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## Fuel cell and hydrogen storage development for a wheel chair

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### Abstract

In this paper are presented, the recent advances of a demonstration project that focuses on the implementation of a hybrid system for a wheel chair incorporating a fuel cell and a metal hydride hydrogen storage system. Advantages regarding weight reduction and greater autonomy are emphasized, apart from the use of clean energy and the drastic reduction in charging time, when compared with the system before conversion.

**Keywords:** PEM fuel cells, metallic hydrides, demonstration project, wheel chair

## 1 Introduction

It is proposed to modify a wheel chair by implementing a hybrid system that incorporates a fuel cell and hydrogen storage based on metal hydrides.

Comparisons between the actual main characteristics of the vehicle with those to be obtained after conversion are depicted in Table 1.

Table 1 Main characteristic of wheel chair as received and after conversion (by incorporation of a PEM fuel cell powered by stored hydrogen in metal hydrides).

Characteristics	Actual	After conversion
Maximum speed, km/h	7	7
Autonomy, km	25	50
Motor power, Watt	2 x 250	2 x 250
Battery capacity, Ah	2 x 60	2 x 10
Battery weight, kg	~33,2	4
Battery volume, L	~43,2	5,2
Storage weight (kg) and Volume (L)	-	19,2 7,2
Fuel cell weight (kg) and volume (L)	-	2 5,5

Weight reduction and greater autonomy are emphasized.

Table 2 shows the development partners of the proposed conversion project and their respective tasks.

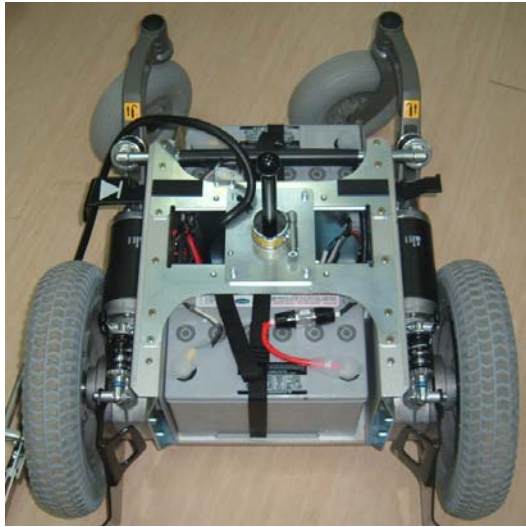
Table 2 Wheel chair conversion project: Partners in development.

	Partners/ Wheelchair Conversion project
Wheel chair	Permobil
Fuel cell stack	INETI (components - bipolar plates); SRE (assembling of stack)
Storage – metallic hydrides	INETI (alloy properties and testing.), LABTECH (alloy and reactor supply)
Integration, engineering and testing	AUTOSIL, EFACEC, SRE, INETI
Conformity to Standard CEI-62282	INETI, SRE
Conformity to Standard EN -12184	Permobil, INETI

Figure 1a) shows the base of the wheel chair, where, in the space actually occupied by the batteries, a new energy system will be incorporated.

A 350 W PEM fuel cell is under development. A moncell of 15 cm<sup>2</sup> has been built and tested as well as stacks constituted by 16 cells, figure 1b); typical polarisation curve for the 16 cell stack is shown in figure 1c).

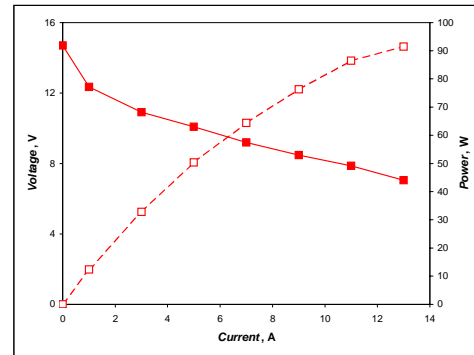
The hydrogen storage sub-system is based on metallic hydrides specified to a capacity of 3000 L of hydrogen, contained in 3 reactors, see figure 1d). The selection of a suitable metallic hydride for the present application was based on its thermodynamic properties and characterization of absorption/desorption cycles, performed using a purpose built Sievert-type apparatus.



(a)



(b)



(c)



(d)

Fig.1 Base of the wheel chair where the new energy system will be located (a);

under development 350 W fuel cell, showing 2 of 4 stack modules (b); polarization curve of one of the 16 cells stack c);

metallic hydride reactors that will constitute the hydrogen storage sub-system – 3 reactors with a 1000 L capacity each (d).