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BATTERY ANODE SUCCESSFULLY PRODUCED FROM COATED BALAMA SPHERICAL GRAPHITE

Highlights:

- **Initial feedback from Japanese anode and battery producers indicate that uncoated Balama spherical graphite is of a superior quality than those currently being utilised**
- **An anode producer has successfully coated Balama spherical graphite and achieved specifications that exceed those of leading Chinese manufacturers**
- **This anode producer has also successfully produced a lithium (Li) ion battery using Balama natural graphite anodes (produced from coated Balama spherical graphite) for initial test work:**
  - **First discharge capacity of 369.95 milliamphere-hour per gram**
  - **First discharge efficiency of 94.5%**
- **These above initial results exceed the performance of typical Chinese natural graphite anodes and a leading synthetic graphite anode**
- **Accordingly, both coated Balama spherical graphite and Balama natural graphite anode have satisfied and exceeds the requirements for computers, communications, consumer and Li-ion battery applications**
- **These initial coated Balama spherical graphite specifications and test results have been distributed to major battery producers and electric vehicle manufacturers around the world**
- **Samples of coated and uncoated Balama spherical graphite have also been distributed to some of these parties**
- **A Preliminary Economic Study for a spherical graphite plant is underway which considers a 25,000 tonne per annum (tpa) scenario in both Mozambique and the United States for a combined production of 50,000 tpa**

INTRODUCTION

Syrah Resources Limited (ASX: SYR, Syrah or the Company) is pleased to provide an update regarding its lithium (Li) ion battery grade spherical graphite development using natural graphite from the Balama Project in Mozambique.

UNCOATED SPHERICAL GRAPHITE

On 20 November 2014, Syrah announced that it has successfully produced battery grade uncoated spherical graphite from its spherical graphite pilot plant. The feed material for this was less than 100 US mesh (sub-150 micron) graphite as Li-ion battery grade spherical graphite is typically made from fine flake graphite. Initial feedback on these specifications from Japanese anode and battery producers indicates that the uncoated spherical graphite is of a superior quality than those currently being utilised.

COATED SPHERICAL GRAPHITE

The uncoated Balama spherical graphite specifications achieved were also consistent with those of leading Chinese manufacturers. Samples were subsequently sent to an anode producer for trial coating and electrochemical testing. This anode producer is a leading supplier of coated spherical graphite to major global battery producers.

Syrah is pleased to advise that this anode producer has successfully produced coated Balama spherical graphite with the following specifications. As shown in Table 1, these results exceed those of leading Chinese manufacturers.

	Balama specifications	**Typical Chinese specifications**
d90	32.05 microns	≤ 34 microns
d50	20.35 microns	20.5 ± 1.5 microns
d10	12.81 microns	≥ 12 microns
BET specific surface area	2.01 m^2/g	≤ 3.01 m^2/g
Tap density	1.07 g/cm^3	≥ 0.9 g/cm^3

Table 1 – Specifications of coated Balama spherical graphite produced by an anode producer versus typical Chinese specifications

A lower Brunauer–Emmett–Teller (BET) specific surface area reduces the irreversible charge loss that occurs during the first cycle whilst a higher tap density increases the volumetric energy capacity of an anode.

