ASX Announcement **17 July, 2018**

Hexagon Reports Highly Encouraging Cell Cycling Results For McIntosh Graphite

HIGHLIGHTS

- ✓ Cell cycling tests using McIntosh graphite achieve results that exceed benchmark reversible capacity levels of 350mAh/g, attaining reversible capacity of up to **363.1mAh/g** and **357.5mAh/g –** results typical of synthetic graphite and advanced grades of natural crystalline spheroidised flake graphite
- ✓ Tests were completed using uncoated graphite from the McIntosh project – carbon coating for use in anodes could further improve results, in particular, the irreversible capacity loss values
- ✓ Results indicate McIntosh produces a high-quality material suitable for lithium ion batteries and capable of surpassing high-quality synthetic materials used in Li-ion battery production
- ✓ Hexagon will continue test work on downstream product development and commence a Scoping Study on graphite refining, spheroidisation and classification.

1. SUMMARY

Hexagon Resources Limited (**Hexagon** or the **Company**, (ASX:**HXG**)) is pleased to report impressive initial cell cycling test work results using purified, uncoated spherical graphite sourced from its McIntosh project in Western Australia.

Results from the cycling test work are comparable to the performance of the highest quality synthetic graphite utilised in battery applications – a sector that Hexagon is targeting.

Typically, good battery performance is indicated by reversible capacity levels above 350 mAh/g.

Hexagon's cell cycling achieved results that included:

- (BASF LP30, room temperature electrolyte) - Reversible capacity, near theoretical performance of **363.1mAh/g** and Irreversible capacity of 402.3 mAh/g – resulting in a first cycle irreversible capacity loss of 9.7%; and
- (BASF LP81, low temperature electrolyte) - Reversible capacity of **357.5 mAh/g** Irreversible capacity of 391.5 mAh/g resulting in a first cycle irreversible capacity loss of 8.7%.

Hexagon Managing Director Mike Rosenstreich said: “We are very focussed on the downstream business case and Michael Chan and our US technical partner are working very hard to follow up on the very positive spheroidisation results released in late June – which indicated nearly 100% yield from concentrate to high value battery materials; both anode and conductivity enhancement material. These results indicate that we have high-quality crystalline material suitable for lithium ion batteries, indeed, capable of surpassing the attributes of the highest quality synthetic graphites, which still make up 50 to 70% of the anode material in lithium ion batteries.”

"This is very significant for Hexagon because a core component of our downstream business strategy is the substitution of synthetic graphite, not only in battery anode and cathode conductivity enhancer materials but also in traditional industrial applications – and we are definitely on track."

Figure 1: Hexagon CR2106 Lithium Ion Cells

Hexagon's latest test work aims to verify the July 2017 test work indicating the suitability of McIntosh graphite flake concentrates for lithium ion battery anode material, and provide more detailed data, which is specific to the application of Hexagon's 99.9997 purity spheroidised natural flake graphite. It follows up spheroidisation and product classification test work Hexagon reported on 21 June 2018 undertaken in collaboration with Hexagon's US technical partner, NAmLab[1]. Specifically, these tests are a first-pass examination of the cycling efficiency of anodes made from purified McIntosh graphite flake material.

These initial results are highly encouraging for the utilisation of McIntosh graphite in lithium ion battery anodes because of the consistency across different samples and cells and the favourable quantitative outcomes. The results are exciting because the spherical graphite that has been tested to date is uncoated. Quality anode material must be coated with a thin layer of ultra-fine carbonised material which will result in a significant reduction of the irreversible capacity loss to levels on the order of 5-6%. The key prerequisite for achieving the latter is to ensure that the precursor uncoated spheroidal graphite has irreversible capacity loss of less than 10-11%, which was found to be the case with Hexagon's samples tested to date.

Also, the stable and consistent initial cycling patterns are highly encouraging and comparing the different cycling rates led NAmLab to report that these results are more typical of premium quality synthetic graphite and not natural crystalline flake graphite which generally displays issues with high rate cycling capability. This notion manifests itself in the ability of purified spheroidised graphite from McIntosh to withstand increased cycling rates, such as the C/3 rate, without significant degradation of the reversible capacity, something which synthetic graphites can do while most natural graphite typically can't.

NAmLab concluded that based on these initial cycling outcomes, Hexagon's material had the potential to effectively compete and outperform the highest quality graphitised carbons on the

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[1] Hexagon has formed a technical alliance with a US-based, highly credentialed advanced materials research, testing and speciality manufacturing company that specialises in graphite products and technology. Due to confidentiality requested by the US partner, this company is referred to as "NAmLab".

market. Hexagon plans to undertake additional spheroidisation and classification test work to optimise the sizing and yields of concentrate into anode and conductivity enhancement materials (CEM). This will generate additional anode and CEM for more detailed cycling style test work in preparation for a feasibility study on production of uncoated spherical graphite and CEM as part of a targeted battery materials marketing campaign.

The Company continues to focus on creating greater technical certainty around these outcomes as well as other downstream process routes such as graphite intercalation and its transformation into various grades where synthetic graphite currently has a niche.

In the near-term, Hexagon will continue doing detailed test work on downstream product development, to build up a downstream processing business case. This includes a Scoping Study to enable cost and revenue figures to underpin the business strategy.

