SULZER

TECHNICAL ARTICLE

Driving up efficiency – Optimizing manufacturing processes for the automotive battery industry

The adoption of electric vehicles across the world is increasing rapidly and this demand needs to be matched by the supply of batteries. As new processing plants and manufacturing facilities are constructed, it is important that they employ the latest in pumping technology to ensure optimum reliability and efficiency.

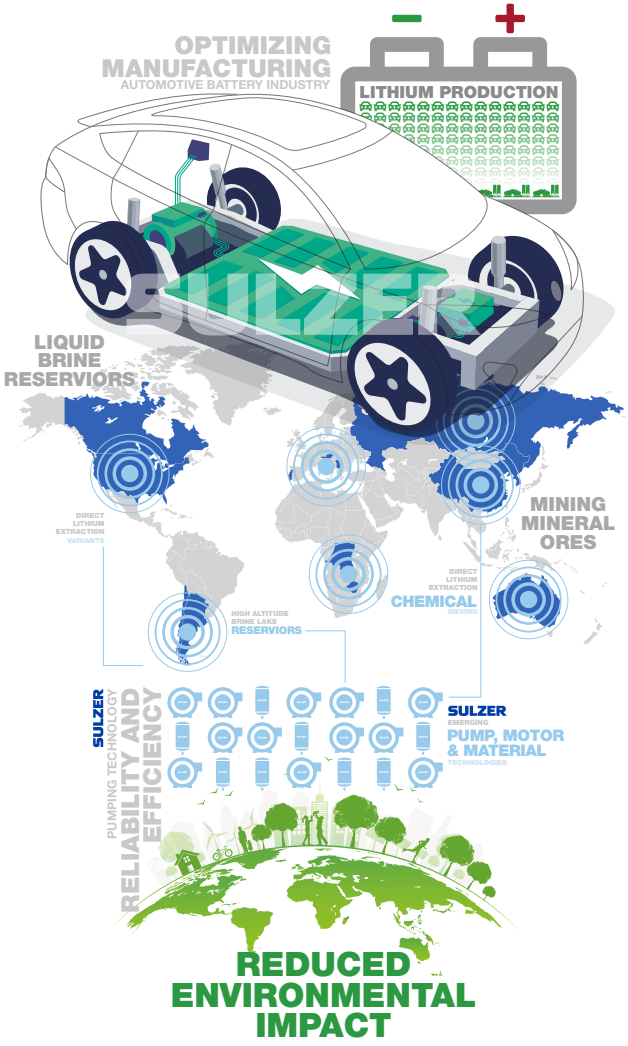
Ilari Pakkala, Head Sales Finland for Sulzer, looks at some of the challenges facing battery manufacturers and how they can be overcome using equipment that is tailored to the application.

The growth of the battery electric vehicle (BEV) market continues to exceed all estimates with an annual sales increase of over 150% in many market areas and this trend needs to be supported by more battery manufacturing facilities. At the same time, production in Europe is being ramped up to match established capacities in Asia, driving the need for production resources even further.

Current methods to capture raw materials

Primarily, the world's battery-grade lithium comes from two main sources – liquid brine reservoirs beneath salt flats and mining of mineral ores.

During the first of these methods, mineral-rich brine from high-altitude salt flats in South America is pumped to the surface into evaporation ponds where it is concentrated and precipitated as lithium carbonate. This is lengthy process, taking 12-18 months to achieve a strong enough distillate to produce the raw material used in lithium-ion batteries. Some plants also employ reverse osmosis (RO) technology to speed up the evaporation process.



To create the required forms of lithium, such as hydroxide, chloride and bromide, the concentrated brine has to be transferred through pre-treatment, chemical treatment and filtration. Each stage requires pumps that are specifically designed for the application to ensure an extended service life and long-term reliability.

The second approach, mining of mineral ores, is a more expensive process but the end product is attained much quicker. Pulverized ore is combined with a chemical reactant, such as sulfuric acid, and then heated, filtered and concentrated to create lithium carbonate or hydroxide. Pumping acidic slurries requires special attention to the materials used in the construction of the pumps and their seals to ensure effective and reliable service.

Emerging alternatives

A third method of obtaining lithium being used in China and North America is known as direct lithium extraction (DLE). There are as many as 60 variants of DLE technology, but the basic process involves using techniques such as nanofiltration or ion-exchange resins. These act like a chemical sieve to selectively collect just lithium chloride from the liquid brine, leaving other salts in the water. The lithium chloride is then purified and concentrated to produce lithium hydroxide, which is used to make batteries.

Other, innovative smaller scale processes are also used, such as extraction from geothermal water, which is currently under way in the UK, Germany and USA. The lithium processing plants are effectively water plants, refining a high-grade lithium output and clean water that can be returned and re-used. Generally, the process includes concentrating a brine, chemical conversion steps to change the lithium form, washing, and final crystallization.

Pumping processes

Throughout all of these extraction and purification processes, there is a need to transfer liquids between each stage and the contents of the liquid/slurry will have a major impact on the design of the pump. As emerging technologies, such as ultra-high pressure RO, gain prominence, so the pump design will have to change to meet the specifications of the process.

Across a typical processing plant, hundreds of pumps and mixers are required and most are installed with no redundancy to minimize costs. It is essential that the equipment features excellent reliability, as unplanned maintenance downtime can have a significant impact on the downstream production processes.

Specialized construction

For some processes in battery manufacturing plants, more specialized materials, such as titanium, Super Duplex or Hastelloy may be required to satisfy the demands of particular applications. For those areas designated as potentially dangerous, ATEX approved designs will be required and the pump manufacturer's design flexibility and expertise should ensure these and any other specifications can be accommodated during the early phases of a project.

This also applies to tank mixers and agitators, which are required for optimum process conditions. Considerable experience in the design and installation of these processes will ensure that pipework layouts and application efficiency are optimized.

Reduced environmental impact

In the battery industry, which is supplying power sources for vehicles that are designed to reduce their impact on the environment, the amount of carbon dioxide (CO2) that is produced by the manufacturing process should be considered. Installing premium efficiency motors and variable speed drives can have a double benefit – optimizing process efficiency as well as minimizing energy consumption.

As the demand for electric and hybrid vehicles continues to rise and some of the original models reach the end of their expected life, so there will be a new requirement for the recycling of the batteries. This process is already in development and as it is rolled out on an industrial scale, so Sulzer will be on hand to support it and ensure that it delivers further efficiencies for the industry.

sulzer.com