Metal Hydride Storage Tank

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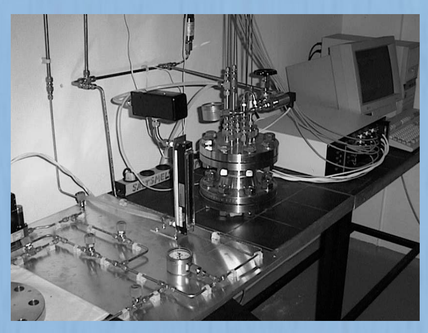
Abstract
A hydrogen storage tank was developed and constructed based on metal hydride powder contained in aluminium compartments. The aim was to develop a tank for a hydrogen powered car with a water cooled internal combustion engine (ICE). A model tank with an internal volume of about one litre was fitted with a heat exchanger and metal hydride alloy powder of the AB_5 type from GfE (Germany). Charging time (95%) was about 20 min. with tap water cooling and discharging time (95%) about 30 min. using 85-90ºC water as the heat source.

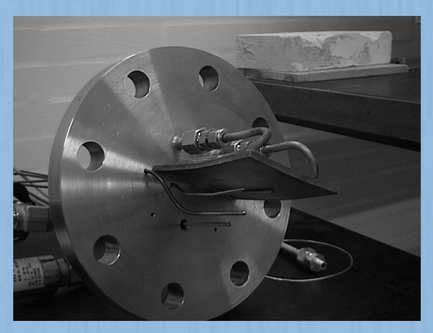
Later the tank was up-scaled, but changed geometrical requirements from the end-user led to a re-dimensioning of the heat exchanger. As a consequence the rates for charging and discharging became somewhat lower.

First tank (vol ~1L)

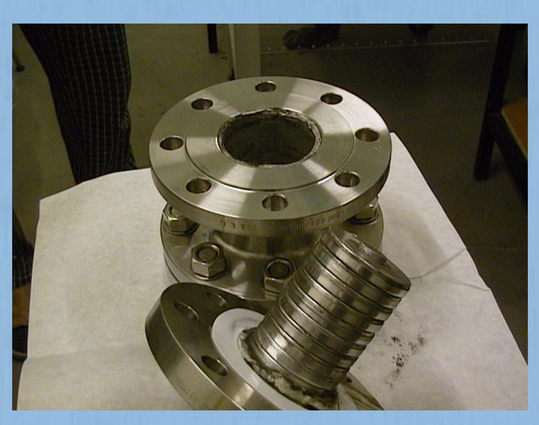


Left: Tank 1 during testing.

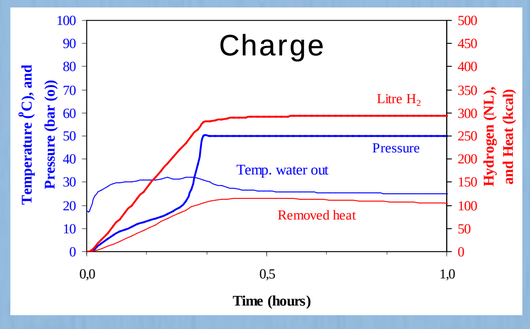
Right: The copper plate heat exchanger after a number of charge discharge cycles. Note it is severely bent due to the expansion forces of the powder.



Second tank (vol ~1L)

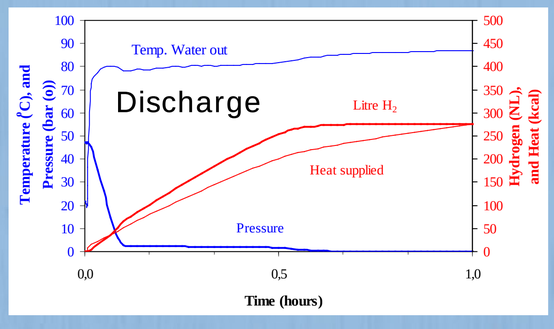


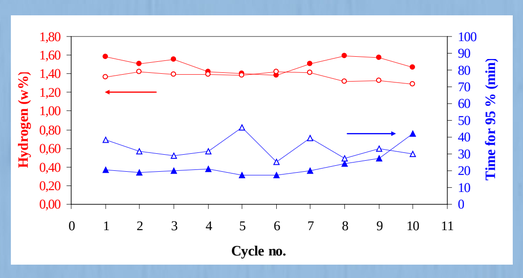
The improved heat exchanger in Tank 2 after testing. The aluminium compartment served two purposes; 1) as heat conductors and 2) to prevent compaction of the powder. The central tube for water cannot be seen. No visible damage was detected.