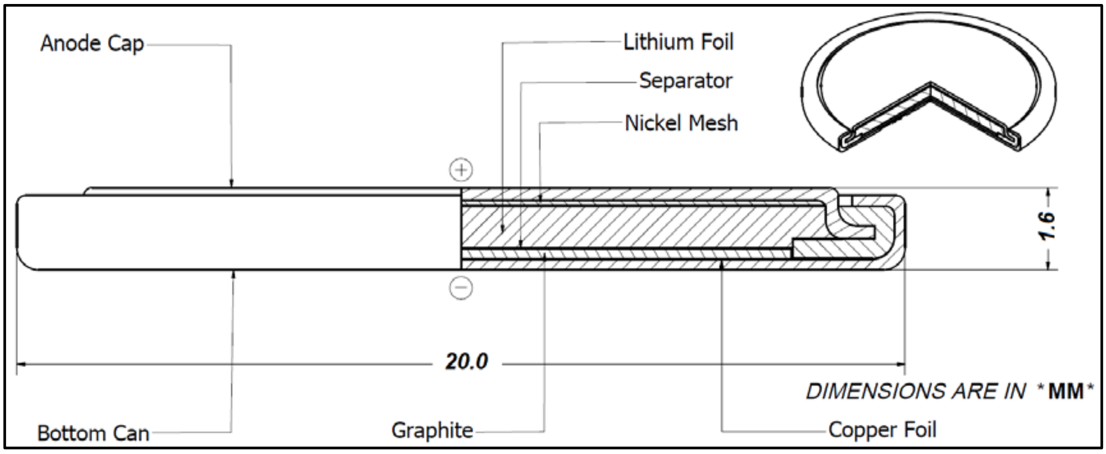
2. CELL CYCLING TEST METHODS

Hexagon and its US-based technical partner NAmLab have continued test work on two samples of McIntosh graphite concentrates grading 97% TGC (total graphite content); HXGCon1 and HXGCon2. These were each purified to 99.999% TGC utilising a thermal purification technology which Hexagon plans to adopt for all of its concentrate material sourced from the McIntosh project.

Purified samples were subsequently spheroidised, classified and then assessed for suitability for either battery anode material in lithium ion batteries or as conductivity enhancement material utilised in a wide range of battery types (Refer ASX Announcement 27 June 2018). This round of test work examined two sample fractions of each of the original concentrate samples as utilised in the anodes of various test cells to assess cycling performance as set out below.

The initial electrochemical performance of lithium-ion battery grade active materials (purified, uncoated, spheroidised and classified graphite) was assessed in NAmLab’s coin cells of a standard size, CR2016. Their cut-away schematic and key dimensions are shown in Figure 2. CR2016 represents a robust technology, commonly accepted by the lithium-ion battery industry as a test vehicle for initial electrochemical characterization.

Figure 2: Cross section through CR2016 lithium-ion cell.



NAmLab assembled 24 CR2016 cells incorporating:

- Different size fractions of the spheroidised material for each of the HXGCon1 and HXGCon 2/3 samples;
- Two different electrolytes, in this case a low-temperature electrolyte LP81 and a room-temperature electrolyte, LP30 (both by BASF); and
- A surface electrolyte interface (SEI) forming additive into some of the combinations above.

The completed cells were connected in batches of three to eight cells to an eight-channel potentiostat for the cycling test runs as follows:

i. C/20 (three cycles): C/20 is “electrochemist shorthand” for a 20 hour-long charge and a 20-hour-long discharge. This is a deliberately slow "formation" regime, to form a SEI - an ultra-thin film around the surface of graphite. For commercial batteries this is typically done at the battery manufacturer's site for 10 or so cycles prior to releasing batteries on the market. Incomplete SEI formation will make the battery defective.

ii. C/3 (three cycles): fully charged in three hours and fully discharged in three hours. This regime is typical of electric vehicle battery requirements.

iii. C/2 (20+ cycles): this is a typical mobile phone regime: two hours talk time (non-stop) and two hours re-charge.

iv. C/10 (three cycles): is a 10-hour charge and 10-hour discharge – a long-term cycling.

