NEWS

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Calix

HIGHLIGHTS

- R&D UPDATE ON CALIX BATTERY MATERIAL DEVELOPMENT
- AQUA-Cal+™ RECOGNISED AS AN ABA100 WINNER
- AQUA-Cal+™ DEVELOPMENTS IN SOUTH EAST ASIA
- SOLVING GLOBAL CHALLENGES: THE HEART OF CALIX STRATEGY

"CALIX'S MATERIAL APPEARS TO HAVE SOME UNIQUE PROPERTIES THAT WE EXPECT SHOULD LEAD TO SUPERIOR BATTERY AND SUPERCAPACITOR PERFORMANCE. THESE ARE EARLY DAYS BUT WE ARE VERY ENCOURAGED BY THE POTENTIAL".

Professor Doug MacFarlane - Monash University and Associate Professor Patrick Howlett, Deakin University;s BatTRI Hub.

EDITORIAL

Welcome to Issue 23 of the Calix Newsletter.

There has been an extraordinary amount of activity over the last couple of months…

Phil Hodgson
CEO

Our award-winning technology continues to deliver, with an Australian Business Award – New Product Innovation achieved for our AQUA-Cal+™ aquaculture water conditioner. Read about the latest AQUA-Cal+™ trials in Thailand and Vietnam, two of the world's largest aquaculture prawn markets, in this newsletter.

Our export efforts also continue to be recognised, where we have reached the finals of the NSW Premier's Export Awards for the third year running.

Calix's technology is also strongly placed to feature in a lower carbon future, and while in Australia this potential is hard to develop, read about all that is happening with a summary article on all the work we are doing in Europe in multiple projects and industries.

Our very exciting potential in advanced battery development has also progressed – read about our recent manufacturing and test campaign in our R&D update.

A recent Australian Financial Review article hinted at our intentions to look at an Initial Public Offering in the near future. While much still has to play out to make this a reality, we are working on this and will keep you posted of progress. Thank you again for your continued interest in Calix.

KEY MILESTONES

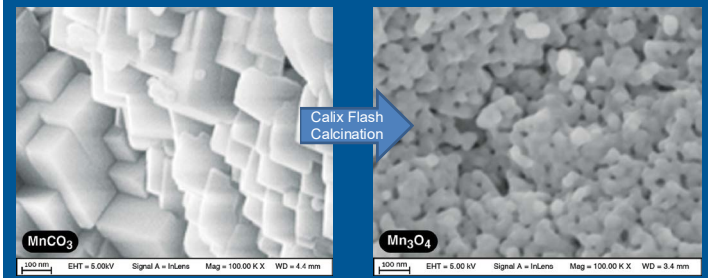
R&D UPDATE: CALIX BATTERY MATERIAL DEVELOPMENT: EARLY RESULTS FROM IMPERIAL COLLEGE

Calix has recognised that its Calix Flash Calciner (CFC) technology can be used to make a wide variety of mixed metal oxide materials for advanced manufacturing applications. Most recently, we have targeted the production of battery materials using agricultural grade Manganese Carbonate as the precursor to manufacture Manganese Oxide. This material is a common battery material in lithium ion batteries.

Various controlled oxidation and calcination states were produced for testing by Dr Quilei Song's research group at Imperial College, London.

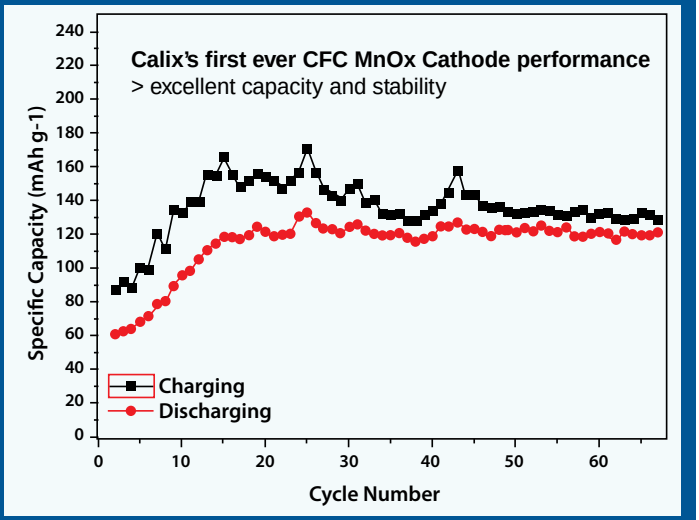
Scanning Electron Microsope (SEM) photographs confirmed we had achieved, via our very simple and inexpensive processing route, our trademark "mineral honeycomb" structure, with uniform nano-pores at 10 to 20nm.

