Test of the replication design of High-temperature E-cat reactor of Rossi

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Report at the workshop on Cold Fusion and Light Ball at the People's Friendship University of Russia [1]
(Translation from Russian language by Stoyan Sarg/Bob Greenyer)

Note by translator: The first 8 slides of the report [1] give a brief introduction to the Rossi's E-cat HT test described in the Lugano report [2]. This part is not translated. The slides after this introduction are translated with the pictures and graphics taken from the original report of A. Prohorov.

(Slide #8)

Isotopes of Li and Ni in fuel and ashes (in %) measured by ToF-SIMS и ICP-MS according to the Lugano report and the natural abundance

	Fuel		Ashes		Natural abundance
	ToF-SIMS	**ICM-MS**	**ToF-SIMS**	**ICM-MS**	
^{6}Li	8.6	5.9	92.1	57.5	7.5
^{7}Li	91.4	94.1	7.9	42.5	92.5
^{58}Ni	67	65.9	0.8	0.3	68.1
^{60}Ni	26.3	27.6	0.5	0.3	26.2
^{61}Ni	1.9	1.3	0.0	0.0	1.8
^{62}Ni	3.9	4.2	98.7	99.3	3.6
^{64}Ni	1		0		0.9

1. The isotope ratio of lithium and nickel in the fuel is practically not different from the natural abundance
2. 2. In the ashes the relative quantity of ^{6}Li increased significantly, while ^{7}Li decreased.
3. With the exception of ^{62}Ni, the quantity of all other isotopes of nickel decreased significantly in the ashes. The quantity of ^{62}Ni increased from 3.6% to 99%.

(Slide #9)

What happens inside of the Rossi's reactor at high temperature

During the heating the lithium-aluminum-hydride decomposes

One gram of lithium-aluminum-hydride delivers 0.105 g hydrogen (or 1.17 liters at normal air pressure)

$$2Li[AlH_4] \xrightarrow{125-180^0 C} 2LiH + 2Al + 3H_2$$

$$2LiH \xrightarrow{>850^0 C} 2Li + H_2$$

If the internal diameter of the fuel cylinder is about 4 mm, the volume is about 2 mL. Then 100 mg of lithium-aluminum-hydride deliver about 100 mL at normal conditions (air and temperature). If this 100 mL are compressed to 2 mL, the pressure rises to 50 atmospheres. Additional rise in pressure contributed by the heat. For this reason the pressure of the Rossi's sealed reactor may reach about 100 atmospheres. At the temperature of working Rossi's reactor the nickel mixed with the liquefied aluminum and the hydrogen in fact appears in the gas environment of lithium and hydrogen. The residual air reacting with the hydrogen, lithium and aluminum in fact makes a small quantity of nitrogen, ammonia, nitric oxide and oxides of lithium and aluminum.

[1]
https://docviewer.yandex.com/?url=ya-disk-public%3A%2F%2FejFRuMB3GiCF6ZXZHI9lIxg2OeCo5GTI6HuLUo5jb5Y%3D&

name=%D0%90%D0%BD%D0%B0%D0%BB%D0%BE%D0%B3%20%D0%A0%D0%BE%D1%81%D1%81%D0%B8.pdf&c=549f2e90f6ce
[2] http://www.e-catworld.com/2014/11/02/report-on-jonp-positive-reception-from-iterareva-scientist-to-lugano-report/

