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Pneumatic conveying of silicon powder for li-ion batteries

The future of lithium-ion (Li-ion) batteries found in laptops, phones, hybrid cars and other applications may be taking shape at a UK start-up.

Nexeon Ltd has built a plant at its headquarters in Abingdon, Oxfordshire, to produce a silicon anode it developed that significantly improves the energy density and operating life of Li-ion batteries.

A critical part of producing the silicon anodes involves transferring precise amounts of silicon powder and other ingredients from a bag dump station to a slurry tank for mixing in an aqueous solution, using a dilute-phase, Pneumati-Con vacuum conveying system from Flexicon.

The transfer is dust-free and safe. "Silicon powder is combustible and can be explosive under the right conditions," says David Bent, production director at Nexeon. "Flexicon analysed the powder and developed the pneumatic system for it, including dust control and explosion protection measures."

Bag dump station contains dust

The first step in transporting the powder is manually emptying bags of silicon powder and additives into the bag dump station mounted on a floor hopper. A bag tray support provides a work surface for the operator to stage, clean and open bags.

A dust collection system integral to the bag dump station draws airborne dust through two cartridge filters, as reverse pulse jets automatically clean the filters to and return accumulated dust to the hopper.

Pneumatic conveying system feeds weigh hopper

The powders flow from the bottom outlet of the floor hopper through a pickup adapter into the two-stage pneumatic conveying line.

Left: Silicon powder and additives are manually emptied into the bag dump station and floor hopper. The station includes a bag tray support and dust collection through two cartridge filters. Powders flow from the hopper outlet through a pickup adapter into the pneumatic conveying line.
Below: Powders move from the bag dump station through the pneumatic conveying line to the filter receiver (rear) in the main processing area. Fully enclosed system prevents the escape of dust.

Nexeon produces silicon anodes that improve the performance of lithium-ion batteries.

From the pneumatic line, the filter-receiver separates the silicon powder from the air stream before the powder enters the receiving hopper and is delivered to a slurry tank. A reverse pulse jet system cleans the filter cartridges at timed intervals.

The first vertical section rises 90 degrees from the hopper outlet and connects to the second horizontal section, which runs from the silicon unloading area to the main processing area. The receiving hopper empties into a slurry make-up vessel.

A side channel blower downstream of the filter-receiver atop the receiving hopper provides a vacuum that pulls the material through the pneumatic line, improving dust control. The fully enclosed system transfers the silicon powder virtually dust-free. Since the system operates under vacuum, even if the integrity of the enclosed system is unintentionally compromised, the silicon powder will remain within the conveying system.

Silicon powder is the main ingredient in Nexeon's manufacture of silicon anodes.

Silicon Anode substitute boosts Li-ion performance

Nexeon's technology replaces conventional carbon/graphite anodes (the negative electrode terminal) in Li-ion batteries with a proprietary silicon formulation structure that increases the energy density of the cell and addresses inherent expansion issues of silicon.

The market for improved lithium ion anodes is enormous globally as they are found in consumer electronic devices such as smart phones, tablets and laptops. The largest emerging market is electric vehicles where demand is expected to triple, says David Bent, production director.

Filter receiver is isolated, safe

The filter receiver separates the silicon powder from the air stream before the powder enters the receiving hopper. Like the bag dump station, it has a reverse pulse jet system that automatically cleans the filter cartridges at timed intervals.

The filter-receiver is isolated in a safe area and protected with an explosion relief panel designed to exhaust the energy associated with an explosion without causing a catastrophic failure of the filter receiver. At the bottom outlet of the receiving hopper, a pneumatically actuated slide gate valve discharges the silicon powder into the slurry tank.

One set of load cells beneath the floor hopper at the bag dump station in combination with load cells beneath the filter receiver send signals to the PLC which automate the delivery of a predetermined amount of powder to the slurry vessel.

A low level sensor near the bottom of the floor hopper signals the PLC to stop the conveyor until more material is dumped into the hopper in order to achieve the total batch weight. On the receiving hopper, a high level sensor signals the PLC to stop the conveyor if the hopper is about to overflow in case of a system malfunction.

Nexeon says it avoided a piecemeal approach to equipment selection and installation by relying on a complete system from Flexicon. "We are very happy with the design, construction, installation and commissioning service provided by Flexicon," explained Mr. Bent. ■

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Siemens modernises drive system for ore mills in Chile

As one of the world's biggest copper producers, the Chilean mining company Compañía Minera Doña Inés de Collahuasi SCM based in Las Condes in Chile commissioned Siemens to modernise the drive system of four of its ore mills.

The mine is located in the North of Chile, around 180 kilometres southeast of the port of Iquique. The contract required Siemens to supply complete systems comprising new motors and Flender couplings with torque limiting shear pin, as well as new Sinamics SL150 cycloconverters with thyristor stacks. Siemens says the new drive systems will give a huge boost to the reliability and consequently also the throughput of the mills. The contract is valued in the double-digit million Euro range.

The modernisation project includes two 8 MW SAG (semi-autogenous) mills and two 1.7 MW ball mills with dual pinion drives. The new drive systems are replacing the existing synchronous motors and direct converters for the SAG mills and the drive systems of the ball mills, which were installed by a different manufacturer. "The standardised system design now offers all the benefits of controllable drives also for the ball mills," stated Siemens' publicity.

"When implementing this project, to prevent costly standstill periods and also to minimise risk it was vital for the new motors to fit on the foundations constructed for their predecessors. Also with a view to minimising any risks associated with the conversion, a decision was taken to replace the entire mill automation system with modern technology rather than undertaking the laborious task of adapting the hardware and software.

"The direct converter and the new automation systems were installed in ready-assembled new "E-Houses" which were completely developed, produced and pre-tested in the plant in Santiago/Chile, to be subsequently connected and commissioned on site.

"The location of the mine at an altitude of over 4,200 meters meant that particular care had to be taken with the electrical and thermal dimensioning of components." ■