

Technical Note



This technical note compares the different batteries used in photovoltaic systems. They often differ from other common applications, as the key technical consideration is that the battery experiences a long lifetime under a nearly fully discharge condition. In this note, we consider two of the major battery types used in solar marine lanterns – Lithium ion (Li-ion) and Nickel Metal Hydride (NiMH).

Lithium-ion (Li-ion):

Li-ion batteries are a combination of lithium cobalt oxide (cathode) and carbon (anode). Li-ion is the fastest growing battery system. Li-ion are used where high-energy density and light weight is of prime importance.

Nickel Metal Hybrid (NiMH):

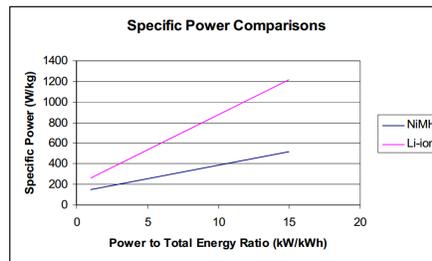
The anode is made up of rare-earth or nickel alloys, and the cathode is made up of potassium hydroxides. NiMH batteries have good design flexibility, environmental acceptability and require simple storage and transportation conditions.

The key factors to be considered are: Energy density, self-discharge rate, power & efficiency, battery lifetime and battery maintenance.

Advantages of Li-ion over NiMH:

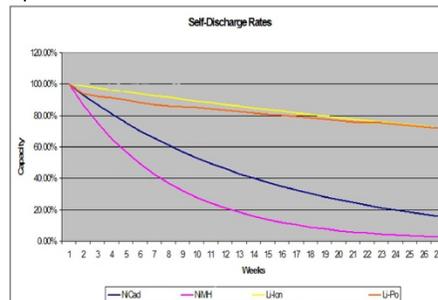
Energy density

Li-ion batteries have significantly higher energy density compared to NiMH batteries. The key technical consideration is the measure of energy density (Wh/Kg) as shown in the chart below.



Self-discharge rate

Li-ion batteries have a lower self-discharge rate than other types of batteries. Typical Li-ion discharge rates are 3-5% per month compared to NiMH, which can self-discharge up to 50% a month.



Power & efficiency

Li-ion and NiMH batteries hold a similar amount of power, but the Li-ion cells can be charged and discharged more rapidly. Li-ion is less affected by memory effect than NiMH batteries.

Lifecycle & lifespan

Li-ion batteries offer improved discharge and charge efficiency, longer lifespan and the ability to deep cycle while maintaining power. NiMH performance will deteriorate if repeatedly deep cycled.

Maintenance

Compared to NiMH batteries, which require regular full discharge to prevent crystalline formation, Li-ion batteries have lower maintenance requirements as no period discharge is needed.

Disadvantages of Li-ion over NiMH:

Cost

Li-ion batteries are generally more expensive than their NiMH counterparts. However, due to a longer shelf life and longer lifecycle, their total cost of ownership is lower than NiMH.

References

1. Battery Universit, What's the Best Battery? [Link here.](#)
2. Electrochemical and Structural Analysis of Li-ion Battery Materials by in-situ X – Ray Absorption Spectroscopy by Soojeong Kim.
3. Comparison of NiMH and Li-Ion Batteries in Automotive Applications by Aditya Jayam Prabhakar, Missouri University of Science and Technology.
4. A Guide to Understanding Battery Specifications by MIT Electric Vehicle Team, December 2008.