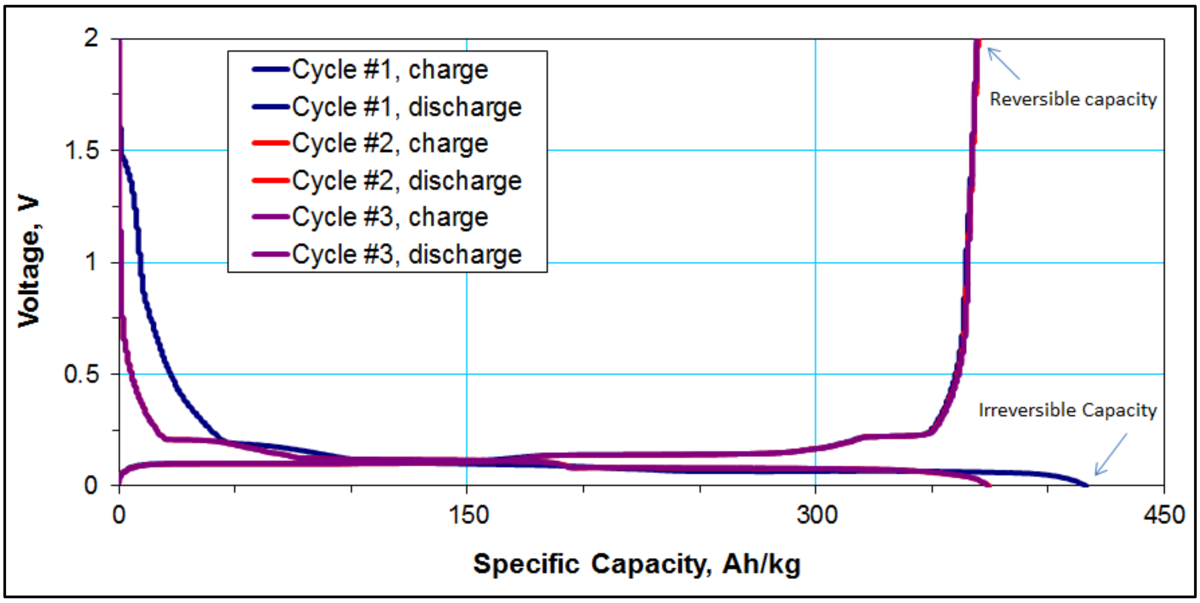
v. C/5 (one cycle) is a five-hour charge and five-hour discharge – a medium-term cycling.

Though a number of performance parameters are typically studied, the reports specifically focused on the performance of cells during the SEI formation cycle. NAmLab measured and reported the following variables:

- Irreversible capacity (i.e. the initial charge capacity of each cell over the actual weight of graphite in that cell at 0.01V vs. Li/Li^+);
- Reversible capacity (i.e. the initial and subsequent discharge capacity of each cell over the actual weight of graphite in that cell at 2V vs. Li/Li^+);
- Irreversible Capacity Loss (defined here as 100% - Reversible Capacity / Irreversible capacity).

These variables are presented for reference in Figure 3.

Figure 3. Initial Galvanostatic Cycling of graphite in CR2016 Coin Cells vs. Li/Li$^+$.



3. CELL CYCLING TEST RESULTS

Due to the possible variability associated with manually assembled cells and of the constituent materials, compared to automated factory production, it is standard industry practice to report a singular result for each data series. That is, for the one cell that performed best within each test group as presented in Table 1.

Table 1: Summary Results for Initial Galvanostatic Cycling of McIntosh Graphite

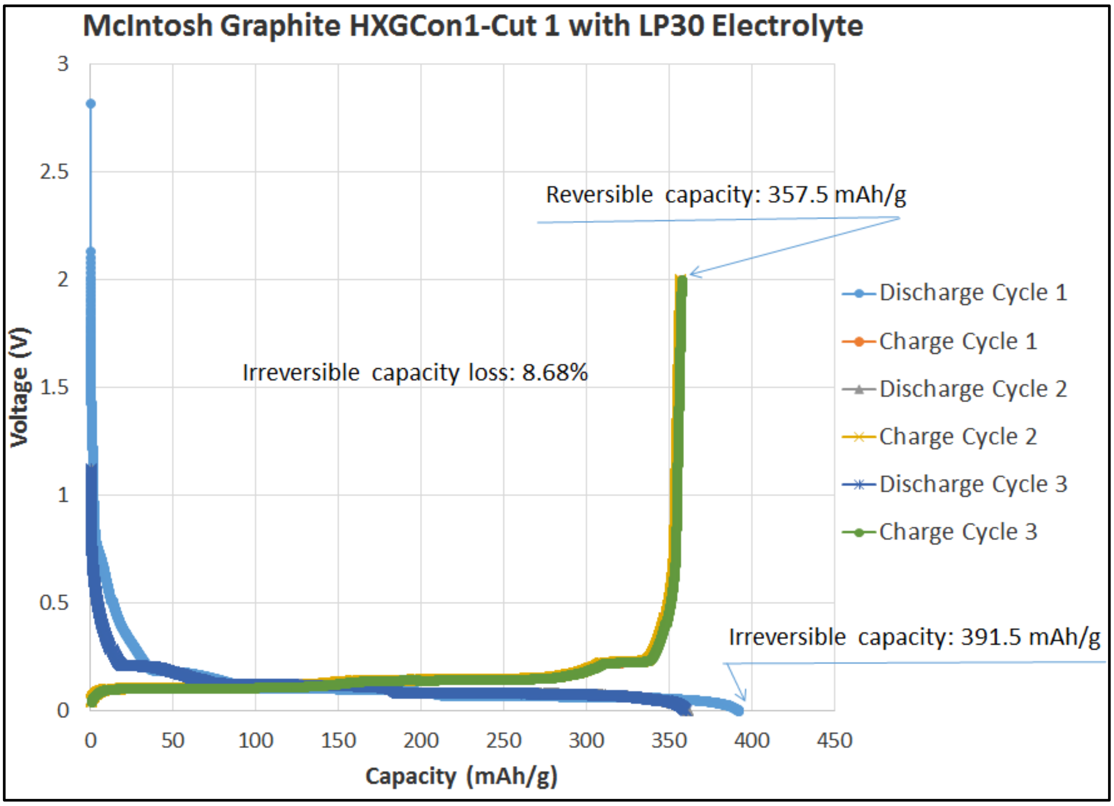
Sample Description	Electrolyte	Reversible Capacity	Irreversible Capacity	Irreversible Capacity Loss	Figure Reference
		mAh/g^3	mAh/g	%	
HXGCon1 (Cut 1)	LP-30	357.5	391.5	8.68	Figure 4
HXGCon1 (Cut 1)	LP81+vc	363.1	402.26	9.73	Figure 5
HXGCon1 (Cut 2)	LP30	354	390.4	9.32	Figure 6
HXGCon2/3 (Cut 1)	LP81+vc	363.1	403.8	10.08	Figure 7
HXGCon2/3 (Cut 2)	LP81+vc	352.6	390.8	9.77	Figure 8

