Lithium battery details

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How does a lithium-ion battery work? It"s a question many battery users have asked themselves when eyeing these high-quality lithium batteries that are winning over an increasing share of the RV, boat, and other deep-cycle markets. And the science behind these batteries can get complex and confusing for the average person, to say the least.

But if you"re trying to figure out how lithium-ion works, wonder no more. We"re breaking down this fantastic technology, its differences from traditional batteries, and why they"re becoming more and more popular.

When it comes to the parts that explain how a lithium-ion battery works, it"s actually fairly simple. There are really only four essential components inside a lithium battery: the cathode, the anode, a separator, and the electrolytes. These basic components are, in many ways, the same as any other type of battery or electrochemical cell. With these four simple pieces, batteries can harness an incredible amount of lithium energy.

The negatively charged anode is similar in design but made with different materials. Typically, this is copper foil coated in graphite. These weren"t chosen by accident. All the compounds involved here play crucial roles in battery chemistry.

Electricity is all about electrons, and their movement is the key to the crucial changes that occur when you charge a battery. The very first charge of a lithium-ion battery is usually done by the manufacturer because of the lithium in the electrolyte.

When the battery is connected to a charger, a chemical reaction takes place involving the LiFePO4 on the cathode. This chemical reaction causes the compound to split into electrons, positively charged lithium ions, and an iron phosphate remainder.

The electrons flow to the anode through the charger. Meanwhile, the positively charged lithium ions migrate through the electrolyte to combine with the graphite on the anode. Finally, they meet again and form a compound known as lithiated graphite. Eventually, all of the lithium ions and electrons have completed this movement, resulting in a fully charged lithium-ion battery.

When answering how does a lithium-ion battery work, it can be helpful to distinguish it from old-school lead-acid batteries. As opposed to the aluminum/lithium cathode and copper/graphite anode of lithium-ion batteries, lead-acid batteries have cathodes and anodes both made of lead sulfate (PbSO4). Lead-acid batteries also use sulfuric acid as their electrolyte (H2SO4) instead of the lithium solution used in lithium-ion batteries.

For those without an interest in chemistry or electronics, these differences might seem technical or abstract.

But they manifest in significant ways when these batteries operate. Here are a few of the most notable.

As noted above, lead-acid batteries use a sulfuric acid solution to serve as the electrolyte within the battery cell. Unfortunately, sulfuric acid is highly corrosive and can be dangerous if ingested, spilled on the skin, or inhaled. Even worse, many lead-acid batteries require users to regularly open their batteries to top off the electrolyte solution as it evaporates, potentially exposing users to this harmful substance.

In contrast, the lithium solution used in lithium-ion batteries presents a far lower risk. Better yet, lithium batteries are completely sealed, meaning there"s little to no chance users will come in contact with the solution except in cases of serious battery damage.

One of the most apparent differences between these battery types is weight. The reason is simple: lead is exceptionally dense, weighing a remarkable amount for its size. In contrast, lithium is light. Lithium-ion battery components are also far lighter. This can be particularly important for weight-sensitive uses like boats and RVs.

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