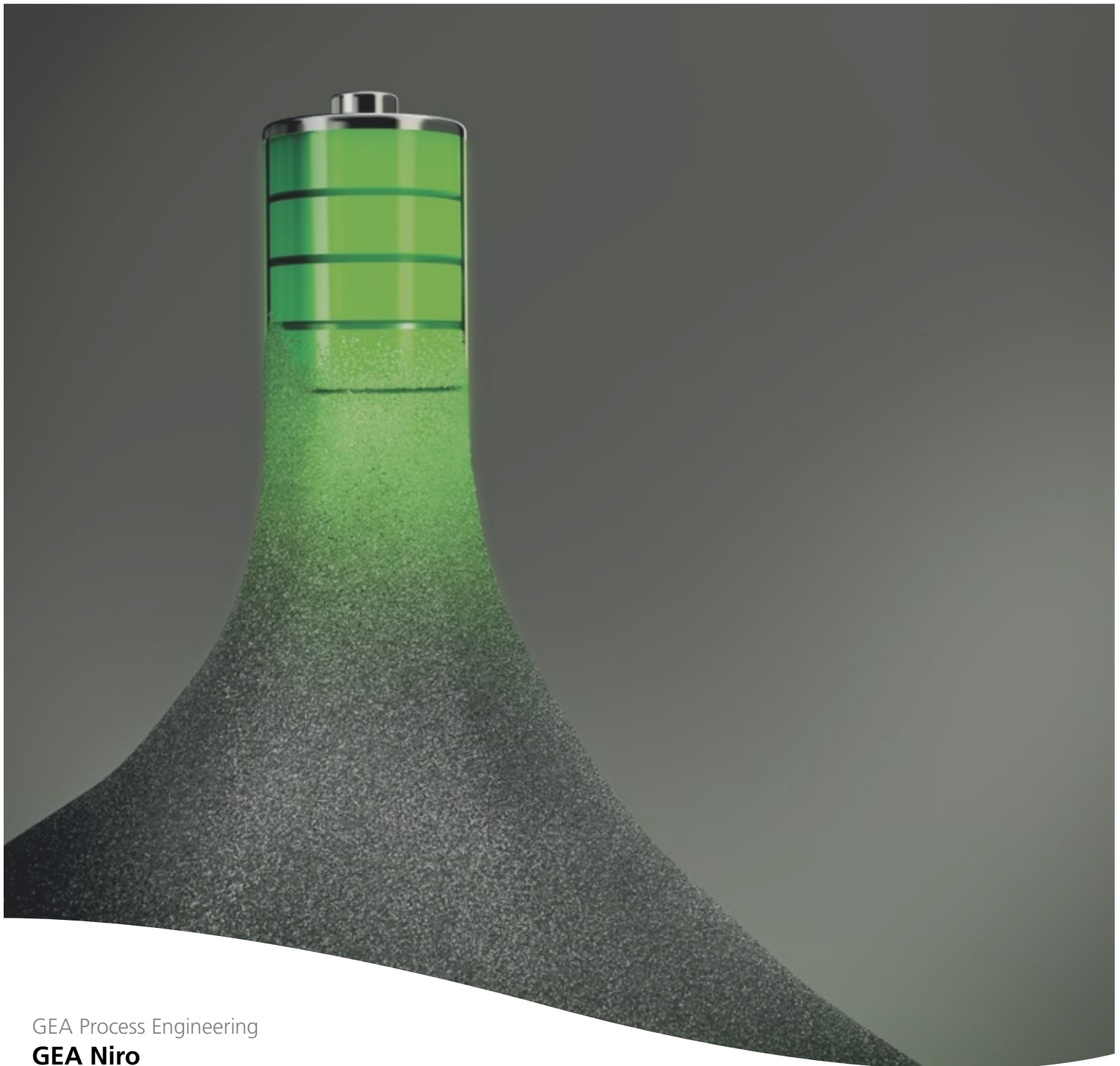


# Developing Li-ion battery materials

Take charge with GEA Niro spray drying



# You get the power to go further with GEA Niro

As the quest to develop lithium-ion batteries with increasingly greater performance continues, it's more crucial than ever to realize the full potential of every aspect of the battery-making process. No matter where you envision your Li-ion battery materials being used, GEA Niro has the expertise to meet precisely your spray drying needs.

## You deserve a spray drying specialist

There's no such thing as a "one-size-fits-all" solution when it comes to the spray drying of Li-ion battery materials. Because individual cathode and anode powders vary widely in composition and characteristics, GEA Niro's powder engineers tailor each solution to the specific application and specifications.

Comprehensive pilot plant testing enables us to select and optimise the process design, so that you can produce powders of consistently superior quality – in the most energy-efficient and cost-efficient way. It's something we've been doing for more than 75 years.

## Get a system that's right for you

When we develop your spray drying solution, we consider two types of atomization devices: rotary and nozzle (with pressure and pneumatic nozzles, including combination or multi-flow nozzle systems).