Discussion of the initial cycling test results of the cells in the test program is presented in the following section. Additional data for the two McIntosh samples, listed by sample fraction or “Cut” is summarised in Appendix 1 (from ASX Report dated 27 June, 2018).

3.1 HXGCon1 Cut 1

Figure 4 summarises the initial galvanostatic cycling of HXGCon1-Cut 1. This graph illustrates a series of “classic” galvanostatic curves which are characteristic of natural crystalline flake graphite. Note - the high degree of crystallinity of purified McIntosh flake has been recently confirmed by XRD at the Advanced Photon Source of Argonne National Laboratory, USA.

Figure 4. Initial Galvanostatic Cycling of McIntosh graphite HXGCon1-Cut 1.
CR2016 Coin Cells vs. Li/Li$^+$. Electrolyte: Selectolyte LP-30 (BASF).



The HXGCon1-Cut 1 material had a reversible capacity of 357.5 mAh/g (measured at 2.0 V vs. Li/Li$^+$) and irreversible capacity of 391.5 mAh/g. The estimate of the first cycle loss is 8.68%, which is an excellent value considering that this is uncoated graphite. Test results will vary with changing parameters of the system, such as with switching to a different electrolyte, as illustrated below.

An alternative electrolyte was used for the same sample material as above, with the results presented in Figure 5. In this case the electrolyte was BASF's Selectolyte LP-81 (low temperature composition) with the addition of an SEI[2] forming additive, vc[3]. In this test, NAmLab reported that "this test condition has scored an impressive 363.1 mAh/g. We define the latter value as "near theoretical" performance, which is indicative of the premium quality of this graphite". The irreversible capacity registered at 402.26 mAh/g and the resultant estimate of the first cycle loss of this system is 9.73%. Given that the material is not carbon coated, this is an excellent result. We anticipate that surface coating will reduce the ICL[4] to much lower value.

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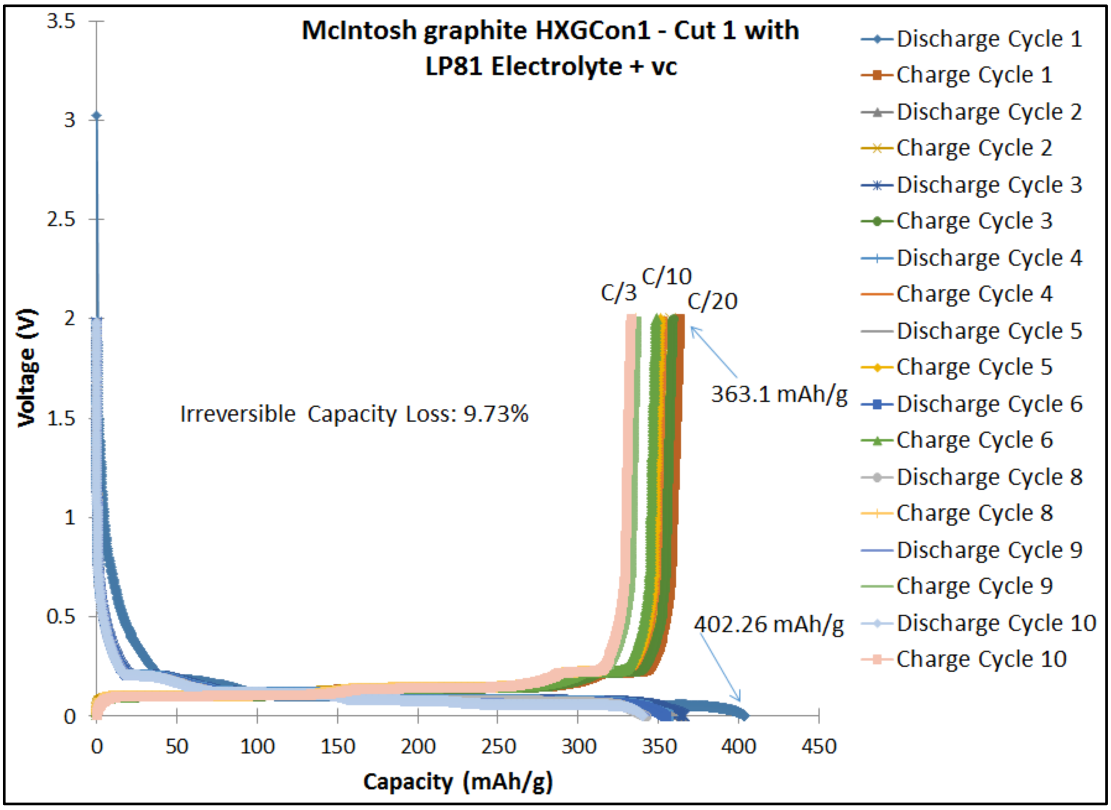
[2] SEI is a commonly accepted term in the lithium-ion battery electrochemistry and refers to "Surface-Electrolyte interface".
[3] VC is vinylene carbonate (a commonly accepted abbreviation).
[4] ICL is refers to Irreversible Capacity Loss, also sometimes referred to as "first cycle loss".

