
dragonfly
ENERGY

Lithium battery technology breakthrough offers a healthy alternative

Advancements in PFAS-free lithium battery technology offer eco friendly energy storage, addressing environmental and health concerns while providing efficient, cost effective, and sustainable alternatives to traditional manufacturing methods.

Technological advancements have paved the way for lithium iron phosphate (LiFePO4) batteries to emerge as an innovative, eco friendly choice for energy storage. Lithium-ion batteries have revolutionised the battery landscape over conventional lead-acid batteries due to their increased energy density, extended lifespan, improved safety, temperature tolerance, and faster charging capabilities.

But globally, concerns continue to mount over substances typically used in lithium battery electrode production; per- and polyfluoroalkyl substances, commonly referred to as PFAS. These substances are widely used in battery components, from electrolytes to electrode binders, and lithium-based solid state batteries. Today, traditional lithium-ion battery production relies on both PFAS and toxic solvents like NMP (N-Methyl-2-Pyrrolidone).

'Forever chemicals' pose risks to health and environment

The lithium battery industry is at a critical juncture, as overarching concerns about PFAS are forcing manufacturers to consider risks inherent to traditional processes. Many of the approximately 10,000 substances that fall under the umbrella of PFAS classification are harmful to human health and the environment.

They are known as 'forever chemicals' due to their environmental persistence, they can remain in the environment for generations after their release. Humans absorb PFAS primarily through food and drinking water, and they can be detected in soil, animal feed, and consumer goods. They're considered carcinogenic and suspected of harming hormones and immune systems.

'If their PFAS releases are not minimised, people, plants, and animals will be increasingly exposed, and without a restriction, such levels will be reached that have negative effects on people's health and the environment,' reports the European Chemicals Agency (ECHA). 'The authorities estimate that around 4.4 million tons of PFASs would end up in the environment over the next 30 years unless action is taken.'

Because PFAS are released into the environment during the production, disposal, and recycling of traditional lithium-ion batteries, these substances pose a growing challenge for the energy industry. This means industry leaders in green energy

storage are tasked with addressing a critical challenge. Companies are attempting to serve the dual imperatives of environmental sustainability and technological advancement by innovating significant breakthroughs in battery manufacturing by producing PFAS-free electrodes in lithium battery cells.

'The battery industry is stepping up research and development towards PFAS-free batteries,' notes ZVEI, Germany's Electro and Digital Industry Association, in its PFAS in Batteries factsheet. 'If there are suitable alternatives for PFAS with comparable properties, the battery industry is committed to using these.'

The challenge has been to develop a sustainable and community sensitive route to PFAS-free lithium battery production that is both widely implementable and cost effective at market scale. Research and development are rising to this challenge through technological innovations.

Dry electrode manufacturing: a revolutionary solution with PFAS-free electrodes

Challenges like this demand innovation. Dragonfly Energy, an American comprehensive lithium battery technology company specialising in cell manufacturing, battery pack assembly, and full system integration, is one such company working towards a sustainable and widely implementable solution. It has successfully dry deposited lithium iron phosphate anode and cathode electrodes at scale using a new, innovative, patented battery manufacturing process.

Notably, this process has successfully produced a working lithium cell using PFAS-free electrodes.

Dragonfly Energy's dry electrode battery manufacturing uses patented spray coating technology to deposit anode and cathode electrodes, eliminating the need for large, energy intensive equipment such as slurry coaters, conveyor dryers, and NMP processing equipment. The pilot line's success shows exceptional scale and reveals performance at a level sufficient to support large scale production.

Advantages of the dry-deposition process

A dry electrode process serves the overarching mission of being an environmentally safe, reduced cost energy storage manufacturing solution that is free of PFAS. Among the advantages achieved in this new process is eco friendly green technology. The process allows the cells to be manufactured without the toxic solvent present in conventional cell manufacturing, which not only makes the process more environmentally friendly but also more cost effective.

