

BATTERY POWER PRODUCTS & TECHNOLOGY

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Rechargeable Batteries *Keeping Pace with the Digital Age?*

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Rechargeable batteries come in a variety of chemistry designs, ranging from the mature lead acid battery to the newcomer, lithium ion polymer. From wet or sealed lead acid to wound cylindrical, prismatic or lithium ion polymer, these rechargeable battery chemistries are relied upon in the industry. Without them, the world would be very different; think about it, a world without car batteries? Cellular phones? Unimaginable!

This article zeros in on the mobile information technology (IT) and communication devices markets, reviewing trends in devices and battery chemistries. Mobile IT devices include laptops and personal digital assistants (PDAs); mobile communication devices include cell phones and cordless phones.

Advancement in Digital Devices

Consumers are demanding several battery capabilities for their mobile IT devices ranging from notebook computers to tablet computers or PDAs. These include smaller, lighter, simpler, cleaner and most importantly, less expensive batteries. These demands, although elementary in theory, are difficult to fulfill currently. Vendors of rechargeable batteries are facing immense pressure to keep pace with the ever-advancing electronic devices, as they must provide the required energy capacity, longevity and reliable batteries to power these devices.

Examples of improvements in the mobile devices technology include 3G phones, PDAs with built-in cameras and wireless connectivity that enable greater functionality such as browsing the net, accessing emails, etc. from any location. With a great emphasis on wireless connectivity and convergence, the devices are becoming saturated with additional functions that are power hungry.

Manufacturers are focusing on innovative advancements to battery technology used in these devices. For example, Sony offers a 3 mm thick Li-Ion polymer cells that can reside within the liquid crystal display (LCD) panel of a PDA or laptop. By taking advantage of the wide footprint of the screen, the battery space issue has been effectively solved.

Economic Rebound Impacts the Market Positively

The economic conditions in the global market has led to a great decrease in battery revenue and unit shipments. Manufacturers must buffer these negative conditions; therefore, products have been manufactured at much lower costs and purchased at lower prices decreasing the profit margin.

As a result of the economic slowdown, 2001 and

2002 were tough years for almost all the participants in the rechargeable battery industry. Consumer spending decreased and there was a slowdown in business spending in 2001 and 2002. As a result, the market for batteries that are incorporated in the various mobile devices also faced a reversal of fortunes.

The economy is, however, expected to stabilize and the market is likely to make a recovery. Additionally, the growing demand in the Asian region is also likely to help the vendors overcome the impact of this restraint. Sales of mobile phones and computers are expected to increase at double-digit rates in 2004 and 2005. The Asia-Pacific region dominates the global production and demand for mobile phones and computers, with China as the main driver.

Chemistries Utilized

There are four main battery chemistries used in today's mobile IT and communication devices; nickel-metal cadmium (NiCD), nickel-metal hydride (NiMH), lithium-ion (Li-Ion) and lithium-ion polymer (Li-Ion Polymer). Chart 1 depicts the market split.

Nickel-Based Battery Technology

Nickel Cadmium Batteries

A typical NiCD battery chemistry consists of three components: nickel oxide in its positive electrode called cathode, a cadmium compound at the negative electrode called anode and a potassium hydroxide (KOH) solution as the electrolyte. A separator to prevent contact between the electrodes isolates these cell components.

The NiCD batteries used in mobile devices are rather small, lightweight and function in every position. NiCD batteries deliver high operation current and despite their small dimensions provide considerable output. However, gravimetric energy density of NiCD battery is not comparable to that of other rechargeable batteries in the market. With devices becoming miniaturized and more sophisticated, the need of the hour is for lighter weight batteries with greater capacity. Since the nominal cell voltage of NiCD is only 1.2 volts, the number of cells required to cater to devices demanding higher voltages is more, thereby making the device heavier.

One of the drivers influencing the growth of rechargeable batteries in the mobile IT and telecom device market is the growth of the mobile workforce. Hence, there is a greater emphasis on the portability feature of these devices. A NiCD battery by virtue of its low nominal cell voltage of 1.2 volts needs to be used in more quantity than its lithium-based counterparts. Therefore, the demand for NiCD batteries for use in mobile devices is anticipated to decline.

Even in 2003, the usage of NiCD batteries in mobile IT devices has been restricted to a minimum.

However, in mobile communication devices market, the NiCD battery's performance is slightly better due to the predominance of this battery chemistry in cordless phones.

Nickel Metal Hydride Batteries

A typical NiMH battery is made up of three components, a positive nickel electrode (nickel-hydroxide), a negative hydrogen-absorbing alloy electrode and an electrolyte of potassium hydroxide.