Figure 5: Initial Galvanostatic Cycling of McIntosh graphite HXGCon1 - Cut 1.
CR2016 Coin Cells vs. Li/Li+. Electrolyte: Selectolyte LP-81 (BASF) with vc.



The fact that HXGCon1 - Cut 1 has performed notably better in LP 81+vc compared to LP 30 indicates the potential of further optimisation work to achieve enhanced cycling outcomes. It also suggests that McIntosh flake could be better performing in low temperature systems.

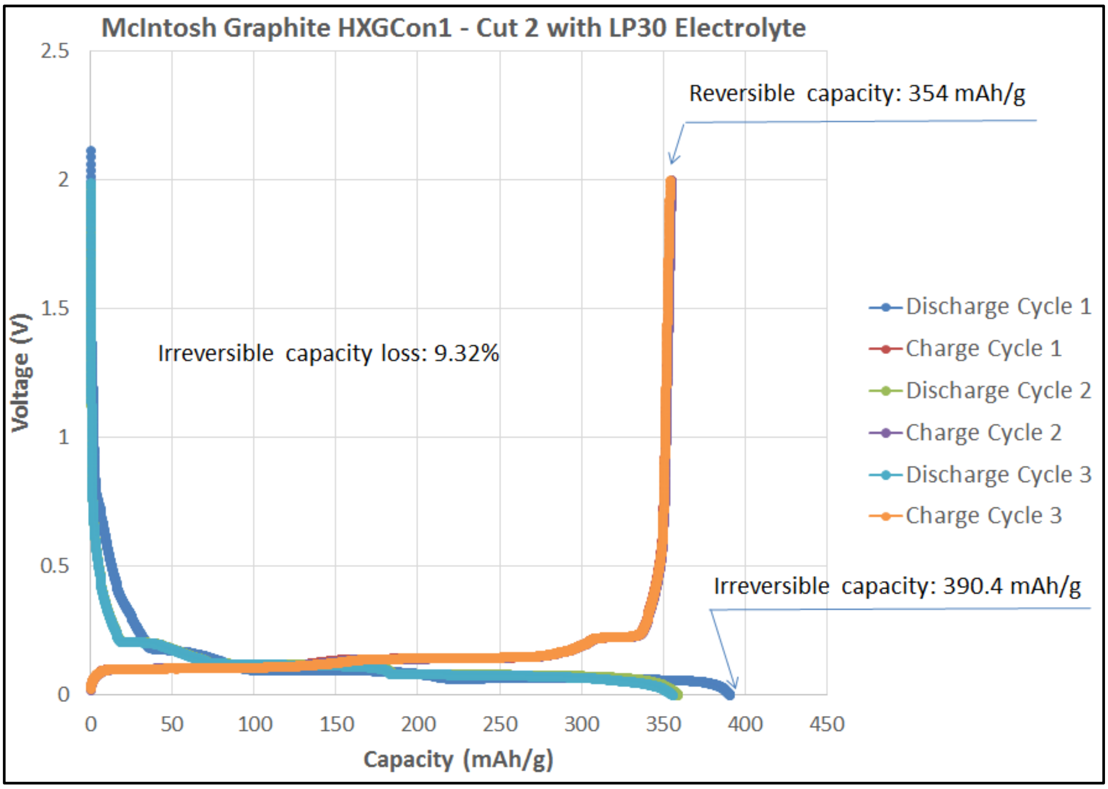
Both of the test runs discussed above suggest very stable cycling properties as indicated by the subsequent curves which either closely track or exactly overlay each other. The cycling test results presented in Figure 4 has helped to identify how HXGCon1 – Cut 1 performs at elevated rates of discharge. This cell was discharged with C/20 (refer above section 3.1 Test Methods for explanation), which was followed by C/10 and C/3 regime.

The C/3 over C/20 regime ratio is 92.53%. This means that by going from the “formation regime” (C/20), to a typical rate used by an electric vehicle (C/3), the cell retains nearly 93% of the design capacity. NAmLab reported that “such performance is characteristic of premium quality synthetic graphites and is not typical of natural crystalline flake graphites, where there are typically issues with high rate capability. Data presented by Figure 4 positions Hexagon’s material to effectively compete and outperform the finest quality graphitised carbons on the market.”

3.2 HXGCon1 - Cut 2

Test outcomes for the HXGCon1 - Cut 2 are presented in Figure 6. Cells with this sample as anode delivered a reversible capacity of 354 mAh/g and irreversible capacity of 390.4 mAh/g in BASF Selectolyte LP 30 room temperature electrolyte. The first cycle loss was calculated at 9.32%. Both values of reversible capacity and first cycle loss are indicative of a solid performer in the industry sector.

Figure 6: Initial Galvanostatic Cycling of McIntosh graphite HXGCon1 - Cut 2.
CR2016 Coin Cells vs. Li/Li$^+$. Electrolyte: Selectolyte LP-30 (BASF).

