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THE NEW WAY OF MIXING

/// Inline mixing and dispersing systems for the production of coating compounds

Greatly increasing market demand and new materials require to rethink the conventional mixing processes of electrode pastes for rechargeable batteries. Read why switching to inline processes is an efficient way to minimize manufacturing costs and maintain quality at a consistently high level.

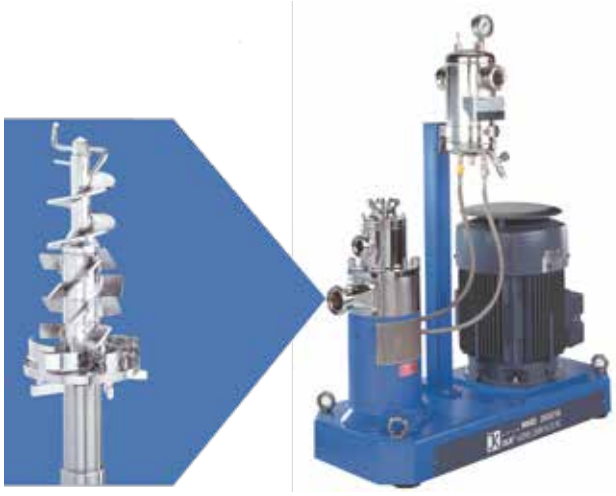
By Ralf Buergelin, Director Product Management at IKA

Whether regenerative energy, electro mobility or mobile electronics, all these electrical systems require a storage medium of electrical energy for their function. Capacity needs for such systems are skyrocketing and will grow exponentially in the future. Rechargeable batteries based on lithium-ion technology (LIB) are state of the art.

Battery research has its focus on choosing the best materials and formulations. The use of a suitable manufacturing technology for mass production, is an important element in order to produce rechargeable batteries in consistently good quality with the least cost. While only minor optimizations are possible in terms of material costs, there is still potential for reduced production costs, shortened process times and automated production.

The LIB technology combines high energy density, high available capacity per cell with short charging times and long life. Therefore it is far superior to traditional battery technologies. A LIB rechargeable cell usually consists of the main components anode, cathode, separator and conductive electrolyte. It is essential that the high-viscosity coating compositions on the electrodes are homogeneous and without changes in the material properties. This achieves identical electrical properties and full performance, which is critical during production.

In the preparation of the coating compositions, liquid solvents are mixed homogeneously with pulverulent solids, such as binders and active material, to give a high-viscosity mass, with the risk of agglomeration formation. The incorporated solvent volatilizes as temperature increases. Since mechanical mixing processes inevitably release heat energy, dispersing with high efficiency is very important.



The mixing and dispersing systems CMX (top) and MHD meet the new requirements in the production of coating compositions and can be used as a stand-alone or as a complete unit for the manufacturing processes of the future.

CONVENTIONALLY MIXED

In the past, the production of the coating compounds could be done with low-efficiency, slow-running batch processes. High-speed stirrers for binder solutions and planetary mixers were and are mostly used for blending. The low energy input is one of the reasons why these machines have very long mixing and dispersing times. As a result, many batch devices are required, which are expensive to purchase, maintain and clean. In order to achieve an even dispersion, the complete batch is always circulated by means of a large stirring tool.

Since this process often leads to lump formation and the mixture remains inhomogeneous despite long mixing times, additional filters and subsequent dispersing processes must be used. After the container has been emptied, residual amounts to the stirring tool as well as the container wall remain adhered which leads to complicated cleaning and large solvent use.

ADVANCED MIXED

The rapidly increasing demand for coating materials and demanding materials down to nano-size require advanced production technology that works extremely efficiently and is suitable for mass production. At the heart of advanced dispersion technology are inline devices. The product to be dispersed is forcibly fed by a pipeline to the mixing tool. In this case, mixing energy is entered in the smallest volume with high-speed tools, thereby completely processing all product components in an extremely efficient manner.

Output and results are now measureable with throughput and possibly with the number of runs. Inline devices can be used both in a recirculation batch inline process and as fully continuous systems operating in one pass. Material losses are minimized, cleaning is carried out in a continuous cleaning-in-place (CIP) cycle.

THE OPTIMAL PROCESS

The optimal process for the production of coating materials for rechargeable batteries consists of two process steps:

1. In the first step, the binder solution is prepared with an inline suction-dispersing device. For this purpose, the solvent is introduced in the mixing vessel. The necessary amount of binder and conductivity agent is metered in using two separate solid funnels. The disperser circulates the solvent and draws in the binder powder. Solid and liquid combine in the smallest volume under highest turbulence. As a result, the binder powder is optimally wetted and dissolved agglomerate-free. Next, the carbon powder is then inducted in and dispersed. The machine generates a vacuum that processes large quantities in a very short time. After completion of the carbon paste, the product is transferred to a buffer tank.

For optimum adaptation of the machine configuration to the process target and the raw materials, apart from the rotational speed as a process parameter, interchangeable tools and a stable characteristic curve are also essential, even with increasing viscosity.
The IKA CMX inline powder inductor fulfills these requirements. Due to its multi-stage design, the intake suction power of the machine also remains at the end of the process with increasing viscosity without the additional circulation pumps. Throughput and pressure are sufficient to transfer the product at the end of the mixing process and to function as a pump on the CIP nozzles when needed. The most ideal version for the production of binder solutions is the CMX system, a compact system series with the CMX as the center piece, including mixing tank, agitator and control. The plant is optimized for the production of high viscous media.

2. In the second process step, the active powder is introduced and dispersed by gravity using an inline dispersing unit. Gentle dispersion of a large percentage of powder with low temperature increase and minimized air intake is the goal. The binder-C paste, produced in the first process step, forms the liquid phase. This is supplied continuously with a mass flow-controlled positive displacement pump. At the same time, the active powder is also metered in through a differential dosage scale and regulated in the correct proportion. The MHD 2000 from IKA is suitable for such a process.

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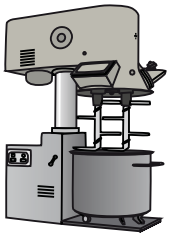
In this in-line dispersing machine, the product components are mixed, dispersed and discharged at a high intensity in the smallest volume. The throughput is determined by the feed systems for the liquid phase and the solids. Additionally the mixing intensity is determined by the speed and choice of the product adaptable dispersing tool. Through the process management in each pass the finished product is produced with minimum temperature increase and highest efficiency. Fully continuous operation eliminates material losses and cleaning costs. To avoid shutdowns, the entire system is simply cleaned with solvent in the CIP process.

Do you have any usability questions, or would you like a quote? Our team is at your disposal at all times.

Phone: +1 910-452-7059 x 600
eMail: processorders@ika.net

COMPARISON OF CONVENTIONAL MIXING VS. INLINE MIXING



Plant mixer

- 15 kW engine power
- 400 l capacity
- Batch process

Inline mixer MHD 2000/05

- 5.5 kW engine power
- 400 l/h throughput
- Inline process

IKA Works, Inc.
2635 Northchase Pkwy SE, Wilmington, NC 28405, USA
Phone: +1 910-452-7059 x 600, Fax: +1 910-452-7693
eMail: processorders@ika.net

www.ikausa.com

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