Comparison of Lithium Ion to Lithium Iron Battery

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What are the major differences between Lithium Ion and Lithium Iron batteries? Is the only difference the letter "R" in "iron" versus "ion"? Hardly. This article will describe the numerous differences between those two rechargeable batteries.

Lithium Ion vs Lithium Iron Batteries

A lithium-ion battery (a.k.a Li-ion) is rechargeable kind of battery with lithium cobalt dioxide ($LiCoO_2$) or lithium manganese oxide ($LiMn_2O_4$) as a cathode. On the other hand, a lithium-iron battery is also a rechargeable type of battery but made with lithium iron phosphate ($LiFePO_4$) as the cathode material. Generally, anodes are made up of carbon in both batteries. Actually lithium-iron is a newer version in the lithium battery family.

The low discharge rate in idle state and high energy density make lithium batteries suitable for consumer electronics devices such as laptops, cameras, portable DVD players, etc. These days these batteries are also finding good applications in electric vehicles and military appliances.

Comparison of the two for the following parameters is given below.

Safety

Safety is the first concern for any battery being used in portable devices. It should not get overheated or catch fire in case of overcharging. The Lithium-iron battery has edge over the Li-ion battery in such situations. It has superior chemical and thermal stability. A Lithium-iron battery remains cool at room temperature while the Li-ion may suffer thermal runaway and heats up faster under similar charging conditions. $LiFePO_4$ is a nontoxic material, but $LiCoO_2$ is hazardous in nature, so is not considered a safe material. Lithium cobalt dioxide is an allergen to eyes and skin. It could cause a major harm if swallowed. Disposal of Li-ion battery is a big concern for the manufacturer and user.

Air Plane Incidents reported due to Li-Ion Batteries

Li-Ion battery packs are considered a high risk material for airplanes. In a number of incidents this battery during the time of March 20, 1991 to May 18, 2011, according to the Federal Aviation Administration (FAA), was found the common reason for some plane crashes.

1. A UPS jet carrying Lithium-ion batteries fatally crashed near Dubai as these batteries caused a fire on the main deck.
2. In another incident, a cargo plane from South Korea crashed into the southern coastal waters. This was also carrying shipment of Li-ion battery packs.
3. On March 21, 2011 another airplane incident happened. According to the initial report, Federal Express reported that the package offered for air shipment from Mumbai, India to Shenzen, China "was observed to be smoking by a customs official at the facility in Guangahou, China. Subsequent investigation indicated that the package contained the Li-ion batteries contained in equipment including Lithium polymer batteries." (*Source:* FAA Batteries and Battery Powered devices (PDF). So the administration of many countries has signaled a big no for transporting lithium-ion batteries, at least in bulk, not in personal devices (so far), via planes.

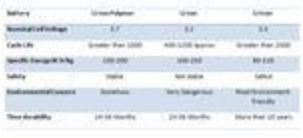
Performance

Performance is a major criteria to choose a suitable battery for an application. Long life, slow discharge rate and less weight should be basic features of a daily use battery. Lithium iron batteries are slightly heavier and more bulky in size than Lithium ion batteries. For this reason Li-iron is more commonly used for portable devices. The discharge rate of a Li-ion battery keeps increasing over the time as compared to Li-iron. But a brand new Li-ion battery has more energy density than a Lithium-iron battery and thus delivers better performance for a few initial days.

Durability, Reliability, and Cost Effectiveness

Battery life is defined by the number of charge/discharge cycles a battery can survive. Li-iron is more durable than Li-ion as the former lasts for around 2000 charge/discharge cycles while the later survives up to 1000 cycles. When not in use, a battery should not lose its charge at a faster rate. It should deliver almost same performance if using after a year or so. This so called shelf life is around 350 days for lithium-iron and about 300 days for a lithium-ion battery. Cobalt is more expensive than the iron and phosphate used in Li-iron. So the lithium-iron phosphate battery costs less (safer materials make it less expensive to manufacture and to recycle) to the consumer than the lithium-ion battery.

Lithium Ion Vs Lithium Ion Polymer Batteries



Lithium-ion batteries came into being in 1979 and were available for consumers in the late 90s while lithium polymer batteries came into existence in the 90s. Li-ion batteries have more capacity than Li-polymer and have an even larger size than Li-po. Both Li-ion and Li-polymer batteries are secondary batteries, i.e. rechargeable, and are more costly to manufacture than nickel-based rechargeable batteries. Following are some basic differences between these two batteries.

- Lithium-ion polymer batteries or LiPo's chemical composition is different from Li-Ion battery. The electrolyte used in Li-polymer is a nonconducting solid polymer composite (polyacrylonitrile), which allows ion exchange between the two electrodes.
- The cell thickness of Li-polymer is less (0.039 inches) than Li-ion.
- The battery life of Li-polymer is slightly lesser than the Li-ion battery.
- Li-Po is safer for overcharging situations, unlike Li-Ion. There is less probability of electrolyte leakage for Li-polymer batteries.
- LiPo's manufacturing cost is less than the Li-ion. LiPo are quite rugged and adapt to variety of shapes.
- Lithium polymer batteries are used in consumer market applications such as in PDAs and cell phones. Its use has also started in applications such as radio controlled aircraft or cars.

Source:
http://www.brighthubengineering.com/power-generation-distribution/123906-comparison-of-lithium-ion-to-lithium-iron-battery/