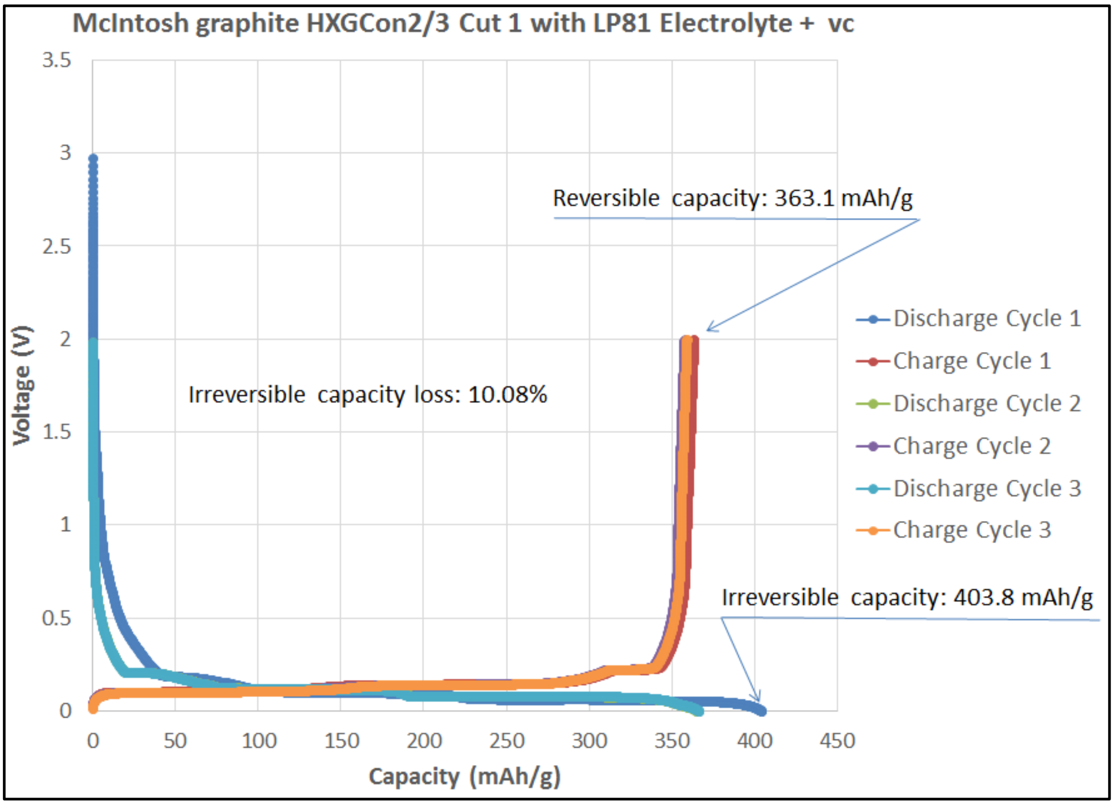


3.3 HXGCon2/3 Cut 1

Building on the earlier successful results generated with the low temperature electrolyte Selectolyte LP-81 with additions of vc, Figure 7 presents the initial galvanostatic cycling performance of sample HXGCon2/3 - Cut 1 in CR2016 coin cells vs. Li/Li$^+$ reference electrode.

This test achieved a reversible capacity value of 363.1 mAh/g. Remarkably, this is identical to the reversible capacity measured for sample HXGCon1 Cut 1, in a similar electrolyte system presented in Figure 4. This indicates consistency of how the “Cut 1” fractions of the two concentrate samples behave in the same electrochemical systems. The only notable, though small difference between the outcomes of the two materials is in the ICL (first cycle loss); which are 10.08% (HXGCon1-Cut 1) and 9.73% (HXGCon2/3 - Cut 1). This is likely due to the higher BET surface area of HXGCon1, which can be reduced through carbon coating.

Figure 7: Initial Galvanostatic Cycling of McIntosh graphite HXGCon2/3 Cut 1.
In CR2016 Coin Cells vs. Li/Li$^+$. Electrolyte: Selectolyte LP-81 (BASF) with vc.