NiMH batteries utilize hydrogen-absorbing alloys in its negative electrode (anode) and nickel oxide or nickel hydroxide or nickel oxyhydroxide in its positive electrode (cathode). The potassium hydroxide makes up a large portion of the electrolyte of the NiMH battery. A small amount of electrolyte is used in this sealed design and is absorbed by the separator and the electrodes.

Having an energy density of 60 to 80 Wh/Kg, the NiMH battery has slowly gained the market share lost by NiCD batteries. Though it is more expensive than the NiCD battery, the disparity between the two chemistries has come down substantially.

However, the usage of NiMH batteries is losing market share drastically due to the migration of cellular device manufacturers to lithium-based battery technology.

Lithium-Based Battery Technology

Lithium Ion Batteries

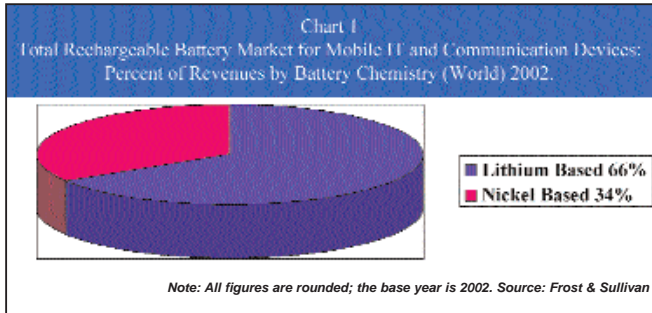
The use of lithium batteries is expected to increase during the forecast period. In 2009, this chemistry is expected to make up 91.8 and 78.8 percent of the total revenue and units for rechargeable batteries used in mobile IT and communication devices, respectively. The advantages of using lithium ion instead of other secondary battery chemistries include:

- **Lightweight** - this battery chemistry reduces the weight by half and volume by 20 percent to 50 percent compared to the same capacity NiCD and NiMH batteries.

- **High voltage capacity per cell** - since it provides three times the voltage of NiCD and NiMH batteries, fewer cells are required. This contributes to miniaturization of electronic devices.

Unlike the NiCD battery, partial charging is possible as lithium-based batteries suffer from no memory effect. Li-Ion batteries are typically more expensive than the nickel-based batteries. One of the reasons being the safety circuit built into the Li-Ion packs. Hence, the increase in the sale of more expensive Li-Ion battery has a positive impact on the revenue of the total market.

Battery Trends



Lithium Polymer Battery

Unlike Li-Ion batteries, the Li-Ion Polymer batteries utilize a solid-state electrolyte. In most cases, the anodes are made of Carbon, either Graphite or Coke, while the cathode is of Cobalt, Manganese or Lithium material.

The advantage of using a solid-state electrolyte is that it eliminates the need for a container. Because a thin laminated foil can be used, cell weight and size are reduced. This allows the battery to lend itself to various configurations. Additionally, the lack of flammable liquid electrolyte makes the polymer battery safer.

This is one of the latest battery technologies. Hence, it still has certain limitations associated with it such as higher cost-to-energy ratio than lithium ion, is more expensive to manufacture and has decreased cycle count compared to lithium ion. However, as demand for Li-Ion Polymer batteries increases, the prices are expected to fall due to mass production. With the decline of prices, the number of device manufacturers incorporating the thinner, slicker Li-Ion Polymer battery is

anticipated to increase.

Hence, the percentage contribution of Li-Ion Polymer batteries toward the total rechargeable battery revenue is anticipated to increase in both the mobile IT and communication devices markets.

That's a Wrap

Increasing demand from customers for smaller, lighter and more capacity power source coupled with mature technology places a lot of pressure on the battery manufacturers. It is imperative for battery vendors to invest in research and development activities to improve the existing product offering and develop more advanced technologies. This is likely to give the vendor the much-needed first-mover advantage in case of a breakthrough.

As wireless connectivity continues to increase with the demand for mobile workforce and convenience, the power demand will also continue to expand, creating a positive impact on the rechargeable battery market. To demonstrate this trend, wireless telecommunications provider T-Mobile USA and network service provider iPass Inc. recently reached an agreement to their customers access each other's networks. iPass' Wi-Fi network has 1,550 hot spots in the US and is expected to grow by more than 3,900 in the first quarter of 2004, according to the company. Also last week, MCI partnered with Boingo Wireless, Inc. to add more than 2,000 global wireless hot spot access points to the telecommunications company's existing 600 US Wi-Fi locations. This increase spells good news for battery vendors.

For more detailed information (revenue forecast, competitive information, demand analysis), please see newly released Frost & Sullivan research World Rechargeable Battery Markets for Mobile IT and Communication Devices (A575-27). For more information regarding the article, please contact sbradford@frost.com