Innovative mixing technology in LiB electrode production

How to reduce power consumption, CO_2 emissions, space requirements and overall costs in Gigafactories

1. Summary

The demand for lithium-ion batteries is continuously increasing.

In Europe alone, production capacities are expected to grow tenfold from the current level by 2030. The prerequisite for this is that energy storage manufacturers, in close cooperation with their technology partners, succeed in making the production process as efficient as possible. On the one hand, European battery manufacturers can only be competitive on the global market if the increased electricity costs are at least compensated. Secondly, the European Union's requirement must be implemented: The current 27 member states of the EU are to become climate-neutral by 2050.

The first step now is to achieve a 55 % reduction in greenhouse gas emissions by 2030 compared to 1990 levels. Manufacturers of lithium-ion battery cells for electromobility and stationary energy storage are not the only ones who need to take swift action if they want to achieve this ambitious target.

Important levers for greater energy efficiency in Gigafactories lie in electrode production, particularly in mixing technology. Planetary mixers have been used as standard for slurry production for some time. However, alternative mixing processes perform significantly better in a comparison of energy consumption, CO_2 emissions, space requirements and costs. The efficiency of the Eirich solution deserves to be highlighted in particular.

Experts also see potential for an even more efficient electrode production process overall in innovative dry electrodes. Further savings are expected in terms of energy consumption, CO_2 emissions, production costs and the use of resources.

Solutions were presented, for example, at the first Dry Coating Forum in Dresden in June 2024, also by Eirich. With the Eirich mixer, the company also offers a promising solution for this application.

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2. Innovation drivers today

More and more Gigafactories for the production of lithium-ion battery cells are being built around the world, particularly in China, the USA and Europe - with the current focus on France and Germany. According to current estimates, production capacities in Europe, for example, are expected to increase to around 0.8 - 1 terawatt hour by 2030.

High raw material costs and the associated considerable capital lock-up when transporting cells from overseas are good reasons, despite the current high electricity prices in Europe, to locate cell factories close to major consumers in the future, including automotive OEMs or electricity grid operators who use battery packs to stabilize the grid.

Machine builders and cell manufacturers are faced with the challenge of significantly reducing production costs in cell manufacturing. It appears necessary to reduce costs at cell level by at least a third from the current level of around US$ 80-100 to US$ 50 or less.

Changes in the production chain, including technological leaps, are therefore absolutely necessary in order to compensate for the increased electricity costs as best as possible by reducing electricity consumption, for example, and ideally even to exceed them. In addition to electricity costs, however, there are other factors that influence the manufacturing costs of battery cells. These also need to be kept in mind and reduced wherever possible.

3. Approaches for greater efficiency in Gigafactories

The most important approaches for greater efficiency in Gigafactories lie in electrode production. Possible starting points are:

3.1. Reduction of rejects

Scrap rates in Gigafactories today are in the range of 10-40 %. If you consider the large number of production steps, this is easy to understand. With typically 15 production steps and an efficiency of 98 %, for example, corresponding to a scrap rate of 2 % per production step, this effectively results in almost 35 % scrap at the end of the production chain. That is a considerable amount. It is therefore highly advisable to keep the reject rate in each individual manufacturing step to a minimum. Linked to the proportion of rejects are additional costs for recycling or reprocessing the materials used. These are also factors that have a considerable impact. High reproducibility and accuracy in the dosing and mixing process as well as good temperature control are the basis for minimal deviations in slurry quality in terms of solids content, density and, above all, viscosity, and an essential prerequisite for reducing the reject rate.

3.2. Reduction of drying costs

The drying costs [1] currently account for around 25 % of the total costs for wet coating of electrodes within the production chain. As a rule, however, the costs stated in this context do not consider the costs for the solvents used, nor the additional costs for reprocessing the deposited condensates, as is common in large Gigafactories directly on site. If it is possible to increase the solids content of the coating slurry by just 1 or 2 % points with the same viscosity, considerable cost savings are already possible.

