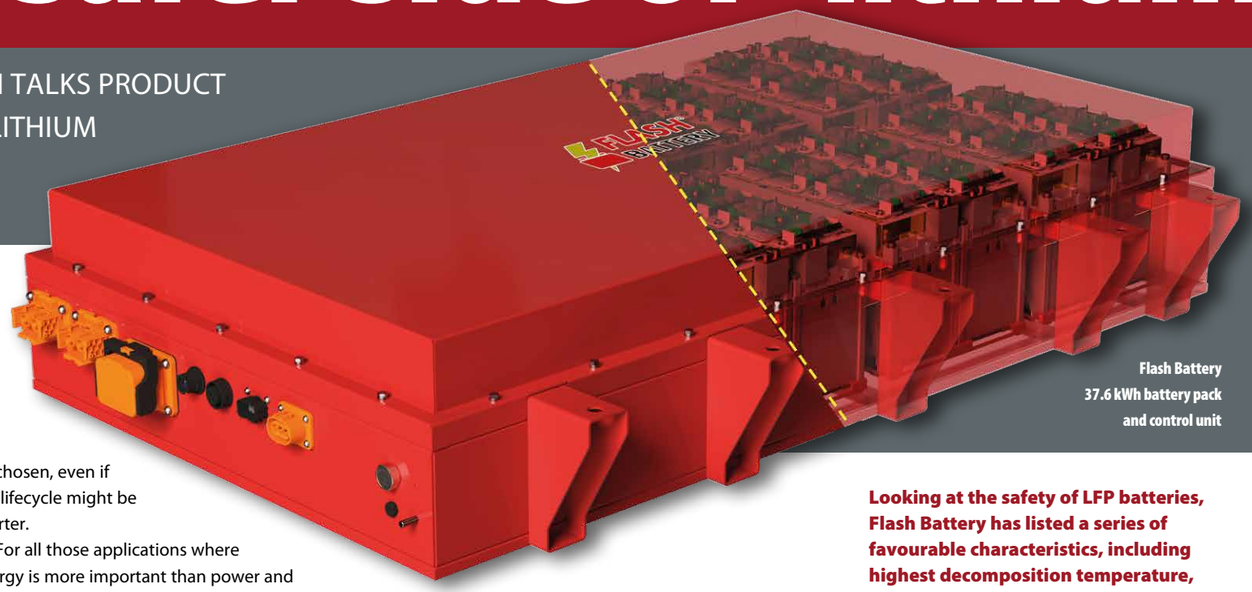
BATTERIES FLASH BATTERY NPP NEW POWER PROGRESS

The safer side of lithium batteries

FLASH BATTERY'S **MARCO RIGHI** TALKS PRODUCT DEVELOPMENT AND SAFETY IN LITHIUM BATTERIES WITH **ROBERTA PRANDI**



Flash Battery 37.6 kWh battery pack and control unit

DPI: Referring to developments in batteries for industrial use, it seems that lithium iron phosphate (LFP) batteries are the preferred choice for characteristics such as longer lifecycle and safety. Can you explain these advantages in more detail?

MARCO RIGHI: Among the available battery types, those utilizing LFP chemistry are the ones better responding to the needs of the industrial sector. LFP is the most stable and safe technology and is available in large capacity formats, something that's required by industrial and off-highway machinery as it avoids the parallel connection of several small units to reach the necessary capacity. That's a less stable solution that can compromise the safety of the entire working machine.

The intrinsic safety of the [battery] chemistry and the achievable lifecycle are the most important parameters to consider when choosing what type of batteries are most suitable for a certain application. Flash Battery chose $LiFePo_4$ chemistry for industrial and off-highway applications, as the operating life can exceed 4000 charging cycles.

What are the limitations of LFP technology?

The energy density. LFP chemistry has about 30% higher volume and weight than lithium nickel manganese cobalt (NMC) technology. For industrial and off-highway use these are not major problems though, as very often there is quite some space available on the machines. Sometimes it is even necessary to add ballast in counterbalanced applications.

On the other hand, for applications needing high power and light weight – for example, motorbikes or racing cars – more compact and lighter battery types need to be chosen, even if the lifecycle might be shorter.

For all those applications where energy is more important than power and where discharge cycles are longer, as in most industrial applications, safer and longer-life batteries like LFP are preferred.

It seems like LFP batteries need more precise balancing and consequently a more sophisticated control strategy. Can you give more detail about the control tech developed by Flash Battery?

The software for battery management systems does make the real difference in optimally exploiting the battery technology, guaranteeing reliability and performance over time. It also has a crucial role in the discharge phase, but even more so in the recharging process.

Flash Balancing System is the proprietary electronic balancing system of Flash Battery; it acts on every cell with a combined balancing – that is, both active and passive – which is 20 times superior to that of conventional lithium batteries in all phases. This technology supports balancing below 30 minutes in cyclical applications, which makes it insignificant in the total time for recharging. The lithium cells are balanced across the whole battery life, which is approximately 4500 recharging cycles.

