Lfp battery life

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Recent independent degradation tests of commercial lithium batteries reveal a big surprise! Contrary to the claims of many NMC-based lithium battery manufacturers, LFP chemistry is superior compared to NMC - it is safer, offers a longer lifespan, and is generally less expensive than NMC, NCA.

Of all the various types of lithium-ion batteries, two emerge as the best choices for forklifts and other lift trucks: Lithium Ferrum Phosphate, or Lithium Iron Phosphate (LFP) and Lithium Nickel Manganese Cobalt Oxide (NMC).

The LFP battery chemistry has been around the longest. NMC is a relatively new technology. However, that doesn’t always translate into being a universally better technology. In electric vehicles (EVs), such as cars and trucks, it’s often the preferred choice due to overall less weight and higher energy density per kilogram. However, in the warehousing environment, where ambient temperature extremes are possible and weight is not the issue, the LFP battery is widespread and conversely may be a more favorable choice.

As a default, both NMC and LFP chemistries’ useful life can range between 3,000 to 5,000 cycles. However, with opportunity charging, that can be increased significantly, anywhere up to 7,000 cycle count. Whereas lead-acid shouldn’t be charged until it’s depleted to 20% battery capacity, Lithium-ion batteries thrive on what it calls opportunity charging. While the two types--LFP and NMC--operate similarly, there are some differences.

According to a 2020 paper from the Journal of the Electrochemical Society (Degradation of Commercial Lithium-Ion Cells as a Function of Chemistry and Cycling Conditions), LFP batteries have a longer lifespan than NMCs. This data contradicts the wide-spread notion that NMC cells are more durable and have a longer life span. These tests were first published in September 2020 but reached the news sections of material handing publications only recently. The authors of the article give one possible explanation - the data on real commercially available cells may vary with the change of manufacturing process, however subtle.

Under strict test conditions, commercially available lithium cells of both types were repeatedly discharged and charged from 0% to 100%. The result? According to the paper, “The LFP cells exhibit substantially longer cycle life spans under the examined conditions.”

The tests were performed at the Sandia National Laboratories as “part of a broader effort to determine and characterize the safety and reliability of commercial Li-ion cells.” The study examined the influence of temperature, depth of discharge (DOD), and discharge current on the long-term degradation of the commercial cells.

In the graphical representation shown (taken from the Journal’s 2020 technical paper), you can easily see that the discharge capacity retention for the LFP lithium battery (blue data points) far exceeded the NMC battery retention (indicated by the black data points) for each round of charge/discharge cycling. The graph indicates that the NMC degrades almost twice as quickly as the LFP, showing the superior overall performance of the LFP cells.

The testing showed LFPs had a better RTE (round trip efficiency) than NMCs, calculated by dividing the discharge energy by the charge energy. This calculation shows that the LFP is the more efficient, economical choice.

Lithium nickel cobalt aluminum oxide battery, or NCA, was also a part of this experiment and performed similar or worse than NMC. We do not focus on NCA in this article as it is not mainstream in the commercial use of lithium batteries for Material Handling, mainly due to safety and cost issues.

Both NMC and NCA cells demonstrated strong dependence on the depth of discharge, with greater sensitivity to full SOC range cycling compared to LFP cells.

LFP cells had the highest cycle lifetime across all conditions, but this performance gap was reduced when cells were compared according to the discharge energy throughput.