3.3. Reduction in costs for dry rooms

The costs for dry rooms depend on the enclosed space and are around 35 % of the total costs [1]. They are influenced by the enormous amount of floor space required and the height of the buildings around the mixing plants, coaters and calenders. Ever-increasing requirements for the ultra-low dew points due to the use of high-nickel cathode materials such as NCM 811 are currently further increasing operating costs. More compact machines and system concepts or even micro-environments can significantly reduce the size of dry rooms or even eliminate them particularly.

3.4. Replacement of technologically outdated mixing technology

Planetary mixers, which are often still used for slurry processing, are extremely energy-hungry in the production of high-quality electrode slurries. In addition, cooling energy is required to eliminate the dissipated heat produced in the process. Furthermore, the space requirement and thus the required enclosed space is comparatively large. Innovative, highly efficient mixing technology offers enormous optimization potential here. Detailed information on this can be found in chapters 4 and 5.

3.5. Technological leaps in electrode production

Wet-processed electrodes are still the standard in the production of lithium-ion battery cells. Now, processes to produce dry electrodes are increasingly coming into focus [5-7]. Among other things, they promise enormous energy savings, for example through significantly smaller dry rooms and no energy consumption for drying or processing solvents. The space required for dry electrode production is also smaller overall, which can lead to further cost savings.

4. Optimization potential in the production of wet electrodes

The standard mixing technology traditionally used in the wet processing of electrode slurry is - as already mentioned - the planetary dissolver mixer (PD mixer), often simply called a planetary mixer. Its prevalence within the industry is due to historical reasons. After the PD mixer was used alongside dissolvers in development laboratories for slurry production at the end of the 1990s, it was used in the 2000-2015s in the more manufacture-like production of cells for cell phones, consumer electronics and electrical tools. From around 2015, the PD mixer also became increasingly established in large-scale production and Gigafactories, where it is now the standard.

4.1. Disadvantages of planetary mixers

Planetary mixers have become larger and larger over time. The mixer volumes have increased from 50-100 liters in the past to up to 4,600 liters today with a drive power of over 560 kW and an empty machine weight of 50 t, whereby the effective usable volume is less than 70 %. Mixer sizes in the range of 1,200 to 2,000 liters are currently common. As this is often not enough to achieve the required capacity, several mixers are installed in parallel. This in turn leads to enormous space requirements. The gigantic machines are up to 10 meters high. The required floor space is sometimes equivalent to the floor area of a small single family home.

However, due to the long charging, mixing and emptying times of 6 to 8 hours, even the gigantic PD mixers have a rather low effective output. It is a few hundred liters per hour and machine, i.e. about 1-2 GWh production capacity. In some plants, the mixing time is reduced to a few hours, but then upstream dry mixers and downstream dispersing mills are required to compensate for the inadequate mixing quality. These require additional energy and space.

4.2. Alternative mixing processes

In short, planetary mixers are space-consuming and inefficient. This has been recognized not only by Maschinenfabrik Gustav Eirich, which has its MixSolver® in its portfolio for slurry production,

but also by other machine suppliers. With twin screw extruders or inline dispersers, they offer continuous mixers as an alternative. The manufacturers like to argue with the advantages of the continuous process. However, this is misleading. Although mixing is continuous, the continuous mixers are integrated into a batch process. The manufacturing processes in these methods can be better described as an interplay of batch processes with continuous mixing and dispersing processes in sections. In order to operate the demanding and rather inflexible continuous dispersion process on an industrial scale, the production of binder solutions and powder premixes, circulation around the continuous dispersion unit as well as batch degassing and slurry buffers are necessary.

What ultimately counts in slurry production is that qualified coating material is continuously supplied to the coating heads in the desired quantity and quality. In addition to the MixSolver®, Eirich offers a solution that guarantees this with the ContiFeeder® technology, so that it makes no difference to the operator at the coater whether a batch or continuous mixer is integrated in the upstream step.

