Chemistry Comparison Chart

Chemistry	Cell Voltage (Open Circuit)	Cell Voltage (Operating)	Operating Temperature	Typical Cycle Life	Specific Energy Density	Self Discharge Rate (% loss per month)
Lithium Ion	4.20V	4.00 - 3.00V	-20 to 50°C	1000+ Cycles	~425Wh/L at 20°C	2% at 20°C
Lithium Ion Polymer	4.20V	4.20 – 3.00V	0 to 50°C	1000+ Cycles	~385Wh/L at 20°C	2% at 20°C
Nickel Metal Hydride	1.40V	1.25 – 1.10V	-20 to 50°C	300-600 Cycles	~240Wh/L at 20°C	15-20% at 20°C
Nickel Cadmium (Sealed)	1.29V	1.25 – 1.00V	-40 to 45°C	300-700 Cycles	~120Wh/L at 20°C	15-20% at 20°C
Sealed Lead Acid (Portable)	2.10V	2.00 – 1.80V	-20 to 45°C	250-500 Cycles	~90Wh/L at 20°C	4-8% at 20°C

Chemistry Comparisons

Lithium Ion (Li-ion)

Advantages: High energy density, low self-discharge, light weight, long cycle life, no memory effect, low maintenance

Limitations: Requires protection circuit, moderate to high discharge current, subject to transportation regulations

Popular Applications: Portable medical devices, military radios, small handheld devices, emergency lighting and consumer products

Lithium Ion Polymer

Advantages: Light weight, flexible form factor, improved safety, ultra low profile, custom size pouch construction is more cost-effective in comparison to custom cylindrical construction

Limitations: Slightly lower energy density and cycle life in comparison to Li-ion, more expensive to manufacture on a per unit basis

Popular Applications: Cellular phones, some portable medical devices (requiring a thin form factor) and small handheld devices

Nickel Cadmium (NiCd)

Advantages: Excellent cycle life, long shelf life, fast simple charge, low internal resistance, high discharge rate, desirable low temperature performance, forgiving if abused, easy storage and transportation

Limitations: Low energy density, memory effect (if not completely discharged before recharge), high self-discharge, environmentally unfriendly (Cadmium is toxic)

Popular Applications: Two-way radios, portable medical equipment, power tools and consumer products

Nickel Metal Hydride (NiMH)

Advantages: High energy density - 40% higher capacity over standard NiCd, less prone to memory effect, easy storage and transportation, environmentally friendly, popular substitute for alkaline with similar voltage and performance, advantageous in high current applications

Limitations: Short life cycle, limited discharge current, high internal resistance, more complex charge needed, high self-discharge, high maintenance – performance degrades if stored in elevated temperatures

Popular Applications: Communication devices, audio/visual equipment, emergency lighting and consumer products

Lead Acid (Pb)

Advantages: Inexpensive, mature/well understood technology, low self-discharge, high discharge rate, no memory effect, low maintenance

Limitations: Low energy density, limited cycle life, prone to thermal runaway, environmentally unfriendly

Popular Applications: Hospital equipment, wheelchairs, emergency lighting and UPS systems

Chemistry Comparison Summary Chart

	Nickel Cadmium	Nickel Metal Hydride	Lead Acid	Lithium Ion	Lithium Ion Polymer
Nominal Voltage	1.25V	1.25V	2V	3.7V	3.7V
Gravimetric Energy Density (Wh/kg)	45 – 80	60 – 120	30 – 50	110 – 160	100 – 150
Volumetric Energy Density (Wh/L)	120	240	90	400 – 450	350 – 420
Internal Resistance (mΩ)	100 – 200	200 – 300	<100	150 – 250	200 – 300
Cycle Life (To 80% of initial capacity)	1500	300 – 500	200 – 300	500 – 1000	300 – 500
Load Current -Peak -Best	 20C 1C	 5C 0.5C	 5C 0.2C	 >2C 1C	 >2C 1C
Operating Temp	-40C to +60C	-20C to +60C	-20C to +60C	-20C to +60C	0C to +60C
Maintenance	30 – 60 days	60 – 90 days	3 – 6 months	None	None
Self Discharge (Per month @ RT)	20%	30%	5%	2% – 5%	2% – 5%
Overcharge Tolerance	Moderate	Low	High	Very Low	Low
Commercial Use Since	1950	1990	1970	1991	1999