It effectively translates to other applications too. This process is chemistry agnostic, meaning it can be used for diverse purposes across a variety of lithium chemistries and a broad spectrum of applications, including energy storage systems, electric vehicles, and consumer electronics.

Additionally, this process allows for the creation of non flammable, all solid state batteries containing a solid electrolyte rather than liquid thereby making it lighter and safer.

There are also advantages to be had in terms of space saving, resulting in further environmental benefits. The process significantly reduces the manufacturing footprint required to produce lithium-ion battery cells by eliminating the need for large, energy intensive equipment such as slurry coaters, conveyor dryers, and solvent reclamation equipment. This significant reduction in energy and space is expected to meaningfully reduce the environmental

impact of future battery production compared to conventional manufacturing.

With these advantages in mind, it's important to consider that the process not only successfully produces PFAS-free electrodes but was also recently validated for its sustainability and cost effectiveness.

Results from this cost and sustainability assessment conducted by Sphere Energy, a global battery testing and advisory firm, concluded that the dry electrode battery manufacturing process resulted in the following:

- 9% reduction in carbon footprint for cell manufacturing with no toxic NMP solvent required, resulting in a significantly more sustainable process.
- 71% reduction in energy usage during electrode manufacturing, using the dry electrode process of spray drying, coating, and calendaring, compared to standard cell manufacturing operations of slurry casting, drying, and calendaring.
- This proprietary manufacturing process requires 22% less square footage by eliminating the need for large and expensive drying ovens.
- 25% reduction in emissions from energy use, making it more sustainable and much more environmentally friendly as compared to conventional manufacturing methods.

Global demand for alternative processes

To survive, lithium battery companies will be forced to find alternate means of production as they recognize the global need to produce PFAS-free electrodes. Both the European Union and US Environmental Protection Agency (EPA) are proposing restrictions on their use. This could negatively impact many battery suppliers, unless they heed the call and develop alternate manufacturing means.

Specifically, the EU is poised for a significant shift in its approach to PFAS regulation, with a proposed ban on over 10,000 PFAS chemicals on the horizon. This aggressive restriction, currently under evaluation by the European Chemicals Agency (ECHA), could take effect as early as 2026. Aimed at safeguarding public health and the environment, this ban presents a significant challenge for the European battery industry, which is undergoing a critical growth phase.

As companies attempt to produce lithium battery cells with PFAS-free electrodes successfully, they'll be positioned to capitalize on market shifts toward sustainable alternatives; undoubtedly, regulations will soon come into effect in some markets while others are still being considered.

The removal of persistent forever chemicals from lithium battery cells also presents an opportunity for differentiation. For example, Dragonfly Energy's scalable cell manufacturing process is now available for global licensing and joint development opportunities, positioning them for international partnerships. These could take the form of licensing a scalable cell manufacturing process, enabling established manufacturers to adopt environmentally friendly technology.

New technology like dry electrode deposition is only one of many future possibilities to address the growing demand for clean energy solutions worldwide.

Paving the way for improved processes and increased sustainability

The dry deposition process during the manufacturing of lithium batteries will result not only in the advantages outlined above, but also increased economic growth, job creation, and bolstering of the lithium battery economy. Thanks to new technology, this can all be done in a manner that is safer for the environment and human health.

As clean energy leaders continue to progress on their mission to produce sustainable lithium batteries and eliminate reliance on PFAS, demand for lithium batteries is skyrocketing. New technology will shepherd the industry toward enhanced sustainability.

The lithium battery industry is essential to the EU, to the US, and to global economies and is a crucial enabler for sustainable development, green mobility, clean energy, and climate neutrality. RECHARGE, Europe's industry association for advanced rechargeable and lithium batteries, noted in its industry report: 'To achieve EU Green Deal objectives, the European Commission has identified batteries as a strategic value chain.'

Innovative processes like dry electrode manufacturing and the removal of PFAS may be the game changing solution to a green energy storage future and safe, efficient, reliable batteries powering our world.

www.DragonflyEnergy.com