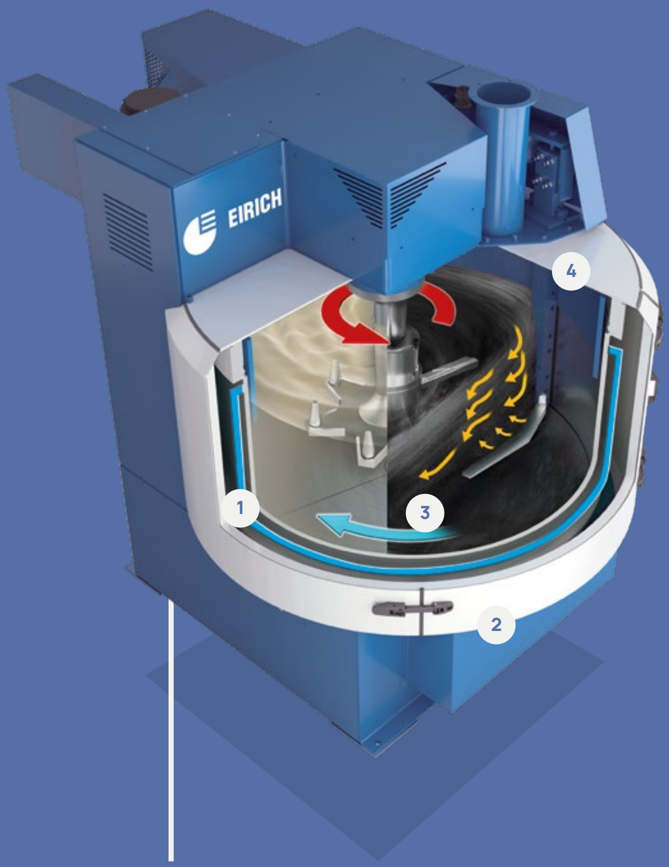
From the planetary mixer to the MixSolver®

The planetary mixer was invented by Eirich in 1907. Less than 20 years later, in 1924, Maschinenfabrik Gustav Eirich introduced the patented Eirich mixing principle with a rotating container and eccentrically arranged mixing tool to the market. This eliminated the typical weak points of the planetary mixing principle. The mixing technology experts from Hardheim have therefore only been offering this extremely efficient Eirich mixing principle for 100 years now.

It has also been used in the production of lithium-ion batteries since 2010, both in electrode production and in the upstream production of raw materials for cathode (precursor/Li mixtures, functionalization of synthesized CAM) and anode (synthetic graphite, graphite-SiOx composites).

Since 2018, the Eirich mixing principle, which has previously proven itself in research and development, has been used in more and more Gigafactories and large 1:1 Giga Scale pilot plants with plant sizes of currently up to 6 GWh. The mixer types optimized for battery slurries, the Eirich-MixSolver® in vacuum design, are equipped with:

- **integrated double jacket cooling,**
- **100 bar high-pressure liquid additions for optimized slurry preparation with self-cleaning effect, which can of course also be used for cleaning the machines in special cleaning sequences before maintenance work, and**
- **special discharge systems for the finished coating slurry.**



Specially tailored to the requirements of electrode slurry production: the Eirich-MixSolver®

1 Double-walled mixing vessel for temperature-controlled process
2 Pressure housing for degassing the slurries under vacuum (EvacMix® technology)
3 Special patented discharge closure for slurries, alternatively vacuum suction system for structured dry mixes and slurries
4 High-pressure liquid addition and cleaning system

The mixers, which have similar geometries for volumes of up to 3,000 liters, enable highly efficient slurry production in just 15-20 minutes for most of the cell chemistries. This applies to laboratory operation on a 1 liter scale as well as to full-scale production operation, e.g. on the 500 l RV12 mixer. MixSolvers® have been proven to impress with their uniquely simple scale-up with identical production times and specific energy consumption.