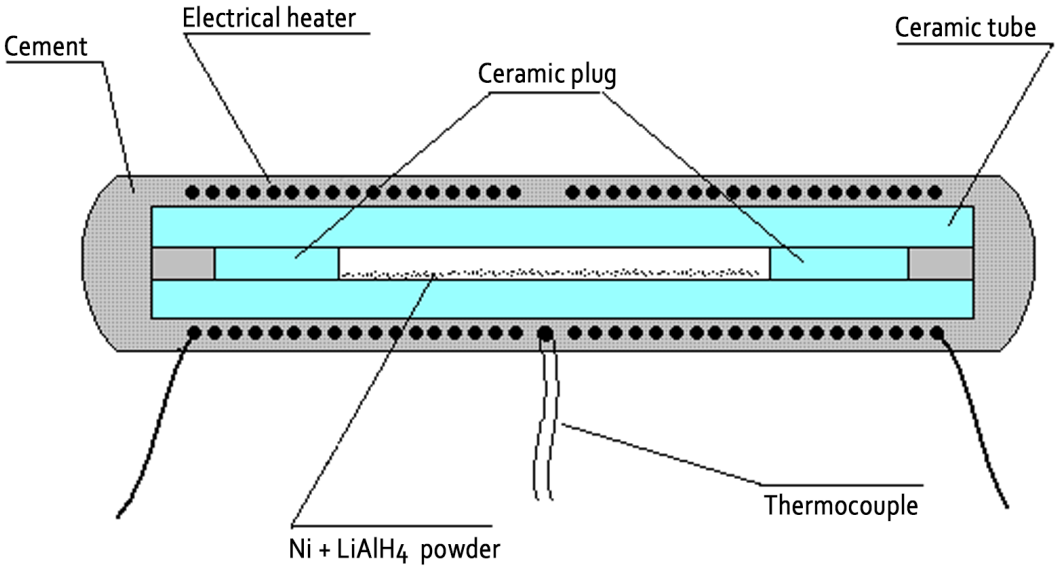
Slide #10

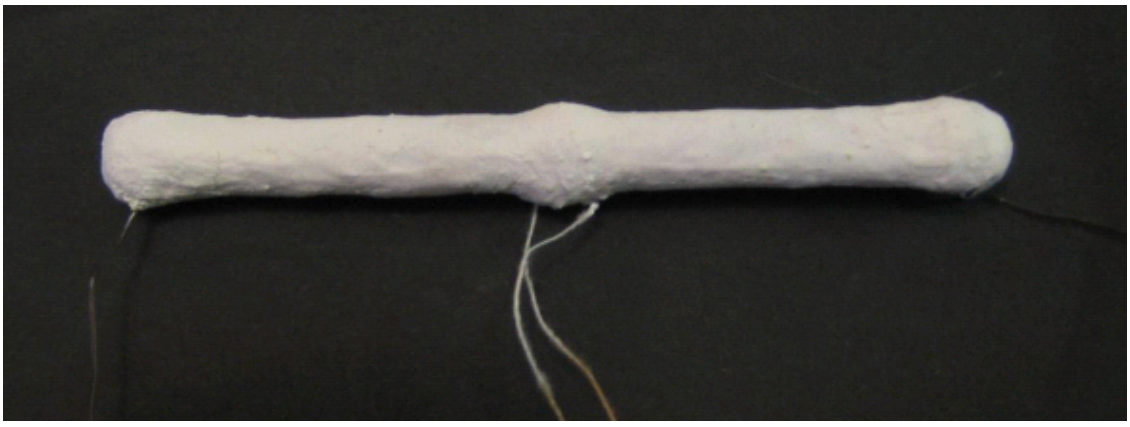
Following the above-mentioned considerations one may assume that the high-temperature reactor of Rossi is simply a small ceramic cylinder sealed by high temperature resistant cement, containing a nickel powder with added lithium aluminum-hydride (about 10% weight). For starting the process this ceramic cylinder must be heated to the temperature of $1200^0 – 1400^0$C.

If our assumption is true, in order to build an analog of Rossi's reactor, one must made a device sustaining a high pressure at high temperature, containing inside a mixture of nickel powder and lithium aluminum-hydride.