Left: Charging of tank 2. Cooling by tap water.

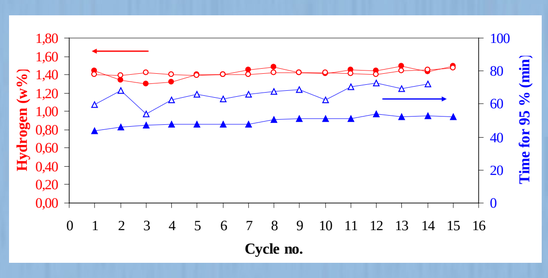
Right: Discharging. Heating by 85-90ºC water (attempted cooling water from vehicular ICE)



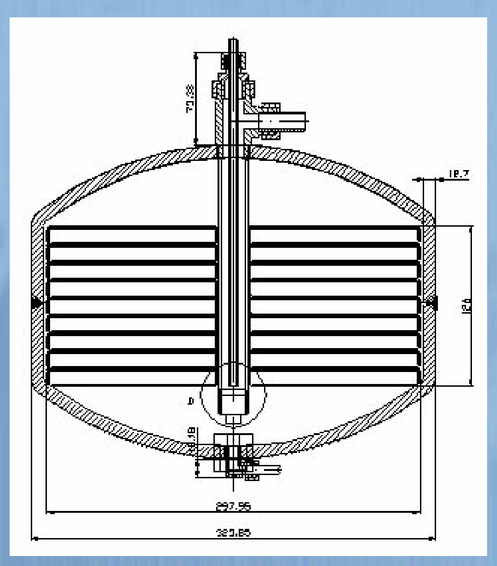


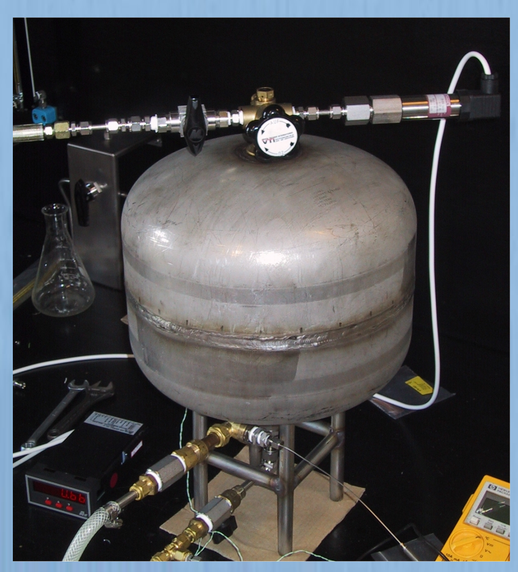
Left: The result of 10 charge/discharge 10 cycles of tank 2 with pure hydrogen (99.9999%). Filled markers: filling, open markers: discharge. Time for 95% completion.

Right: 10 more cycles with technical quality hydrogen. (low purity)



Third tank (vol 17,5L)





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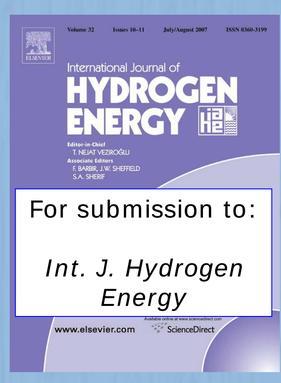

Left: Cross section of final tank. Mid: The final tank. Volume 17.5 L. 29 kg hydride. Right: one compartment during filling (in air)

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