5. In comparison: Energy consumption for mixing and dispersing work

Depending on the cell chemistry and the reject rates set by the operating company, the usual throughput rates of Gigafactories are currently between 100 and 300 l/h GWh/a with average values in the range of 180 - 230 l/h GWh/a per polarity. The throughput of a 10 GWh/a production plant is around 2,000 liters of slurry per hour. Slurry production must be mapped using appropriate mixing technology with the highest possible efficiency (lowest energy consumption, downtimes for cleaning and maintenance as well as waste).

At symposia and on machine manufacturers' websites, information on energy consumption is increasingly being provided, which will be compared below using the example of a 10 GWh/a factory. For the Eirich MixSolver® , in addition to published values from Haberzettl [2] for laboratory and pilot machines, there are also measured values from 1:1 scale pilot productions such as at UKBIC and also running Gigafactories, which confirm these values in large production machines.

Although the MixSolver® is equipped with relatively large motors for the respective mixer size (e.g. 55 kW for a 500 l RV12 mixer; corresponds to 110 W/l - in comparison, a planetary mixer has approx. 175-200 W/l installed power), the maximum power, which mainly depends on the batch mass, is only called up briefly for a few dozen seconds at the start of the kneading phase. The power consumption in the 1-minute dry mixing phase of all powdered raw materials including the binder before and in the 3-4 minutes dilution phase following the kneading phase is only a fraction of this. Even during the kneading phase, the motor power drops exponentially as the raw materials are continuously dispersed and the binder is dissolved, resulting in significantly lower average power consumption than the peak power.

Haberzettl specifies a value of 22 Wh/l for graphite anodes and 17 Wh/l for NCM cathodes. On a Gigafactory scale, e.g. on a current 500 RV12 mixer, slightly lower values of 15-17 Wh/l for anodes and slightly higher values of 16-20 Wh/l for NCM cathodes are determined in production operation.

In comparison, Polek gives values of 75/85 kWh/t for 93 mm twin-screw extruders [3], which, converted to liters, corresponds to a value of 100 Wh/l for anodes with a slurry density of 1.3 kg/l and 170 Wh/l for NCM cathodes with a slurry density of 2.0 kg/l, respectively. For planetary mixers, however, values between 300 and 750 Wh/l can be found in the literature [3,4]. In contrast, values of 125 Wh/l are given for inline dispersers, for example [4].

The following table shows what this means for a 10 GWh production line with an annual throughput of 2000 l/h per electrode. Assuming rather low electricity costs of €100/MWh for Germany and CO_2 emissions of 428 gCO_2/ kWh CO_2 electricity equivalent [9] for an operating time of 8,500 h/a, there are enormous differences for the various mixing systems with a calculated throughput of 17 million liters/year and electrode.

	Total electrical consumption mixer per 10 GWh factory (GWh/a)	Total electrical consumption chiller per 10 GWh factory (GWh/a)	CO_2 emissions mixing per 10 GWh factory (1000t/a)	CO_2 emissions chiller per 10 GWh factory (1000t/a)	Operating costs electricity mixing @ 100 €/MWh in Mio €/a	Operating costs electricity chiller @ 100 €/MWh in Mio €/a	CO_2 EU carbon permits costs forecast 2025 @150 €/t CO2 in (Mio.€/a)
Eirich MixSolver	0,6	0,83	0,28	0,36	0,06 €	0,08 €	0,09 €
PD Mixer	13,3	17,09	5,7	7,3	1,33 €	1,71 €	1,95 €
Twin Screw Extruder	4,6	5,90	2,0	2,5	0,46 €	0,59 €	0,67 €
Inline Disperser	4,3	5,46	1,8	2,3	0,43 €	0,55 €	0,62 €

The planetary mixer has by far the highest electricity consumption with a total of 13.3 GWh/a (with average consumption values). While twin-screw extruders and inline dispersers only consume around a third of the electricity of a planetary mixer, the Eirich MixSolver® consumes even significantly less. With a total of less than 1 GWh/a, its electricity consumption is once again significantly lower than that of the continuous mixers, at around one fifth.

