

The Power of 3

ISSUE 15
May
2017

Driving the future further

THE HIDDEN LIVES OF LITHIUM

"Lithium is like a beautiful lady, very much sought and pursued..."

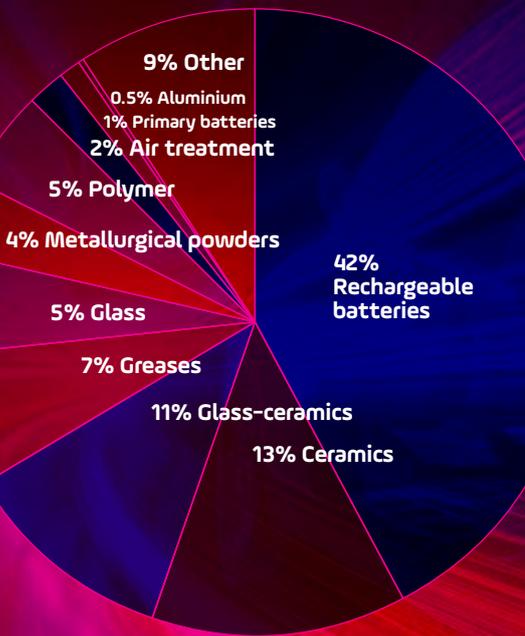
~ Evo Morales, President of Bolivia

Overview

The hype surrounding lithium batteries right now is enormous ... so much so that many assume the battery industry has always been the primary consumer of lithium and its various compounds. However, while there's no doubt this market represents the fastest growing sector in terms of demand for Earth's lightest solid element, lithium, historically, has had many other uses.

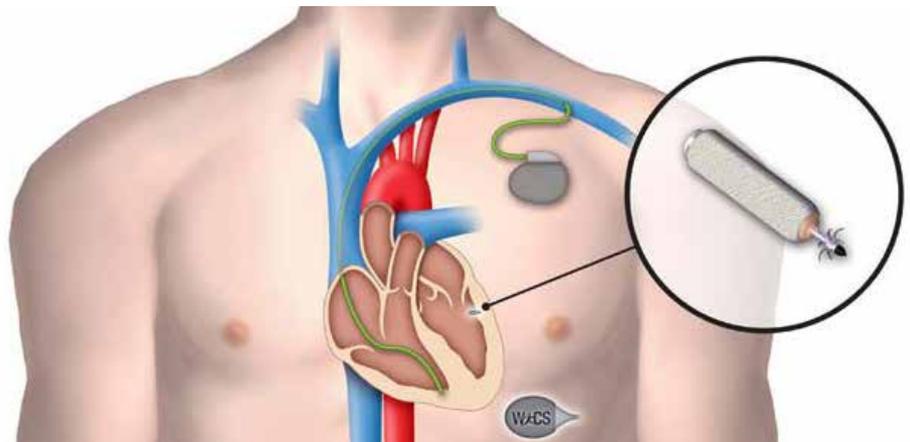
In the past, most lithium was produced for the glass and ceramics industries but, more recently, its applications have become multifarious. It's now utilised in everything from aeroplanes to golf balls, toilet bowls to stove tops, prescription medications to lubricants, space craft to welding fluxes, air-drying and air-purification systems to road-marking paints, and much, much more.

In fact, the use of lithium has become so widespread that it could be described as the world's most versatile element.



Living with lithium

Most rechargeable batteries available today incorporate lithium metal or alloys. That makes lithium vital to 21st century living – it boosts the juice that drives mobile phones and tablets, laptops, digital cameras, hand tools and all manner of electric vehicles, and allows for stationery storage of electricity from renewables (arguably, though, not utility-scale storage, despite Elon Musk's assertions to the contrary).



Lithium is often a component of primary (non-rechargeable) batteries too, the kind that power things like pacemakers, kids' toys and clocks.

Lithium metal and heat transfer go hand in hand, and it's a valuable reducing and alkylating agent in many chemical reactions. *Walter M. Fenton et al* outline its value "in the production of synthetic vitamin A and other pharmaceutical products, as an ionic catalyst in new polymer technology, as a direct reducing agent in certain organic reactions, as a flux in new brazing techniques, as a starting point in the production of metal hydrides and borohydrides and as a potential heat-transfer agent in new engineering developments."

Many metals are combined with lithium to form alloys, among them lead, copper (to reduce free oxygen and porosity), silver, silicon, aluminium and magnesium. Adding lithium to the latter two elements makes them stiffer, stronger and lighter. Magnesium-lithium alloys, for instance, are used for armour plating, while aluminium-lithium alloys are used in components for aircraft (including space vehicles), bicycle frames and high-speed trains.

Various lithium compounds play important roles as industrial chemicals, being widely used in the processing of metal oxides, for making adhesives and, when mixed with oils, creating high-temperature lubricants.

