Technical Report

Rechargeable pipette batteries

Comparison of three technologies

Anyone familiar with rechargeable flashlights, cell phones, or cordless drills knows the frustration of a battery that is not fully charged. Fortunately, rechargeable battery technologies have improved, leading to batteries that hold charge longer and can be reliably recharged more times. Rechargeable batteries are not all alike – several rechargeable battery technologies are commonly used in small hand-held devices such as electronic pipettes. Table 1 compares properties of several rechargeable batteries.

Table 1: A comparison of rechargeable batteries

	NiCd	NiMH	Li-Ion
Energy capacity/weight (Watt-hours/Kg)	40-60	60-80	100
Theoretical cycle life (# of recharges)	1000-1500	500-1000	500-1000
Cycle life typically Achieved in actual use	400-900	300-800	500-1000
Charging issues Memory effect	High	Low-Modest	Insignificant
Maintenance frequency (Full discharge) for maximum life	30 days	90 days	Not required
Self-discharge per month	20%	30%	10%

Nickel Cadmium

Nickel Cadmium (NiCd) batteries were used in RAININ's original EDP and EDP Plus electronic pipettes. When properly maintained, NiCd batteries have a long life, and are capable of delivering a high current. However, they are heavy, lose charge over time during storage, and are susceptible to a charging-discharging phenomenon referred to as "memory effect". If the battery is often left on a charger and not completely discharged regularly, the battery will not completely charge to full capacity. This memory effect will worsen over time, requiring more frequent recharging. For many sporadic applications, such as pipetting, the memory effect
creates problems because regular maintenance (complete discharge) can be forgotten. Although Table 1 shows NiCd as having the highest Theoretical Cycle Life (number of recharge cycles), this is rarely achieved because of the maintenance issues.

Nickel Metal Hydride

Nickel Metal Hydride (NiMH) batteries, used in RAININ's EDP1 electronic pipettes, have a high energy density, an average life span, and deliver modest current. NiMH batteries are also heavy and are limited by a high self-discharge rate. While a mild memory effect exists, regular maintenance can be delayed much longer than with NiCd batteries. Theoretical Cycle Life as displayed in Table 1 is, like NiCd, difficult to achieve in actual use because battery maintenance (complete discharge), again, is a consideration.

Lithium Ion

Lithium Ion (Li-Ion) batteries, used in RAININ's EDP3 electronic pipettes, are finding widespread utilization in many applications because they are light, provide high energy density, hold charge well over time, have a longer life and require little or no maintenance. This is why they are found in most cell phones as well as precision electronic pipettes. While very early Li-Ion batteries were susceptible to damage from over-charging, the past few generations of Li-Ion batteries, including the EDP3 battery, have control circuitry built into them to eliminate that risk. Hence, the Theoretical Cycle Life for Li-Ion numbers listed in Table 1, while similar to the other types of batteries shown, are very easily achieved by the end user. Therefore, in the absolute sense, Li-Ion batteries are vastly superior in actual use, which can also be seen in Table 1.

Conclusion

Lithium Ion batteries are the best batteries to use for electronic pipettes when reliability, light weight and ease of maintenance are of paramount concern to the researcher or laboratory manager.

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