NREL Advances in Analysis/Assessment at the National Renewable Energy Laboratory

Analytic Studies Brief

NREL Examines Environmental, Health, and Safety Issues Concerning Nickel Metal Hydride Batteries

Assessing EH&S Issues Helps Pave the Way to the Marketplace

A new candidate for powering electric vehicles—the nickel metal hydride (NiMH) battery—is approaching the marketplace. But before it can be commercialized, its safety must be examined and any health and environmental issues must be brought forth and resolved.

Analysts at the National Renewable Energy Laboratory (NREL) examined potential environmental, health, and safety (EH&S) issues that involve the NiMH battery. In the NREL report, *Current Status of Environmental, Health, and Safety Issues of Nickel Metal-Hydride Batteries for Electric Vehicles* (NREL/TP-463-5475), they identify important EH&S issues and suggest areas in which further analysis is needed.

Recent advances in NiMH battery technology and concerns about nickel cadmium batteries—working with cadmium and disposing of it—helped spark interest in using NiMH batteries. Several companies are developing these batteries for a variety of applications, including small appliances, aerospace applications, and electric vehicles. Many of the major battery companies have a NiMH product or are developing one. But even though some batteries have been produced, much of the research is still at the battery cell level.

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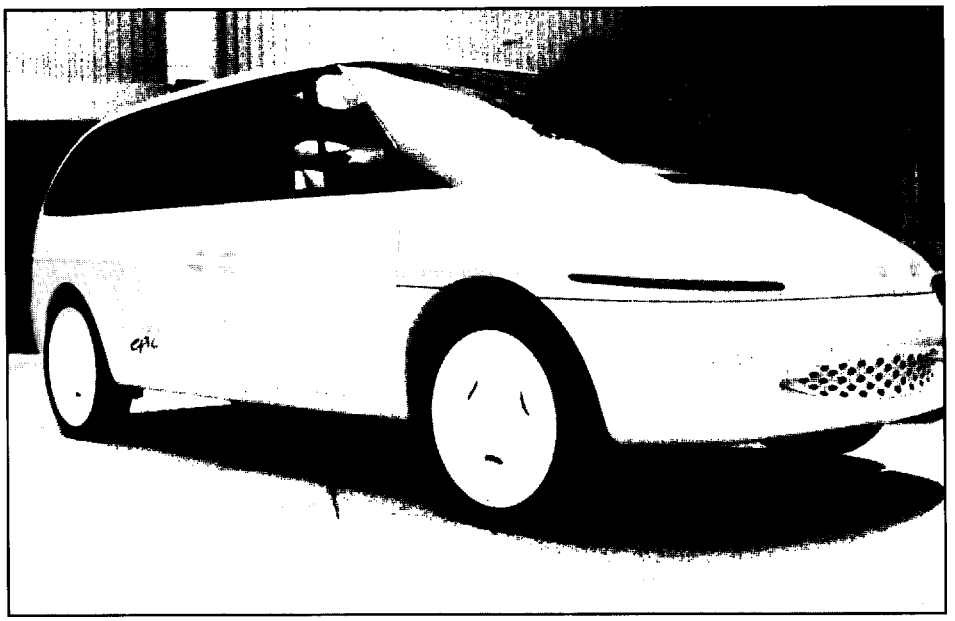

Nickel metal hydride batteries could someday power an electric vehicle such as this one.

NREL analysts concentrated their study on NiMH batteries being developed for electric vehicles by the Ovonic Battery Company. Ovonic is participating in a cost-shared contract with the U.S. Advanced Battery Consortium to help commercialize NiMH batteries.

Findings

In general, NREL's study found that NiMH cells and batteries present few health and safety risks, primarily because the electrode materials are nontoxic. One potential hazard the study did find was the possible rupture of the battery cell caused by an internal gas buildup. However, analysts noted that this risk is minimized because the cell design includes a vent for releasing gases at high pressures. These NiMH battery cells for electric vehicles have been tested for internal gas buildup and performed well; no cells exploded or ruptured during the tests. Another potential hazard involved venting hydrogen from a NiMH battery. But analysts found that this hazard, too, is minimized by using a specially designed cell—one that limits the

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amount of hydrogen evolved during abusive overcharging. However, under certain unlikely conditions, NiMH cells may vent hydrogen gas. Therefore, battery packs need to be designed to prevent the buildup of this gas in battery enclosures.

In addition to battery and cell safety, analysts examined workplace health and safety related to manufacturing NiMH batteries. Even though the National Toxicology Program considers the nickel and nickel compounds in these batteries to be probable carcinogens, risks associated with these substances should be acceptable if Occupational Safety and Health Administration standards are met during manufacturing.

Analysts also examined the Department of Transportation (DOT) requirements for shipping NiMH batteries. Because specific tests are necessary to determine if a battery is "nonspillable," and therefore exempt from many DOT regulations, it is recommended that shipping take place under the more stringent "spillable" requirements until the testing can be completed. Further regulatory relief is available if the batteries meet the "dry" criteria (not capable of leaking or spilling any free liquid if the battery is ruptured). Providing the batteries can meet the "dry" criteria and providing they pose no other transport hazards, such as the generation of excessive heat, they would not be subject to DOT regulation at all.

In-vehicle safety was another area investigated by NREL analysts. They found no safety issues that applied exclusively to NiMH batteries. However, they did review in-vehicle hazards related to electrical systems and the crashworthiness of electric vehicles—safety issues shared by all electric vehicles.

Environmental concerns about NiMH batteries were found to be minimal. The main concern is the recycling or disposal of metals from these batteries. According to tests on Ovonic's NiMH battery, it would not be classified as a toxic hazardous waste under Environmental Protection Agency regulations. However, the NiMH battery would be considered a toxic hazardous waste by the more stringent California and European Community regulations for waste disposal.

As well as examining specific NiMH battery issues, NREL's report reviewed the general EH&S issues that nickel-based batteries have in common. These issues concerned three areas: venting characteristics, toxicity of battery materials, and hazardous waste classifications for recycling and disposal.

Recommendations

Although the EH&S issues concerning NiMH batteries were, in general, considered minimal, the report recommends future EH&S work that would bring these batteries closer to commercialization. These recommendations include the establishment of formal procedures for safety tests, preferably performed by an independent organization. Although it is recommended that shipping take place under the more stringent spillable provisions, the report also suggests that NiMH batteries undergo DOT tests to determine nonspillability or whether the battery is dry.

Although the EH&S issues concerning NiMH batteries were, in general, considered minimal, the report recommends future EH&S work that would bring these batteries closer to commercialization.

Finally, the cost of recycling advanced batteries needs to be calculated so those costs can be considered when planning for commercialization. Currently, NREL is examining how to estimate the cost for recycling NiMH batteries.

For More Information

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