Press Release

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NEW BATTERY TECHNOLOGY

The various technologies tested in industry

Nowadays, the battery is the electric vehicle's element that progresses most, with regards to increasing its power and range. Researchers are trying to make it light, powerful and cheap, like the small cells in our mobile phones and portable computers.

Manufacturers are working on it throughout the world. Among them, Saft and Bolloré in France, and Zebra in Switzerland. Although the principle remains the same to store electricity – two electrodes swapping their electrons – various electrochemical couples are being used, each with its own features.

Electric energy is measured in watt hours (wh). To give a rough idea, a private vehicle uses around 150Wh from its battery to run 1km, compared with 1000wh for a 10t bus (100 wh/tonne). Presently, to provide a range of 200km to a light car, nearly one ton of lead battery would be needed! Much too heavy, the energy must be condensed; this is the challenge. One of the comparisons between batteries is their "energy density", i.e. the quantity of energy they produce for the same weight (wh/kg).

The most widespread:

The lead-sulphuric acid battery, Pb-acid. Energy density: 30 to 40 wh/kg
It came into existence around 1850. The electrodes can be arranged either in plates or in parallel tubes depending on the performance sought. Lead is used in nearly all small electric vehicles like fork-lift trucks, golf cars and electric wheelchairs. But this electrochemical couple is not efficient enough for roadworthy vehicles: it is heavy and of low energy density. The cost – significantly lower than other technologies – is the main attraction for car manufacturers. 36V batteries are being tested by some manufacturers. Research is currently being carried out on new, lighter internal architectures (pseudo-bipolar and bipolar), and new ways of processing the active substances (compression, metallic foams).
Advantages: Cost, mass production, well recycled by the industry.


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GEM - e4

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Commercialised in France:

Nickel-cadmium, NiCd. Energy density: 40-60 wh/kg
This type of battery is produced by SAFT, among others. It is used in the following electric cars marketed in France: the Peugeot Partner and 106, Renault Kangoo, and Citroën Berlingo and Saxo. In the US, NiCd is used by Ford in the Think City. Considered as being effective and reliable, NiCd batteries can nonetheless, depending on the way they are used, have a “memory effect” which reduces their usable capacity. However, that effect is reversible. Because of its cost and a lower resistance to improper use, the sealed technology is hardly used for traction

photo: MITI INFO IMAGE

Citroën - Saxo

Advantages: Reliable, robust, good resistance to quick charge and to cold.

Nickel metal hydride, NiMH. Energy density: 70-80 wh/kg
NiMH batteries are all sealed. Because of their high power and cycle features, these batteries are mainly used in hybrid vehicles (Honda Insight and Civic, Toyota Prius 1 and 2). The manufacturer, Panasonic, developed successively two generations of NiMH storage batteries for Toyota. The second generation of prismatic elements, fitted on the hybrid vehicle Prius 2, is a reference in efficiency and reliability. The manufacturer gives an eight-year guarantee on that component.

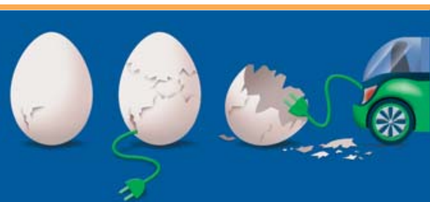
photo: MITI INFO IMAGE

Honda - Civic

Advantages: Low-pollution technology, good performance as regards power, good lifespan.

Zebra, NA/NiCl2: 100-120 wh/kg (operational)
This technology has been developed specifically for electric vehicle applications of heavy and public transport. The internal working temperature is between 270°C and 350°C. The elements are enclosed in an insulated case whose external surface has a temperature of around 30°C. The ceramic electrolyte is the determining element in regard to performance and reliability. The battery is in a one-piece block, integrating everything it needs. The first five buses in France fitted with Zebra batteries were delivered in Lyons in November 2004.

Advantages: High energy density, good energy efficiency, available assembled.



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New Tendencies:

Lithium-ion, Li-ion: Energy density: 120 to 150 wh/kg
To date, it is the most effective couple.
Unlike the couples described above, lithium batteries use a non-aqueous electrolyte, which is an advantage because it eliminates the parasite water decomposition reaction. In France, this technology is developed by SAFT. This type of storage battery is still very little used, mainly because of its cost. It is due to be fitted on the vehicles of SVE company (Heuliez and Dassault Associés). The lithium technology is already widespread for small cells (telephones, computers…). It is mass-produced in South-East Asia, which leads to expect lower production costs. After a difficult start, this technology is now progressing fast.
Advantages: Light and effective. Good French know-how despite the competition from emerging countries.

Dassault - Cleanova

Lithium metal polymer: 120-150 wh/kg.
A technology for the future, still in the prototype stage for electric vehicles. Theoretically, this technology should be more effective than the existing lithium-ion batteries. It works at 80°C and is thus unaffected by external conditions, but it requires to be used regularly in order to avoid its cooling down. Because it is made of thin electrodes placed one on top of the other around a solid extruded polymer electrolyte, the production costs should be attractive. In France, this technology is developed by BATSCAP company (Bolloré Technologies and EDF). In Canada, AVESTOR company, a subsidiary of Hydro-Quebec, was the first to market high-capacity modules for stationary applications.
Advantages: High energy density, anticipated low cost.

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Press Release

Chart 1 Comparing the technical features of storage batteries

	Lead	NiCd	NiMH	ZEBRA	Li-ion	Li--polymer
Specific energy (Wh/kg)*	30-50	45-80	60-110	120	150-190	150-190
Energy density (Wh/litre)	75-120	80-150	220-330	180	220-330	220-330
Maximum power (W/kg)	Up to 700		Up to 900	200	Up to 1500	Up to 250
Number of cycles Charge/discharge)	400-600(1) 1200(2)	2000	1500	800	500-1000	200-300
Advantages	Low cost	Reliability Good performances when cold	Very good energy density	Very good energy density Good cyclability	Excellent energy and power	Thin batteries possible
Disadvantages	Low energy Sudden death	Relatively low energy Toxicity	Cost of base materials Performance/ temperature	Limited power Self-consumption	Safety of large elements Cost	Poor performances when cold Cost

** The lower and upper limits range corresponds to various element sizes (large elements usually have higher energy) or to various types of applications.*
(1) sealed; (2) tubular

Sources: EDF, ADEME