

Lithium ion batteries have a wide range of applications. It has its advantages as well as a host of disadvantages which were experienced by multinational companies across the globe in varied industries like grounding of aircrafts, recalling smart phones etc. This article gives brief inputs on Lithium-ion batteries and latest developments.

Aspiring civil servants need to stay updated with the latest advancements in the field of science and technology and it is an important component of the [IAS Exam](#).

Lithium-Ion Battery - Brief Understanding of Technology

1. In the batteries, lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge, and back when charging. Lithium-ion batteries use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode. The batteries have a high energy density, no memory effect (other than LFP cells) and low self-discharge.
2. Pioneer work with the lithium battery began in 1912 under G.N. Lewis but it was not until the early 1970s when the first non-rechargeable lithium batteries became commercially available. Lithium is the lightest of all metals, has the greatest electrochemical potential and provides the largest energy density for weight.

Lithium batteries were proposed by British chemist and co-recipient of the 2019 Nobel prize for chemistry M. Stanley Whittingham, now at Binghamton University, while working for Exxon in the 1970s.

Lithium-Ion Batteries - Latest News from ISRO

1. ISRO's VSSC has successfully developed and qualified lithium ion cells of capacities ranging from '1.5 Ah to 100 Ah' for use in satellites and launch vehicles.
2. According to ISRO, with the successful deployment of indigenous lithium ion batteries in various missions, VSSC is planning to transfer this technology to the industries to establish production facilities for producing lithium ion cells to cover the entire spectrum of the country's power storage needs.
3. The Indian Space Research Organisation (ISRO) had selected ten companies in 2019 for transfer of its Lithium-ion cell technology.

Lithium-ion Battery - Applications

1. Electronic gadgets
2. Tele-communication
3. Aerospace

4. Industrial applications
5. Lithium-ion battery technology has made it the favorite power source for electric and hybrid electric vehicles.

Lithium-ion Cell technology - Benefits

1. Long life cycle
2. High Voltage
3. High Storage Characteristics
4. High Energy Density

Lithium-ion Battery - Major Issues

1. Lithium-Ion batteries can be a safety hazard since they contain flammable electrolytes, and if damaged or incorrectly charged can lead to explosions and fires.
2. There have been several incidents involving batteries on Boeing 787s.
3. Samsung was forced to recall Galaxy Note 7 handsets following lithium-ion fires
4. Requires protection circuit to maintain voltage and current within safe limits.
5. Expensive to manufacture - about 40 percent higher in cost than nickel-cadmium.
6. Not fully mature - metals and chemicals are changing on a continuing basis.

Environmental Impacts of Lithium-Ion Batteries

As per some studies the following environmental impacts were noted

1. Ecological Toxicity
2. Global Warming
3. Human Health impacts
4. Resource Depletion

Lithium-Ion Batteries - Potential Alternatives

Graphene Batteries

1. Graphene batteries may be an important alternative to lithium-ion batteries, with the latter having limitations due to the frequency lithium requires charging. Graphene is a newly stabilized and isolated material, which won two scientists the Nobel Prize in 2010 and ultimately led to the introduction of graphene batteries.

Fluoride Batteries

1. Fluoride Batteries have the potential to last eight times longer than lithium batteries.

Sand battery

1. This alternative type of lithium-ion battery uses silicon to achieve three times better performance than current graphite li-ion batteries. The battery is still lithium-ion like the one found in your smartphone, but it uses silicon instead of graphite in the anodes.

Ammonia-powered batteries

Ammonia-powered batteries may not be coming any time soon, but the chemical commonly known as a household cleaner is still an alternative to lithium in the way it can power fuel cells in vehicles and other equipment. If scientists can figure out a way to produce ammonia without creating the greenhouse gas emissions that result right now, they can ship it anywhere in the world to be converted into hydrogen to power those fuel cells.

Lithium-Sulfur Batteries

1. Researchers in Australia say they have developed the world's most powerful rechargeable battery using lithium-sulfur, said to perform four times better than the strongest batteries currently available.
2. As per researchers lithium-sulfur batteries are lighter and cheaper than the widely used lithium-ion batteries and can be produced cost-effectively and in an environmentally friendly manner.

Vertically aligned carbon nanotube electrode

1. A company has designed and patented an Ultra Fast Carbon Electrode, which it says is a game-changer in the battery market. It uses a vertically-aligned carbon nanotube (VACNT) design and it is believed that it can boost battery power ten fold, increase energy storage by a factor of three and increase the lifecycle of a battery five times.

Cobalt-free lithium-ion battery

1. Researchers at the University of Texas have developed a lithium-ion battery that doesn't use cobalt for its cathode. Instead it switched to a high percentage of nickel (89 per cent) using manganese and aluminium for the other ingredients.

What's the Difference Between Lithium and Lithium-ion (Li-ion) Batteries?

The biggest difference between Lithium batteries and Lithium-ion batteries is that Lithium batteries feature a single cell construction, meaning that they are single-use and cannot be recharged once empty. On the other hand, Lithium-ion batteries can be used time after time, they are rechargeable and can be charged and emptied hundreds of times.

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