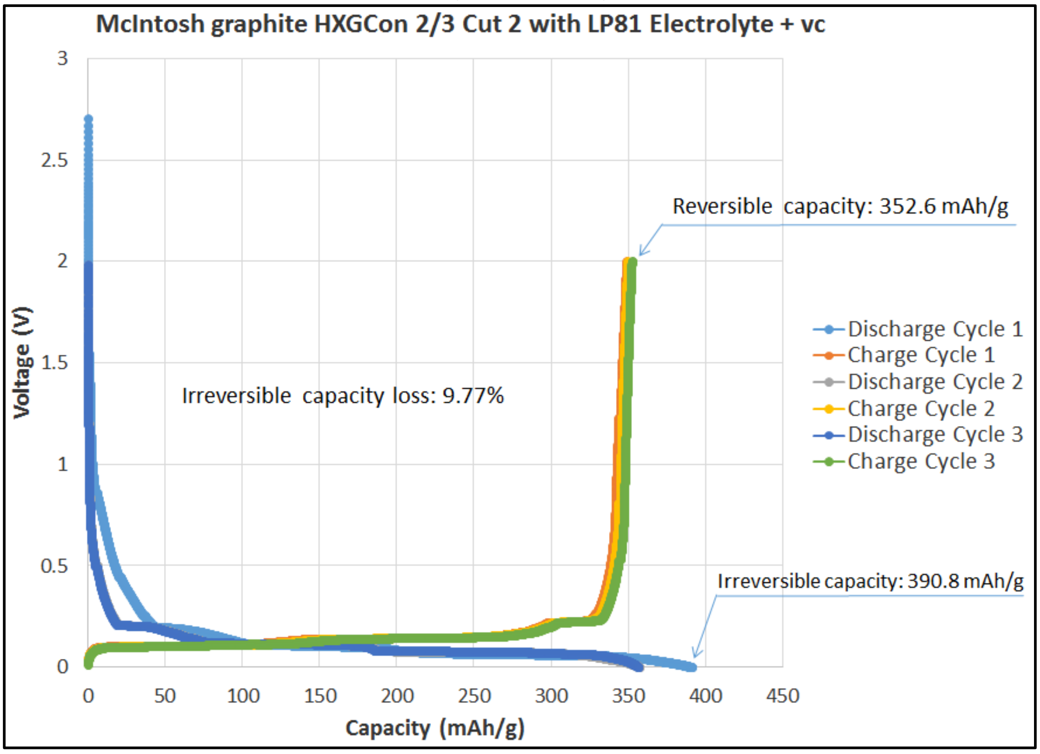


3.4 HXGCon2/3 - Cut 2

Finally, the results for testing uncoated anode material from HXGCon2/3 - Cut 2 are presented in Figure 8. This sample achieved a reversible capacity of 352.6 mAh/g, which is somewhat lower than the result reported for the Cut-1 sample fraction. However it is in line with the results of the HXGCon1 – Cut 2 sample reported above. Notwithstanding the lower result, this is still regarded as a solid contender in the battery sector.

The first cycle loss is estimated to be 9.77%, which is again a good result for uncoated spherical graphite.

Figure 8: Initial Galvanostatic Cycling of McIntosh graphite HXGCon 2/3 Cut 2
In CR2016 Coin Cells vs. Li/Li$^+$. Electrolyte: Selectolyte LP-81 (BASF) with vc.



4. CONCLUSIONS AND NEXT STEPS

Two purified and spheroidised sample fractions for each of the two original graphite concentrate samples were utilised within the anodes of test cells to assess the initial cycling capacity.

The test work was undertaken in collaboration with NAmLab, Hexagon's US based technical partner and a highly credentialed research, test work and commercial cell manufacturer. Its clients and customers include US Government Departments such as the Department of Defence.

As summarised in Section 3 the results highlight:

- Excellent levels of reversible capacity. The industry threshold tends to be 350 mAh/g which all of the reported test outcomes exceeded.
- Favourable irreversible capacity loss estimates of between 8.7 to 10.1%; given that the spherical graphite was uncoated. Surface coating of spherical graphite is the final production step in manufacturing battery ready anode material. The coating is known to be highly efficient in reducing the value of irreversible capacity loss, partly as a result of reduction of BET surface area. Coating typically reduces the level of ICL to around 5-6% for battery-ready materials, as long as the uncoated precursor features ICL of less than 10-11%.
- Selection of electrolyte and addition of a surface electrolyte interface (SEI) forming additive, in this case vc, affected cell performance and highlighted further opportunities to optimise cell ingredient and further enhance performance.
- Subject of further verification test work, the addition of a low-temperature electrolyte appears to highlight that some McIntosh material could be ideally suited for various colder applications i.e. southern latitudes or high altitudes.

The graph plots of the test runs discussed in Section 3 above suggest very stable cycling properties as indicated by the overlapping or closely tracking nature of the curves. The cycling test results presented in Figure 5 has helped to identify how HXGCon1 – Cut 1 performs at elevated rates of discharge. This cell was discharged with C/20 (refer above section 3.1 Test Methods for explanation), which was followed by C/10 and C/3 regime.

In analysing the various cycling tests, such as the C/3 over C/20 ratio of 92.53%, NAmLab reported that "such performance is characteristic of premium quality synthetic graphites and is not typical of natural crystalline flake graphites, where there are typically issues with high rate capability." NAmLab concluded that these initial test results positions Hexagon's material to effectively compete and outperform the finest quality graphitised carbons on the market particularly, synthetic graphite.

In terms of battery application further optimisation work of the spheroidisation and classification process is required as well as long term cycling to 100+ cycles. The company is considering advancing its work into surface coated and silicon-enhanced graphites as part of future work.

5. COMPETENT PERSONS' ATTRIBUTIONS

Exploration Results and Mineral Resource Estimates

The information within this report that relates to exploration results, Exploration Target estimates, geological data and Mineral Resources at the McIntosh Project is based on information compiled by Mr Shane Tomlinson and Mr Mike Rosenstreich who are both employees of the Company. Mr Rosenstreich is a Fellow of The Australasian Institute of Mining and Metallurgy and Mr Tomlinson is a Member of the Australian Institute of Geoscientists. They both, individually have sufficient experience relevant to the styles of mineralisation and types of deposits under consideration and to the activities currently being undertaken to qualify as a Competent Person(s) as defined in the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves and they consent to the inclusion of this information in the form and context in which it appears in this report.