6. Innovative Eirich mixing technology ensures maximum efficiency

The cost savings for electricity alone in relation to the mixing and dispersing work are in the millions per year when using Eirich MixSolvers®, especially if the usual block sizes for cell production of 15 to 20 GWh are taken as a basis. That should actually be enough of an incentive to switch systems. But there are other factors that have a positive effect when switching to Eirich mixing technology.

6.1. Cooling optional

For physical reasons, only a fraction (approx. 10 %) of the power input is converted into mixing or dispersing work during mixing. The majority (approx. 90 %) is dissipated in the form of heat. With the Eirich MixSolver®, typical solid contents of 50 % (anode) and 70 % (cathode) with specific heat capacities of 0.8 kJ/kgK for the solids, 1.7 kJ/kgK for NMP and 4.2 kJ/kgK for water with the above-mentioned energy quantities in Wh/l result in calculated temperature increases of the mixture of 20-30 °C (without cooling or consideration of losses), with continuous mixing of 100-250 °C and with planetary mixers of 300-800 °C. At 202 °C at the latest, NMP starts to boil at atmospheric pressure. This means that in planetary mixers without cooling, a large part of the dissipated energy would be used to vaporize the liquid. Both the solids content and viscosity would be unacceptably altered as a result. As confirmed in practice, the MixSolver® can in many cases even be used without the use of double jacket cooling due to the very low heating. This is not possible with all other mixing systems due to the enormous temperature increase. Cooling and the associated operation of electric chillers with relatively low efficiency is indispensable and energy-intensive. Experience and calculations can easily show up that it doubles the energy consumption calculated above and therefore also the CO_2 emissions.

6.2 Highly efficient batch mixers

The larger a mixer is, the more inefficient it is in terms of energy dissipation over the mixing vessel walls. All mixers have a scale-up-related problem: The motor heat introduced into the cubically increasing volume can only be removed via the quadratically growing heat exchange surface. This makes it more efficient and flexible to process electrode slurry of the same quality with several smaller batch mixers such as the RV12 MixSolver® than in gigantic planetary mixers. The increasingly poor heat dissipation can only be compensated for by extending the mixing time, e.g. through additional cooling times with low energy input. This continues to reduce the specific throughput of the ever larger planetary mixers with volumes of 2,000 to 4,600 liters. Experience has shown that continuously operating twin-screw extruders have to contend with changes in slurry quality when the throughput rate changes due to the corresponding retention time. Enormous efforts have to be made to achieve absolutely uniform dosing of powders and liquids on a permanent basis. Either pre-mixed powders are prepared in batch mixers or special high-performance feeders are used, especially for small additive quantities. In the continuous process, dosing fluctuations are passed through into the prepared product in waves, so that complex and cost-intensive inline sensor technology is also required for stable operation with low rejects.

6.3 Minimized reject rates

In planetary mixers, material build-up on the planetary gears in the mixing chamber and the hot tool shafts of the dissolver disks leads to contamination of the mixture with agglomerates that can no longer be broken down. This is caused by moist machine surfaces to which powder from the addition phase adheres or slurry splashes that dry out and harden on the hot surfaces. If a 1,500 liter batch becomes unusable as a result, considerable material costs in the tens of thousands of euros are almost irretrievably lost. Multiple filtration stages, which tend to clog and thus lead to interruptions, and frequent, time-consuming cleaning stops combat the result but not the cause.

The MixSolver® ensures that no permanent build-up occurs in the mixing chamber or that freshly formed build-up is immediately rinsed off again by adding the liquid naturally required for slurry production at high pressure during certain mixing phases. In this way, the solids content remains constant and uninterrupted batch operation is possible.