When a BMS is designed with care and attention to detail, it guarantees complete control of the battery pack, including performance stability over time, malfunction prevention, self-diagnostic and predictive maintenance.

This is one of the reasons why Flash Battery developed its Flash Data Center, a platform that continuously analyses the charge and discharge cycles of the connected batteries. Through AI algorithms, the center can prevent anomalies before they happen and sends automatic alerts to Flash Battery's service center, avoiding expensive stops in machine operation.

What is the future of batteries for industrial applications? Are there any alternatives in sight to LFP chemistry?

LFP chemistry is having renewed success. From the 100 Wh/kg available a few years ago, now the performance has reached 170 Wh/kg. The automotive market has shown some interest, too, including Tesla with the Model 3 and some other companies, like BYD and the Volkswagen Group. We believe LFP still has quite a few successful years ahead, both in automotive and in industrial/off-highway applications.

Looking at the safety of LFP batteries, Flash Battery has listed a series of favourable characteristics, including highest decomposition temperature, lower heat dissipation, reaction to internal short circuits. Can you explain these in detail?

Flash Battery has been able to guarantee the highest safety levels for its batteries by working on three main aspects: using the correct lithium chemistry, correct assembly of the battery pack, and the proprietary electronic control system.

The fact is that Flash Battery is focused on the industrial market only, which allows the company to work with several European OEMs to deliver tailor-made batteries that fit within the vehicles and offer specific capacity and tension for the job at hand.

We have two characteristics to consider, decomposition temperature, where the highest score highlights the lowest chance of reaching decomposition conditions and heat dissipation, measured in Joule per gram and an indication of the energy the battery cell is releasing as heat. The lower this value, the safer the battery.

	SAFETY	DECOMPOSITION TEMPERATURE	HEAT RELEASE
NMC	★★★	210°C(410°F)	600J/g
LFP	★★★★★	270°C(518°F)	200J/g
NCA	★★	150°C(302°F)	940J/g

SOURCE hiips://www.flashbattery.tech/sicurezza-e-rischi-delle-batterie-al-litio/

Comparison completed by Flash Battery covering three main battery chemistries used in industrial applications

LITHIUM BATTERY GLOSSARY

Lithium NMC Lithium Nickel Manganese Cobalt
Lithium NCA Lithium Nickel Cobalt Aluminium
Lithium LFP Lithium Iron Phosphate
Lithium LCO Lithium Cobalt Oxide
Lithium LMO Lithium Iron Manganese Oxide
Lithium LTO Lithium Titanium Oxide

LCO and LMO are the oldest technologies and less common today. NMC and NCA are the most common in the automotive sector, especially on premium vehicles, as they offer the highest energy density and longer driving range. LFP is the safest chemistry, followed by LTO.

Technologies are constantly evolving, but the chemistry characteristics remain the same. So NCA and NMC are the best for energy density and the most popular for achieving high performance. Lifecycle is not a primary concern for the automotive industry as vehicle use is not intensive and daily battery charges usually cover top ups; complete charge/discharge cycles are estimated to be between 100 and 200 per year. Under these circumstances, the automotive battery pack will have a longer life than the vehicle.

Our target is to identify the right battery technology for the customer vehicle. Our R&D technicians do not just study the different chemistry types, but also perform stress tests to analyse behaviour and develop improvements. One of the tests we perform is the Nail Penetration test, which consists of inserting a nail in the battery to simulate an internal short circuit.

Clearly, these are lab tests conducted under controlled conditions. The chance a battery cell will get perforated during use is quite low. But we conduct this test to simulate the worst that can happen to a cell, that is an internal short-circuit due to a manufacturing fault or abuse.

Cell assembly is the second element contributing to safety. When lithium batteries are assembled in small cells, it's necessary to connect a lot of cells in parallel. Take a 400 Ah battery pack, for example. If it is composed of cylinder cells of 3 Ah each, you will need 130 cells in parallel. If it is composed of prismatic cells of 50 Ah, you need only eight cells in parallel.

In the first case, should one of these cells short circuit it would be absorbing 130 times its capacity. In the second case only eight times.

Flash Battery packs are assembled with a maximum of four cells in parallel. According to our studies, it is the best configuration for our batteries to operate safely under any condition.

The third and last aspect to guarantee safety of lithium batteries is the electronics that control the battery: the BMS. It is key to monitoring the tension and temperature of each cell, as well as interacting with the vehicle and the battery charger to stop charge and discharge in case of critical conditions and, if the case, intervene on contactors.

One of the differences between lithium battery manufacturers is the functioning of the control electronics in dangerous situations.

Flash Battery has built upon critical issues that were limiting the reliability and safety of the batteries. This is why we decided to invest, to differentiate from other manufacturers; the balancing system and the remote control. With Flash Battery products, temperature measurement is capillary and covers all key points. We can even verify contact resistance thanks to two temperature sensors on each cell. NPP