We recommend rotary atomization most frequently, since the equipment is particularly easy to operate and uses little energy. Rotary atomization of Li-ion battery materials typically produces a mean particle size of <10 microns to >100 microns.

GEA Niro's proprietary nozzle technology, including the COMBI-NOZZLE™, enables us to cover an even wider size range, from just a few microns up to several hundred microns. Regardless of the atomization approach, GEA Niro offers compact, single-line spray drying plants of any desired capacity.



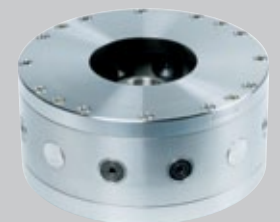
*By tailoring each spray drying plant, GEA Niro helps customers achieve high performance.*

## Rotary atomization

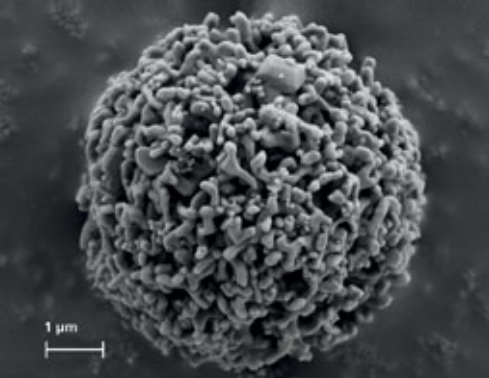
GEA Niro takes rotary atomization technology further than anyone else in terms of performance, capacity and durability. Advantages include:

- **Lowest energy consumption**
- **High flexibility**
- **Easy operation**

The handling of abrasive materials calls for specialised, robust solutions. That's why we've developed abrasion-resistant rotary atomizer wheels for prolonged production of consistently high-quality powders.



*GEA Niro rotary atomizer wheel with WEARSERT™ inserts (patented) for abrasive materials.*



*Optimized particle morphology and size make powders spray dried with GEA Niro ideal for further processing.*

### The world leader in spray drying

GEA Niro pioneered the field of spray drying and remains at the forefront. We are continuously pushing the boundaries of the technology into new, even more beneficial directions. And with the largest spray drying “tool box” in the world, we offer you the most comprehensive range of spray drying solutions anywhere.

This includes plants designed for handling either aqueous or non-aqueous (organic solvent) feeds – where nitrogen is used as an inert drying medium. Furthermore, all GEA Niro plants are designed to meet international health and safety standards.

### Meet rapidly changing demands

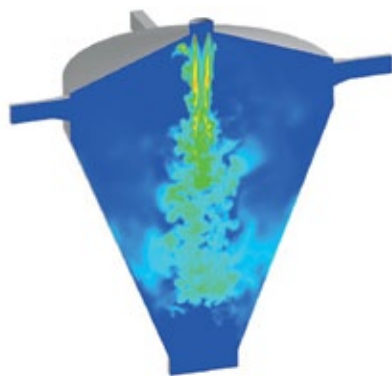
Since you operate in a dynamic environment with rapidly changing needs, we make sure our spray drying plants can be adapted with the same speed. GEA Niro’s unsurpassed understanding of all aspects of the spray drying process makes us an ideal partner. You get a solution with the flexibility to meet future needs, no matter where your research takes you.

### Maximum plant availability and economy

GEA Niro’s success is based on our ability to bring maximum value to customers like you. Our tailored, reliable spray dryer designs and quality components ensure maximum plant availability and the overall best plant economy. When you choose GEA Niro, you get access to the world’s foremost spray drying expertise – which you can use to ensure continuous, optimum performance of your spray drying plant.

### Learn more – at no “charge”

If you’d like to hear more about how GEA Niro can help you realize the full potential of your Li-ion battery materials, please contact us. No strings attached, and no cost!



*GEA Niro’s state-of-the-art capabilities within Computational Fluid Dynamics simulations support the design of our spray drying solutions. This CFD simulation shows the instantaneous fraction of water vapour in a spray dryer.*

## Nozzle atomization

GEA Niro’s COMBI-NOZZLE™ combines the best features of pressure and pneumatic nozzles. The COMBI-NOZZLE™ has been specifically developed for Li-ion battery materials and offers unique advantages over other nozzle types:

- **Smaller mean particle size**
- **More narrow particle size distribution**
- **Lower energy consumption**

A multiple nozzle system allows for a very high single-line capacity and eliminates the need to shut down the plant for nozzle maintenance.



*GEA Niro’s processes use the COMBI-NOZZLE™ (patent pending) for any desired plant capacity.*



## Experience

GEA Niro has contracted and installed more than 10,000 plants worldwide

GEA Niro is a world leader in industrial drying, with spray drying, spray cooling/congealing, flash drying, freeze drying, granulation and fluid bed processing as core technologies. Having installed more than 10,000 plants around the globe, GEA Niro is known for delivering solutions that meet customers' exact requirements. The GEA Niro companies are part of GEA Process Engineering.



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