Initial button-cell tests achieved high and improving stability and capacity on cycling…remarkable for our first attempt at a straight Manganese cathode material.



RAW MANGANESE CARBONATE

HIGHLY POROUS MANGANESE OXIDE



Discussions have commenced on further R&D with local experts such as Monash University and Deakin University's BatTRI Hub.

Professor Doug MacFarlane from Monash University said

"Calix's material appears to have some unique properties that we expect should lead to superior battery and super-capacitor performance. These are early days but we are very encouraged by the potential".

Associate Professor Patrick Howlett, from Deakin University's BatTRI Hub, echoed Professor MacFarlane's comments.

AQUA-Cal+™

SPECIAL FEATURE

AQUA-Cal+™ DEVELOPMENTS IN SOUTH EAST ASIA

AN INNOVATIVE AND SUSTAINABLE AQUACULTURE SOLUTION THAT CONTRIBUTES TO FOOD SECURITY, NUTRITION, LIVELIHOODS AND ECONOMIC GROWTH.

...At one of the largest Vannamei shrimp growers in Thailand...

After more than 2 years of extensive field and laboratory trials in Malaysia, Calix has established AQUA-Cal+™ treatment protocols for both Vannamei (White-legged Shrimp) and Monodon (Tiger Prawn) species under a number of varying culture scenarios.

Current treatment methods to manage disease and maximize yield include probiotic treatments and clear water drainage techniques. Both are expensive and at best partially successful. AQUA-Cal+™ is being trialled as a sustainable alternative to these methods at the second biggest Vannamei shrimp grower in Thailand.

AQUA-Cal+™ has been found to replace pond bottom probiotics, digesting sludge more effectively while locking up ammonia and heavy metals as well as controlling fluctuations in alkalinity and pH. AQUA-Cal+™ also enhances natural algae growth, increasing crop size and the feed conversion ratio.

Our recent entry into the Thai market is starting to yield results with our first product orders coming in October.

A SIMPLE PROCESS

The process is simple: after being mixed on site, AQUA-Cal+™ is loaded on a boat and taken to the middle of the pond to be broad cast manually into the water. Calix accompanies the farmer step by step and provides a full customised protocol for each farm.

...Meanwhile in Vietnam...

Research has begun in collaboration with SHRIMPVET, a renowned research institute in Asia, to analyse and diagnose the effectiveness of AQUA-Cal+™, alone and in conjunction with other possible treatments, on several shrimp diseases such as Early Mortality Syndrome (EMS), Enterocytozoon Hepatopenaei (EHP), White Spot and White Feces.

The long-term prospects for AQUA-Cal+™ in South East Asia looks exciting following successful trials and registrations in Thailand, Vietnam, Indonesia and India. With the support of our local partners Maha Chemicals and Honlex Jones, we are working with local farmers and scientists to develop sustainable and cost effective aquaculture solutions to produce healthy prawns in controlled conditions.

AQUA-CAL+™ RECOGNISED IN THE AUSTRALIAN BUSINESS AWARDS 2017 - NEW PRODUCT INNOVATION.

THE AUSTRALIAN BUSINESS AWARDS ® ABA100 NEW PRODUCT INNOVATION WINNER 2017

The ABA100 Winner in New Product Innovation award reflects once again the company's development efforts with every one of its products, especially in improving their application. The program seeks to engage with the world's business, innovation and technology leaders through a global recognition and knowledge building initiative that is underpinned by the program's established framework.

Phil Hodgson, Managing Director & CEO, Calix, said, *"The award recognises Calix's achievements in the research and development of its aquaculture product AQUA-Cal+™. Calix developed AQUA-Cal+™ as a safe, environmentally friendly water conditioner to directly address problems associated with intense aquaculture such as disease and pollution, and deliver improved feed performance and yield."*

Since launching AQUA-Cal+™, Calix has gained remarkable market knowledge and product development experience via our partners in the Philippines, Malaysia and Hong Kong, More recently, field trials also started in India, the world's largest shrimp exporter, Indonesia and Thailand. We also presented a paper on our continued success in yield improvement and disease prevention in prawn and shrimp farming at the Asia Pacific Aquaculture Conference (APA17) in Kuala Lumpur this year, attended by about 3,000 participants from 46 countries.

