the Campoona Graphite Project to allow Archer to pursue downstream partnership and development opportunities with lithium-ion battery manufacturers and end-users.
- Spherical graphite materials are a high-value (US$3,400 to US$4,400 per tonne)[1] materials entry point for the Li-ion battery market.

Archer Exploration Limited ("Archer", the "Company") (ASX:AXE) is pleased to announce that the Company has successfully assembled and tested several lithium-ion ("Li-ion") battery configurations, incorporating spherical graphite derived from Archer's Campoona graphite project ("Campoona") in South Australia.

Commenting on the battery test results, Archer CEO Dr Mohammad Choucair said, "Our results indicate that Archer can produce a spherical graphite product which could work in lithium-ion batteries.

"There is no one industry standard battery for lithium ion batteries – different manufacturers use different chemistries. We now have the required information that potential partners with the required resources downstream need to perform the optimisation and therefore integrate Campoona graphite in their batteries".

Li-ion Battery Assembly & Testing

Spherical graphite derived from Campoona feedstock materials (40-micron flake size) was used in the testing, which were of a uniform 15-micron particle size (D_{50}) and a favourable $D_{90/10}$ ratio less than 3: morphology properties, which meet a key established market requirement for use in lithium-ion battery applications (ASX announcement 12 March 2019).

Batteries in full-cell and half-cell configurations that are functional and commercially scalable were prepared and tested at the University of New South Wales (*see Background & Market Summary* and Image 1 below). Archer's Campoona graphite materials were used at the anode, with commercially equivalent cathode materials and chemistries used that are commonly found in consumer electronics and electric vehicles. The cathode materials used to construct the full-cells were lithium-iron phosphate (LFP), and lithium-cobalt oxide (LCO), and the batteries were prepared as coin-cells *i.e.* in a small-sized compact battery construction resembling a coin.

Half-cell configurations were also prepared for simple testing *i.e.* only the performance of the anode (graphite) was measured and considered in a controlled environment (only lithium metal at the cathode). Full-cells are Electric Vehicle market-relevant configurations.

Image 1. Battery materials formulation, assembly and testing incorporating Archer Campoona graphite being performed at the University of New South Wales. Tightly controlled chemical and physical environments were used and required to handle battery componentry, with testing being conducted at small-scale levels.

The ASX Announcement on 21 August 2018 focused on performance parameters of specific capacitance and cycle stability (Values) in full-cells, and in achieving unoptimised Values in-line with industry state-of-art for Campoona natural flake graphite. The current prototyping and testing tested reproducibility and repeatability in spherical graphite Values in both half-cell and full-cell configurations, to address a prerequisite market requirement of consistency in technical specification for large-volume production and integrated spherical graphite materials in Li-ion batteries.

The spherical graphite was successfully used to perform charge-discharge cycles in full-cell configurations using LFP and LCO cathodes. The electrochemical behaviour observed in LFP

and LCO systems showed normal lithiation processes that proceed inside the respective full-cell configuration with graphitic materials. Investigations and testing of full-cells are ongoing to assess the specific capacity and cycle stability performance indicators of the spherical graphite against LFP, LCO, and also in lithium-nickel-manganese-cobalt (NMC) batteries.

The spherical graphite can deliver higher Values over the non-spheroidised graphite materials (half-cell testing). The spherical graphite purity alone is insufficient to cause a high enough degree of certainty to differentiate Values at lab-scale, with over 50 batteries assembled and tested *i.e.* other complex factors that go into the design, processing, and function of the battery must be considered (e.g. electrolyte). A higher purity product is found to be important, as, amongst other things, it increases the degree of confidence in reproducibility in the Values.

Next Steps

Archer plans to investigate high-value added graphite product processes (spherical graphite coating; and graphite purification) and other market opportunities (end-use integration) to ensure that the Company can successfully add value to Campoona, and that the project can be successfully developed to return maximum benefit to shareholders and the community.

Thus, Archer has drafted a request to a further 12-month extension to submit a proposed PEPR to the South Australian Government Department of Energy and Mining. An extension to 4 December 2020 would allow Archer to pursue downstream partnership and development opportunities with lithium-ion battery manufacturers and end-users prior to the completion of a PEPR.

In addition to the Campoona graphite project, advanced materials and the development of quantum computing technology remains a core focus of the Company. It should also be noted that graphene materials can alternatively be produced from the Carbon Allotropes inventory and not only from Campoona graphite.

Background and Market Summary

Significant progress has been made by Archer on the development of Campoona since the granting of a Mining Lease (ASX Announcement December 1, 2017). On 6 April 2018, Archer announced that graphite from Campoona is structurally near-perfect down to the atomic scale and on 21 August 2018, it was announced that 99%+ and 95% natural Campoona flake graphite was used to produce commercially scalable full-cell configuration Li-ion batteries at the University of New South Wales. On 12 March 2019, Archer announced the successful conversion of 95% and 99%+ natural flake graphite from the Project into high value spherical graphite using proprietary technology developed by Archer's Japanese Partner for integration into Li-ion batteries.

Spherical graphite materials are a high-value (US$3,400 to US$4,400 per tonne)[1] materials entry point for the Li-ion battery market which is forecast to increase to US$130 billion by 2028 with growth concentrated in the Asia Pacific region[2]. Li-ion batteries consist of a group of batteries which operate with graphite in the anode[3]. Improvements in the anode are based on using graphite with high structural quality and purity, and an appropriate particle size and optimal morphology for effective lithium-ion intercalation chemistry. Materials processing can lead to graphite morphologies that contribute to positive performance trade-offs, with typical examples including spherical graphite.

About Archer

Archer provides shareholders exposure to innovative technologies and the materials that underpin them. The Company has a focused strategy targeting globally relevant materials markets of human health, reliable energy, and quantum technology.

General Enquiries

Mr Greg English
Executive Chairman

Dr Mohammad Choucair
Chief Executive Officer

Tel: +61 8 8272 3288

For more information about Archer's activities, please visit our:

Website:
https://archerx.com.au/

Twitter:
https://twitter.com/archerxau?lang=en

YouTube:
https://bit.ly/2UKBBmG

Medium:
https://medium.com/@ArcherX

Sign up to our Newsletter:
http://eepurl.com/dKosXI

[1] Benchmark Mineral Intelligence. Heilongjiang, China, Tops 90,000 tpa Spherical Graphite Output as EV Battery Demand Surges. December 2018. https://www.benchmarkminerals.com/heilongjiang-china-tops-90000-tpa-spherical-graphite-output-as-evbattery-demand-surges/

[2] IDTechEx. Li-ion Batteries 2018-2028 From raw materials to new materials, through gigafactories and emerging markets. October 2017. https://www.idtechex.com/research/reports/li-ion-batteries-2018-2028-000557.asp

[3] Buchmann, I. Lithium-Ion Batteries: Fundamentals and Safety. In Encyclopedia of Inorganic and Bioinorganic Chemistry, R. A. Scott (Ed.), 2015. https://onlinelibrary.wiley.com/doi/full/10.1002/9781119951438.eibc2300