Just-in-time production and partial quantity preparation make it possible to produce qualitatively identical slurries for the start-up of coaters or for product changes, as well as the mass supply of slurry to the coaters in uninterrupted continuous operation. The reject rates are thus minimized. This further increases the efficiency of the system.

Using a relatively simple inline rheology measurement directly with the mixing tool, comparable to a viscometer, faulty slurries can also be identified before emptying and, if necessary, brought into the desired tolerance range by adding dilution or extending the mixing time.

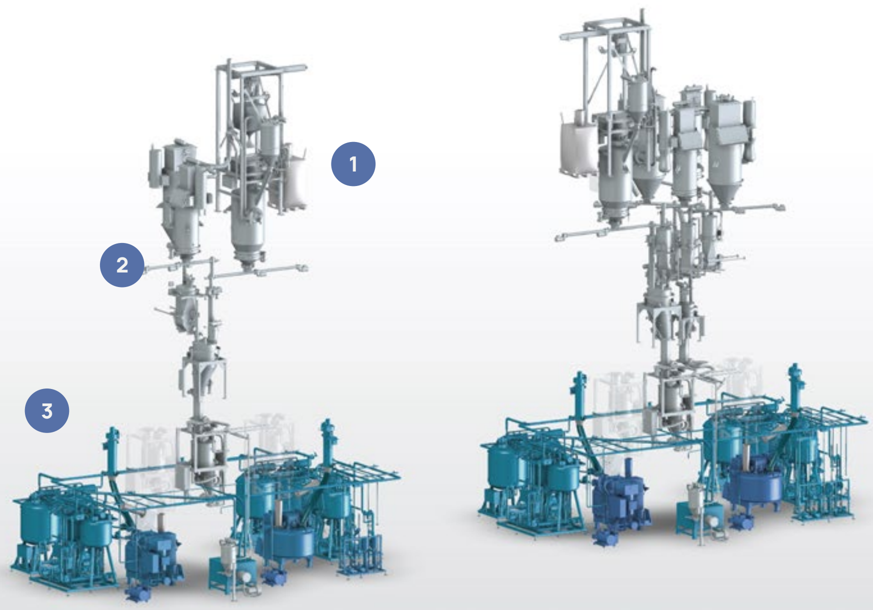
However, experience from Gigafactories has so far shown that this is not necessary in continuous operation of the systems and that the number of faulty mixtures to be rejected in fully automatic operation is close to zero. The viscosity curves of different batches are within very narrow limits - the system runs like clockwork.

6.4 Less enclosed space

If you look at the building volume required for the mixing plants and the dry room built around them in practice, further enormous savings are possible here. Typical large mixing plants with planetary mixers are usually built on two levels. For the huge mixers, room heights of approx. 15-18 m are required on the lower level, and a further 10 m room height on the upper level for powder dosing. Due to their compact machine design, the alternative mixing processes generally fit into the first floor with their entire system height - the upper floor could therefore be completely omitted. Eirich requires even less space for MixSolver® and ContiFeeder® technology, especially for high throughputs, where twin-screw extruders have to install several complete mixing towers, each with its own solids dosing system. With MixSolvers, up to four mixers are lined up in a line with a single solids dosing system. Thanks to the integrated distribution system, they only take up approx. 1/3 of the floor space required for a planetary mixing system. The enclosed space can be significantly reduced. This also results in considerable cost savings for the erection of the dry rooms and for their operation.

6.5 Micro-environment

If a dry room atmosphere cannot be dispensed with, it is possible to realize the dry room atmosphere solely within the system components. The space exposed to the dry room atmosphere is then only a tiny fraction of the space required to install the entire system in a dry room. For this purpose, the inside of the powder feeders, silos, dosing units and scales as well as the mixers are permanently exposed to dried air. Humidity sensors monitor the interior of the system and feed in appropriately treated, dry air where necessary. A controlled micro-environment is created within the system, which massively reduces the investment and, above all, operating costs for a classic dry room. The dry room surrounding the system can be omitted completely or designed at a lower level, e.g. a dew point of -40 °C instead of -60 °C. As a positive side effect, the working conditions for the employees who have to carry out powder logistics and handling in the dry rooms are improved.