Living with lithium

Other-worldly uses for lithium compounds include numerous aerospace applications ... right down to scrubbing carbon dioxide from the atmosphere of manned space flights.



Earth-bound or at sea, lithium nitrate adds colour and drama to fireworks and flares and, in a less visual role, it acts as an anti-static agent for non-woven fabrics.

Lithium acetate improves the viscosity of dyes and helps stabilise PVC, lithium aluminate is used in micro-electronics and nuclear technology, lithium bromide is a medical desiccant and fungicide, lithium borate is added to soap, greases and fluxes, lithium hypochlorite kills algae and sanitises swimming pools, and lithium sulphate is used in electrical conducting glass and as a concrete accelerant.

Lithium carbonate, too, has numerous applications, not least in glazes and quickset cement. When added to molten glass, it makes it lighter and stronger.

Somewhat surprisingly, lithium carbonate also contributes to human health. In the mid-1800s it was considered efficacious for bladder stones, gout, rheumatism, mania, depression and headache. Then, in 1949, John Cade, an Australian physician, found an exciting new use for it: as a mood stabiliser in patients with 'manic depression'. Despite its action on the brain not being fully understood, and in spite of the risks and side-effects associated with its use, lithium carbonate remains to this day an important tool in dealing with the extremes of bi-polar disorder.

Some holistic practitioners aver that lithium orotate achieves results similar to those for lithium carbonate but with less risk of harmful side-effects, and recommend it as a means of protecting brain cells from toxicity, facilitating brain-cell regeneration and improving blood sugar metabolism.



The black dog aside, conspiracy theorists (perhaps in need of lithium too?) might consider how the use of salts such as lithium fluoride in thorium nuclear reactors produces breakdown products far more acceptable to the health of humans and the planet, and wonder why uranium- or plutonium-fuelled reactors are built instead? Well might they ask, since thorium reactors are touted as offering – potentially – so many advantages over conventional solid uranium-fuelled light water reactors. BUT ... a by-product of uranium fission is, of course, plutonium, so useful in the construction of nuclear warheads.

A Huffington Post article, 'Cold fusion heats up', cites claims by Italian-American engineer/entrepreneur Andrea Rossi that he's developed a working table-top reactor, fuelled by a powder of 50% nickel, 20% lithium and 30% lithium aluminium hydride. Although details are shrouded in secrecy, other research teams are also working on abundant heat production from a reactor device using similar materials as fuel. For now, scepticism remains in order; however, the potential impacts for low-energy nuclear reactions could be far-reaching on a global scale, not just politically, economically and environmentally but also in terms of the ramifications for transportation, water purification, small businesses and homes.

Getting back to compounds, lithium oxide is used in the production of specialty glasses and glass ceramics, while lithium chloride and bromide, perhaps the most hygroscopic (absorbing moisture from the air) materials known to man, are used as desiccants in air-conditioners and industrial drying systems.

Lithium stearate is useful as an all-purpose, high-temperature lubricant and lithium carbide (a chemical compound of lithium and carbon) is useful in radiocarbon dating procedures.

Lithium hydride is used to store hydrogen for use as a fuel, while, according to a paper by T. Ichikawa *et al* in the *Journal of Alloys and Compounds* (Vol. 365), lithium nitride:

... reversibly absorbs hydrogen and can be used to store the gas as a solid medium for transport or as a fuel source. Potentially [it provides] a portable energy solution to rival the lithium-ion battery – the hydrogen fuel cell.

Tom Fleischman, writing for the *Cornell Chronicle*, notes that a stabilising molecule to counter performance inefficiencies could pave the way for lithium-air fuel cells that boast energy-density levels comparable to fossil fuels, making them a promising candidate for future transport-related energy needs.



Speaking of transport, lithium is also an additive in hybrid traffic marking and safety paints that are fast-drying, long-lasting and abrasion-, moisture- and solvent-resistant, and in permanent, durable stains for concrete, masonry and the like.

And finally ... A Rice University research team has used carbon nanotubes to develop a paint that can transform any surface into a lithium-ion battery. The researchers believe their paint has the potential to create a functional, rechargeable solar battery on just about any surface. Bring it on!



In the Rice University experiment, ceramic tiles were coated with battery paint, then heat-sealed powered LEDs were used to spell out the word 'RICE' for six hours.

Which Perth-based company aims to revolutionise the production of lithium compounds for a range of applications?



Disclaimer

Links to various sites within this newsletter are for information purposes only and the information presented is not intended to be comprehensive. Nor does this newsletter guarantee, approve or endorse any information, advice or products available on the sites to which links are provided.

The Power of 3 is sponsored by Lithium Australia. Enquiries to info@lithium-au.com.