Lithium: fueling the clean energy revolution

The transport sector alone contributes roughly one-quarter of all energy related CO₂ and is still primarily dependent on fossil fuels. But that’s changing thanks to the lightest solid on Earth, which some are even calling the “new gasoline.”

Lithium, it’s the soft, silvery white metal that’s become a critical component in hundreds of applications, including the auto industry’s new shining star – the electric vehicle (EV). While EVs have been around for some time, it’s due to much-improved lithium-ion (Li-ion) battery technology that we’re actually seeing them on the road in greater numbers. These super-tech batteries keep their charge for long periods (200 to 300 miles), are lightweight and recharge quickly (e.g., 30 minutes via a super charger) – key criteria for buyers.

And, if you look around at the devices and equipment you’re using today, you’ll find Li-ion batteries powering everything from your mobile phone, laptop, digital camera, your cordless hand drill and your e-bike. They’re also used to store energy from wind and solar, which removes even more CO₂ from the environment.

21ST CENTURY GOLD RUSH

Lithium does not occur as a metal in nature, but is extracted from igneous rocks – primarily spodumene – or from bodies of water with high salt content or brine deposits. While not classified as a “critically rare material,” lithium is a coveted commodity. It traded for a whopping US$16,500 per ton in 2018 – up 45 percent from 2017. However, prices vary widely because it’s traded directly between buyers and sellers versus through an exchange.

Latin America is leading the world in production. Its “Lithium Triangle,” made up of Chile, Argentina and Bolivia, hold anywhere from 54 to 80 percent of the world’s lithium resources, much of it in brines. Brine extraction is a less expensive process than obtaining it from ore, but is a longer process, given that it can take up to two years for the evaporation phase.

Australia, the world’s second largest producer, holds the most lithium reserves. Most of it has to be crushed out of rock, so to balance the costs, it is largely shipped to China for processing. China also has its own reserves and is buying rights to mine lithium in other countries. In the U.S., lithium is recovered from brine pools, although how much is produced has not been published. Zimbabwe, and to a lesser extent Portugal and Brazil are also producing lithium in smaller quantities.

WHO’S SUPPLYING THE DEMAND?

The massive price jump for lithium is due to the rise – and the even greater expected rise – in the production and sale of EVs, domestic solar usage and digital devices, all of which require Li-ion batteries. Globally, more than 120 different EV models are expected to hit the road by 2020 in countries like the U.S., China, India and Norway, among others. To power them, both China and the U.S. have ramped up Li-ion battery production, with China in the lead. In the U.S., Tesla has two gigafactories for EV battery and component production and is building another in China. However, EV growth in the U.S. has been slower than expected, making up less than a percent of auto sales and it could be another six to seven years before they become mainstream. In 2016, global Li-ion battery production capacity reached 28GWh and by 2020 it is expected to reach 175GWh – an increase of 521 percent. Not surprisingly, lithium materials demand is projected to grow at a 13.8 percent CAGR between 2018 and 2023.

TIPPING THE BALANCE

Difficult to set a “price” for lithium, trickier to hedge, and market dominated by a few players, makes it more expensive over time. The combined technical improvements, increased model choices and drop in price, as well as the appearance of more charging points, suggest that we’re in for a brighter and cleaner future.

Global lithium-ion battery production capacity will increase by 521% between 2016 and 2020.

On the consumer side, drivers are warming up to EVs, as concerns about product safety, battery durability and range subside. The combined technical improvements, increased model choices and drop in price, as well as the appearance of more charging points, suggest that we’re in for a brighter and cleaner future.

And the award goes to …

In 2017, GEA was recognized with the “Award for Excellent Supplier” by Shenzhen BTR New Energy Materials. A globally leading lithium battery anode and cathode material solutions provider, BTR recognized GEA’s top performance. In particular, the Chinese company recognized GEA’s technology, as well as innovative and pragmatic solutions, which have contributed significantly to the production of high-quality lithium.
How to do it: Processing battery-grade lithium

Lithium hydroxide, and to a lesser extent, lithium carbonate, are used to make Li-ion batteries and must be exceptionally high-grade – 99.5 percent pure – to meet manufacturer specifications. Given extraction costs, it is critical to get as much value as possible out of each ton of ore or brine during processing. Here’s how it’s done:

1. Spodumene ore
   A source of lithium, spodumene, is a mineral found in igneous crystals, often of substantial size.

2. Mineral conversion
   The raw ore is put through a series of crushing and size-classification steps to create the required particle size.

3. First treatment
   The ground lithium ore (lithium sulfate) is heated in a rotary calcining kiln where the lithium is displaced by sodium. The concentrate is cooled, milled into a fine powder and mixed with sulfuric acid and roasted again. Magnesium and calcium are also removed.

4. Compound processing
   Each concentrate is added to both streams, producing lithium hydroxide. This process generates two byproducts: table salt (from the brine) and Glauber’s salt (from the spodumene).
   Lithium carbonate is produced if soda ash (from the spodumene) – GEA has developed state-of-the-art technologies for concentration and crystallization. Irrespective of its source – brine (lithium chloride) or lithium carbonate – GEA has developed state-of-the-art technologies for concentration and crystallization. GEA covers nearly the entire value chain of lithium processing – from evaporative concentration, precipitation, crystallization to purification and drying – tailoring the powder to specific end-use requirements. Our award-winning customer service and unrivaled technologies are valued by lithium manufacturers globally because we deliver a competitive advantage due to higher rates of production, reduced costs and more efficiency, while complying with stringent regulations. GEA test centers allow customers to pre-test their lithium samples so they can make informed decisions before committing to industrial level production.

5. Crystallization
   Impurities of the source – either lithium chloride or spodumene lithium sulfate – GEA has developed state-of-the-art technologies for concentration and crystallization. Each solution is purified and concentrated from evaporative concentration, producing lithium hydroxide. This process generates two byproducts: table salt (from the brine) and Glauber’s salt (from the spodumene).
   When it comes to spray drying, GEA powder engineers tailor each solution to a specific downstream component, utilizing one of two types of atomization devices: rotary or nozzle. Nozzles are available with pneumatic and pneumo configurations as are combination or multi-flow systems. Rotary atomization is the best solution for most scenarios given the equipment is easy to operate and energy efficient. The GEA COMBI-NOZZLE™ combines the best features of pressure and pneumatic nozzles and is specifically designed for Li-ion battery material, offering unique advantages over other nozzle types. Regardless of the atomization approach, GEA offers compact, single-line spray drying plants for any capacity.

6. Cell/battery manufacture
   A layer of coated lithium is inserted between the anode and the cathode to prevent contact between them, while allowing ion movement. The electrode structure is connected to the terminals, plus any safety device, and inserted into the case – which is then filled with an electrolyte solvent and sealed. Once assembled, the battery is activated via a charging and discharging cycle, then tested, after which it can be sold.

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