AT THE HEART OF CALIX STRATEGY...

DEVELOPING NEW PROCESSES AND MATERIALS TO SOLVE GLOBAL CHALLENGES.

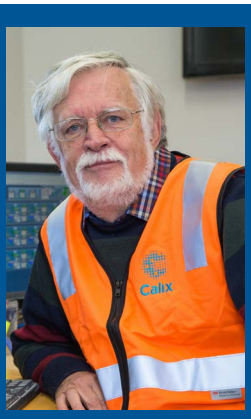
CO_2 reduction is a global problem that will impact future generations if it is not addressed on a global scale. In Europe, for example, discussions with engineers centre on getting on with addressing CO_2 reduction. In Australia, there is still much to do on the policy front with many still willing to debate the need to do anything at all. The lack of a bipartisan approach to this issue in Australia is stymieing innovation and action locally so global collaboration is an essential skill.

Dr Mark Sceats, Executive Director & Calix Chief Scientist, says: "More than 10 years ago, Calix found that advancing our CO_2 capture technology in Australia just wasn't possible because there wasn't demand for it here. We therefore moved the research and development to Europe and the UK, where there was more interest in advancing it, so that we could be in a better position to solve this global challenge."

Calix engineers and scientists are leading the Low Emissions Intensity Lime and Cement (LEILAC) project, as a European-Australian collaboration, which includes a consortium of some of the world's largest cement, lime, and engineering companies, as well as leading research and environmental institutions.

Calix has also won funding from both the UK (DECC) and EU (ASCENT Project) to develop Calix's ENDEX Reactor Technology, which introduces significant new options for energy generation organisations seeking to reduce CO_2 emissions.

This article was published in Carbon News, New Zealand's only daily news service covering the carbon markets, climate change, sustainable business and the growth of the low-carbon economy.



Dr. Mark Sceats said, "The 2015 COP21 Paris Agreement, of which Australia is a part, was a turning point for Australian businesses. There is no doubt companies are looking at the future and their investments with a careful eye on CO_2 emissions reductions. They are assessing the risks, and the highest risk can be to do nothing because there will eventually be a significant price on CO_2 emissions. It is also timely for the government to step in to accelerate the uptake of new, low emissions technologies".

It takes a long time for the ship of innovation to change course to address large issues, such as CO_2 emissions, but it is in the interests of every nation to do so. The recent OECD report *"Investing in Climate, Investing in Growth"* shows that integrating measures to tackle climate change into regular economic policy increases the average GDP of G20 economies by 5% compared to current policies.

Dr. Mark Sceats said, **"Calix has been working hard for the last 10 years to take a technology from a concept and scale it up to a commercial scale, as we successfully seek to provide a range of industries with very cost-effective, low-carbon, production options. That has been done in Australia for magnesite processes, and is being done in Europe for lime and cement. Our next challenge is to couple our technology to renewable energy to make zero and negative emissions products. This work has now started, and is progressing rapidly."**

INTRODUCING

MICHAEL WHEATLAND CENG - BUSINESS DEVELOPMENT MANAGER

Michael graduated from The University of Melbourne with degrees in both Chemical Engineering and Science, majoring in physical and inorganic chemistry. He spent most of his professional career working for BHP Billiton, Alcoa, Rio Tinto in an engineering and process optimisation capacity, developing innovative technologies on a range of different complex chemical, control automation and thermal processes. After more than a decade working in the industry, he is now an internationally chartered engineer through the Institute of Chemical Engineers.

Michael arrived at Calix in 2012 to assist with the design, building and commissioning of the Calix Flash Calciner (CFC). As the Production and Quality Manager he and the team forged a production and quality system that allowed Calix to obtain ISO 9001 accreditation.

Michael now works with Calix customers as a Business Development Manager, identifying, troubleshooting and assisting to solve problems within the water industry.

Michael has a young family, with a wife who has just recently graduated to become a primary school teacher and two boys under 5 years old, so weekends and holidays are often filled with visits to science museums, aquariums, zoos and trampoline parks.

To learn more about Calix technology, products, applications and services,
Visit www.calix.com.au
Or call 02 8199 7400

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