Plant concept 6-10 GWh
for the production of anode and cathode slurries

1. Raw material handling
2. Weighing and dosing of all raw materials
3. Preparation of the electrode mixtures in one, two or up to four MixSolvers® depending on the planned throughput, with slurry and buffer tanks

7. Optimization potential through dry electrodes

In view of the challenges facing this industry, both in terms of cost reductions and the reduction of greenhouse gas emissions, it is important not only to further develop electrode production in an evolutionary way, but also to have the courage to break new ground. Tesla provided a major impetus for groundbreaking technological changes at its Battery Day 2020 with the presentation of the dry electrode process.

It goes back to developments by Maxwell for supercaps in 2014 [7]. While all cell manufacturers were essentially working on classic wet processing before 2020, global research and development work at universities, but above all at cell and raw material manufacturers, increased dramatically due to the cost reduction potential promised by Elon Musk. More and more publicly funded research projects such as CircuBat, ÖkoTrop, DryTreac and ProLit, in which Eirich is also involved, are currently underway. In addition, there is intensive industrial development work, such as by Tesla, AM Batteries and Licap or as recently published by PowerCo and other European OEMs.

7.1. Dry electrodes save space

The dry electrode process eliminates the coating and drying step as well as the vacuum post-drying of the coils. The powder mixtures are usually processed into electrodes in modified heated multi-roll calenders. In addition to the complete elimination of all liquids used, these do not have to be evaporated, condensed or, in the case of solvents, reprocessed. The 50 to 100 m long drying sections between the coater heads, which currently determine the building dimensions, are no longer required. This also applies to the hot air generation and filter/condensation systems for supplying/disposing the dryers with drying air, the cold water generators for the condensers and the distillation systems for reprocessing the NMP separated from the exhaust air.

The building structure of the Gigafactory can therefore be significantly reduced in size, resulting in corresponding savings in construction and operation [7].

7.2. Structured dry mixes as a basis

Two conceptually different processes with different TRL levels are currently in competition.

- Production of a powder mixture with subsequent powder application by spraying, brushing or electrostatics on the current collector foil with subsequent hot calendering [6]

- Production of a powder mixture with superimposed fibrillation of PTFE to produce a moldable, elastically plastic mixture, which is processed into a free-standing film in a calender gap and then laminated onto the current collector foil [5].

In both cases, segregation-free structured electrode dry mixes are required. One possibility for this is to coat conductive carbon black onto the particle surfaces of active materials. The binder must be mixed in homogeneously and, when using PTFE, must also be broken down into fine micro- and nanometer-thick fibres, so-called fibrils, by means of targeted temperature control and high shear. The fibrils link together to form a spider web-like structure, which makes the mixture moldable or rollable into a stable film.

7.3. Convincing Eirich mixing technology

Planetary mixers are completely unsuitable for this technology due to the low tool speeds and energy density. If a production line is converted from wet to dry electrodes, the planetary mixers must therefore be completely replaced.

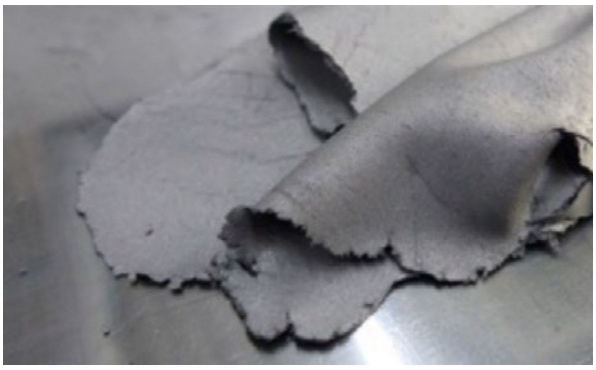
As an alternative for the production of dry electrode mixes, combinations of simple mixing systems such as V-mixers with intensifier bar or plowshare mixers with downstream air jet mills are often proposed. However, it should be borne in mind that the energy consumption of air jet mills, as known from grinding technology, is very high and the safe discharge and material handling of the resulting elastic plastic masses represents a major challenge. Lumpy product is very difficult to convey and dose and must therefore be reground.