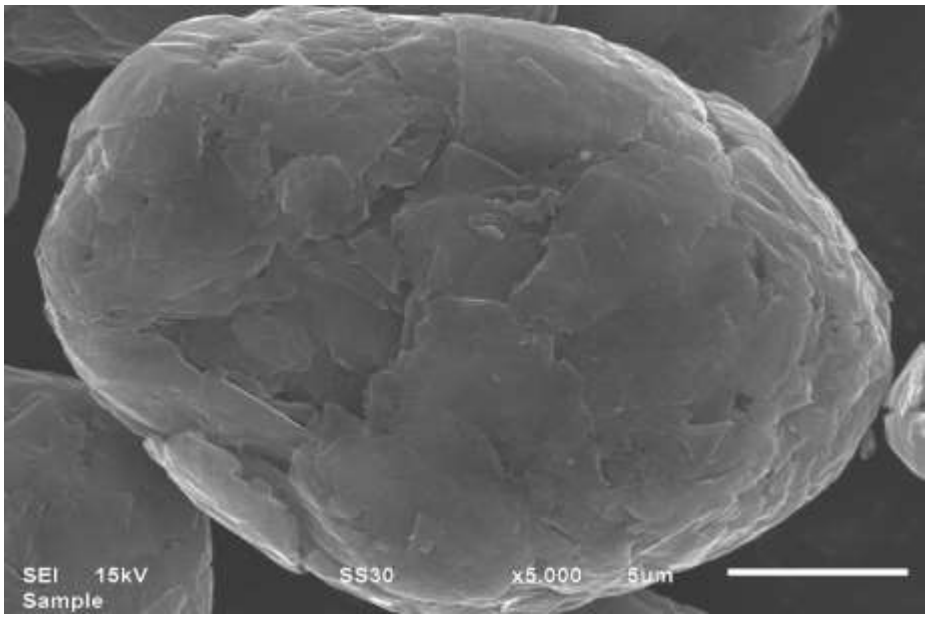

Figure 1 – Purified, coated Balama spherical graphite (Li-ion battery grade)

BATTERY ANODE

Following the successful coating of Balama spherical graphite, this anode producer also manufactured Li-ion batteries using Balama natural graphite anodes for discharge capacity and discharge efficiency tests.

The results of the test work performed by the anode producer is shown in Table 2, along with comparisons against the performance of typical Chinese natural graphite anodes and a leading synthetic anode. The theoretical maximum discharge capacity for natural graphite is 370 milliampere-hour per gram (mAh/g), as noted in a paper published by Chen, Du, Wang, Yin and Shi (2012) in the International Journal of Electrochemical Science.

	Balama natural graphite anode	**Typical Chinese natural graphite anodes**	**Leading synthetic anode**
First discharge capacity	369.95 mAh/g	≥ 360 mAh/g	360 to 362 mAh/g
First discharge efficiency	94.5%	≥ 89%	94.3% to 95.0%

Table 2 – First discharge capacity and efficiency results of Balama graphite anode versus typical Chinese graphite anodes and a leading synthetic graphite anode

As shown in Table 2, the Balama natural graphite anode compares extremely favourably with the theoretical maximum discharge capacity, as well as against competing Chinese natural graphite anodes and synthetic anodes.

Synthetic graphite has traditionally been a major anode material (55%) with natural graphite accounting for the balance. However, due to improvements in natural graphite quality (mainly in relation to the orientation property and tap density) and its lower cost, the use of natural graphite in anodes is rising and expected to continue. This has been confirmed from discussions with anode producers. Coated spherical graphite currently sells for US$7000 to US$10,000 per tonne compared to synthetic graphite which sells for around US$20,000 per tonne.

Consequently, Syrah has been advised by the anode producer that these initial results and the specifications achieved by coated Balama spherical graphite have satisfied and exceeds the requirements required for anodes that are used in 3C (computers / communications / consumer) and Li-ion battery applications.

NEXT STEPS

These initial specifications for coated Balama spherical graphite and the test results for Balama natural graphite anodes have been distributed to major battery producers and electric vehicle manufacturers around the world. Samples of coated and uncoated Balama spherical graphite have also been distributed to some of these parties. As a result of these successful trials, an additional 200kg of samples (in various micron sizes) will be prepared for distribution.

A Preliminary Economic Study for a spherical graphite plant is also underway which considers a 25,000 tonne per annum (tpa) production scenario in both Mozambique and the United States. Syrah believes that a combined 50,000 tpa of spherical graphite production will be required to satisfy a portion of the expected significant growth in the electric vehicle and energy storage markets.

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About Syrah Resources

Syrah Resources (ASX code: SYR) is an Australian resource company that is rapidly progressing its flagship Balama Graphite and Vanadium Project in Mozambique to production. The Project currently hosts one of the largest graphite and vanadium resources in the world with an Australasian Joint Ore Reserves Committee (JORC) compliant resource of 1.15 Bt at 10.2% total graphitic carbon (TGC) and 0.23% V_2O_5. Balama is a 106 km^2 granted mining licence located within the Cabo Delgado province in the district of Namuno in northern Mozambique. The Project is approximately 260 km by road west of Pemba and is accessible by a sealed, main road, running directly from Pemba Airport. The Port of Nacala is approximately 460 km by road south east of the Project and is the deepest port in Southern Africa.