Metallurgical Test Work Outcomes

The information within this report that relates to metallurgical test work outcomes and processing of the McIntosh material is based on information provided by a series of independent laboratories. Mr Rosenstreich (referred to above) managed and compiled the test work outcomes reported in this announcement. A highly qualified and experienced researcher at NAmLab planned, supervised and interpreted the results of the test work. Mr Michael Chan also reviewed this report. Mr Chan is a Member of The Australasian Institute of Mining and Metallurgy. Mr Chan and the NAmLab principals have sufficient experience relevant to the styles of mineralisation and types of test work under consideration and to the activities currently being undertaken to qualify as a Competent Person(s) as defined in the 2012 edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves and have consented to the inclusion of this information in the form and context in which it appears in this report.

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Appendix 1: Detailed Fraction Analysis Data

Sample: HXGCon1											
Sample Fraction	**Yield** % of Total	**D_{10}**	**D_{50}**	**D_{90}**	**D_{90}/D_{10}**	**Mean**	**Tap Density**	**Scott Volume**	**BET**	**Purity**	**Comment**
		Microns				Microns	g/cm^3	g/cm^3	m^2/g	Wt. % C	
1	36.94	17.62	33.99	56.42	3.20	36.46	0.92	0.62		99.999	Suitable Battery Anode Material (BAM) for high-energy lithium ion battery (LiB). It is a little coarse but size can be readily reduced to D_{50}=20um with further milling and further enhancing the tap density to nearer 1.0 g/cm^3.
2	18.62	13.35	26.67	46.62	3.49	29.18	0.88	0.53		99.999	Very well suited for LiB anode (BAM).
3	11.45	10.79	20.90	36.58	3.39	22.92	0.87	0.52		99.999	Ideal BAM material for EV batteries and suitable for general and high-performance LiB.
4	6.27	14.84	28.09	47.43	3.20	30.40	0.79	0.47	7.29	99.999	Conductivity Enhancement Material (CEM) with a little more milling. Possible for LiB anodes.
5	3.99	8.69	18.34	28.74	3.31	18.22	0.64	0.29	9.43	99.999	Ideal for CEM blended with "3" above in LiB, Li Primary and Alkaline batteries.
6	2.92	8.11	15.74	28.63	3.53	17.81	0.80	0.43	7.26	99.999	Suitable as CEM for high-power cells and other specialty applications including finer BAM (16µm) and 3C anode material.
7	1.94	7.52	14.50	25.46	3.39	18.92	0.59	0.26	9.91	99.999	Suitable for CEM with a little more milling.
8	17.72	4.87	10.10	19.76	4.06	11.99	0.57	0.27		99.999	Suitable for CEM with a little more milling.
with additional processing, suitable for:											
BAM	67.01	15.27	29.72	50.31	3.30	32.12	0.90	0.58	-	99.999	Suitable for Battery Anode Material –some fractions possibly also suitable for alkaline battery material but conservatively included in this lower value category).
CEM	32.84	7.68	15.30	27.26	3.55	17.19	0.64	0.33	3.77	99.999	Suitable for Conductivity Enhancement Material
Waste	0.15										

Sample: HXGCon2/3

Sample Fraction	**Yield** % of Total	**D10**	**D50**	**D90**	**D90/D10**	**Mean**	**Tap Density**	**Scott Volume**	**BET**	**Purity**	**Comment**
		Microns				Microns	g/cm^3	g/cm^3	m^2/g	Wt. % C	
1	25.46	16.95	32.78	55.23	3.26	35.32	0.91	0.56		99.999	Suitable BAM for high energy, low discharge rate LiB with thick electrodes -e.g. medical and high capacity solar energy space batteries.
2	21.17	15.32	29.57	50.78	3.31	32.07	0.88	0.54		99.999	As above and also for laptop type LiBs.
3	14.84	11.10	21.60	39.13	3.53	24.04	0.83	0.51		99.999	Ideal BAM for EV batteries and suitable for LiB. Subject to further improvements in Tap Density through carbon coating
4	7.70	10.51	20.05	38.30	3.64	23.16	0.77	0.46		99.999	Potentially suitable as negative electrode active material in LiB. Dependent on carbon coating to improve TD
5	4.94	9.05	17.60	32.77	3.62	19.95	0.72	0.28		99.999	Suitable for CEM with further milling.
6	3.46	8.55	16.15	27.53	3.22	17.36	0.69	0.31		99.999	Suitable for CEM with further milling.
7	2.80	7.64	15.08	29.61	3.88	18.00	0.66	0.25		99.999	Suitable for CEM.
8	18.31	7.11	16.01	51.08	7.18	24.34	0.75	0.29		99.999	Ideal for CEM in LiB, Li Primary and Alkaline batteries.
with additional processing, suitable for:											
BAM	69.17	14.48	27.98	48.53	3.35	30.55	0.87	0.53	-	99.999	Suitable for Battery Anode Material –some fractions possibly also suitable for alkaline battery material but conservatively included in this lower value category).
CEM	29.51	7.65	16.20	43.22	5.65	22.19	0.73	0.28	-	99.999	Suitable for Conductivity Enhancement Material
Waste	1.32										