Eirich mixers, on the other hand, are a convincing solution. The entire process can be carried out in one machine without any problems and can be excellently controlled.

7.4. MixSolver® becomes an Eirich mixer again

The MixSolver® and Eirich mixer are based on an identical basic machine. The brand name MixSolver® was chosen to make it clear to battery customers that the Eirich mixer can be used like a dissolver to produce suspensions. However, the sequence of addition of solids and liquids is reversed in order to massively shorten the suspension process. When producing electrode slurry in the MixSolver®, a short dry mixing phase at moderate tool speeds is used to homogenize

Structured electrode mixture produced in the Eirich mixer.



Dry electrode film made from structured electrode mixture prepared in the Eirich mixer

the powdery active material and binder and to deagglomerate the coarse conductive carbon black agglomerates. The actual dispersion and adjustment of the electrode properties is carried out by hard kneading in the stiff plastic phase. MixSolver® and Eirich mixers differ essentially in the motorization of the mixing tool, the discharge of the mix and the wear protection concept, primarily on the mixing tool. With appropriate foresight, a wet processing plant with MixSolvers® can be converted for the production of dry electrode mixtures with relatively little effort.

The MixSolver® becomes an Eirich mixer that is operated at tool speeds of up to 45 m/s for the production of structured dry mixes for dry electrodes. This is possible because the mixing principle allows the processing of all consistencies. A plastic, fibrillated mixture can be converted into a granulate or powder structure that is easy to convey and dose by means of targeted temperature control in the Eirich mixer. This structured dry mix is then easy to store and can be fed uniformly into calender gaps, where it can be rolled into a thin film.

Users of Eirich mixing technology are therefore future-proof, regardless of which technology comes out on top in the medium and long term. In any case, they will be rewarded with the lowest energy consumption and therefore a particularly small CO_2 footprint.

8. Conclusion

Batteries must become "greener" and more cost-effective. Saving electricity, reducing CO_2 emissions and minimizing space requirements are the main goals that manufacturers of energy storage systems are currently pursuing. Im-portant levers lie in electrode production, particularly in mixing technology. Eirich solutions in particular offer ad-vantages in terms of cost, flexibility and efficiency. Savings potential results from the generally lower investment costs (equipment, buildings, additional infrastructure) and ongoing operating costs, particularly the lowest energy consump-tion compared to all other mixing processes.

In addition, the Eirich mixers optimized for slurry production as MixSolver® are future-proof. They can be modified without significant changes so that they can also be used in the various processes for the production of dry electrodes (powder application process, free-standing film formation) when these become established technologically. A decision in favor of Eirich is therefore also a decision for the future, as it gives battery manufacturers the opportunity to make the technological leap towards dry electrodes, regardless of which approach proves to be the ultimate solution.

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From its headquarters in Hardheim in Southern Germany, the Eirich Group is a family-run group of companies specializing in the supply of machinery for process engineering applications. As a globally leading manufacturer of machinery and systems for the preparation of raw materials, Eirich has been pioneering advanced technology for mixing, granulating, dispersing, kneading, reacting, temperature control, and fine grinding since 1863.

Under the brand label EIRICH digital, the group also offers numerous services that are designed to support the machinery and systems throughout their entire lifecycle, ranging from online spare parts ordering to AI-based assistance systems. With an annual revenue of €180 million and over 400 patents, Eirich is an innovation leader in mixing and preparation technology. Now in its fifth generation of family ownership, the company is led by Stephan Eirich and Ralf Rohmann and employs around 1,200 employees at 13 different locations in eleven countries.

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