Slides 11 & 12

Design of the reactor prepared for test





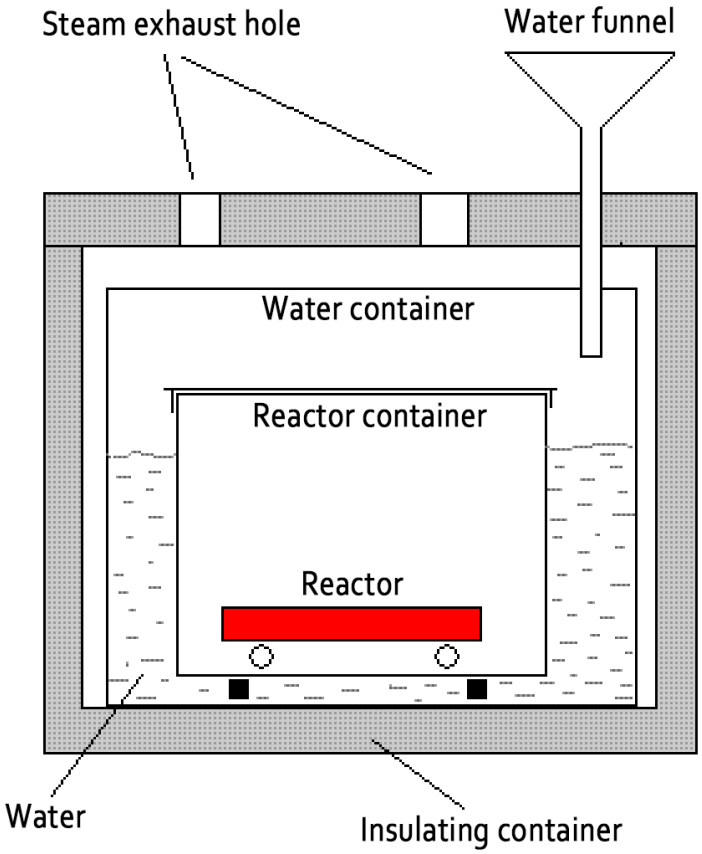
Design and picture of the reactor prepared for test (Courtesy of A. Parkhomov)

For building of the reactor a ceramic cylinder of Al_2O_3 with a length of 120 mm, external diameter of 10 mm and internal diameter of 5 mm was used. An electrical heater is wound around the cylinder. Inside of the cylinder is 1 g of powder Ni +10% $Li[AlH_4]$. A thermocouple is attached at the external surface of the cylinder. The ends are sealed by high temperature resistant cement. The whole cylinder is then covered by the same cement.

Slide #13

Measurement of the released heat

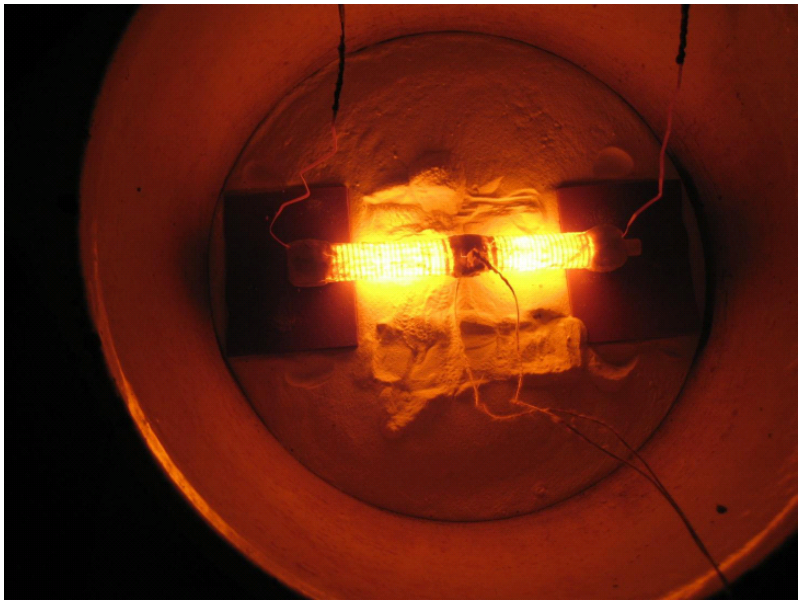
The method used for test of the Rossi reactor based on the IR optical radiation is complex. The method in described here experiment is based on the quantity of the vaporized water. This method is elaborate and experimentally verified multiple times. Yuri N. Bazutov



The reactor is enclosed in a metallic vessel. This vessel is immersed in water. When the water boiling begins a fraction of water goes out as a vapor. The released heat quantity is estimated by measuring the water quantity (before and after the experiment). The correction for the heat lost through the isolation can be estimated by the rate of cooling after turning off the experiment.
Reactor test experiment (Courtesy of A. Parkhomov).

Slide #14

Working reactor



Picture from the top (the cover of water vessel was removed). (Courtesy of A. Parkhomov)

Slide #15
Measurement equipment

Picture of measurement equipment

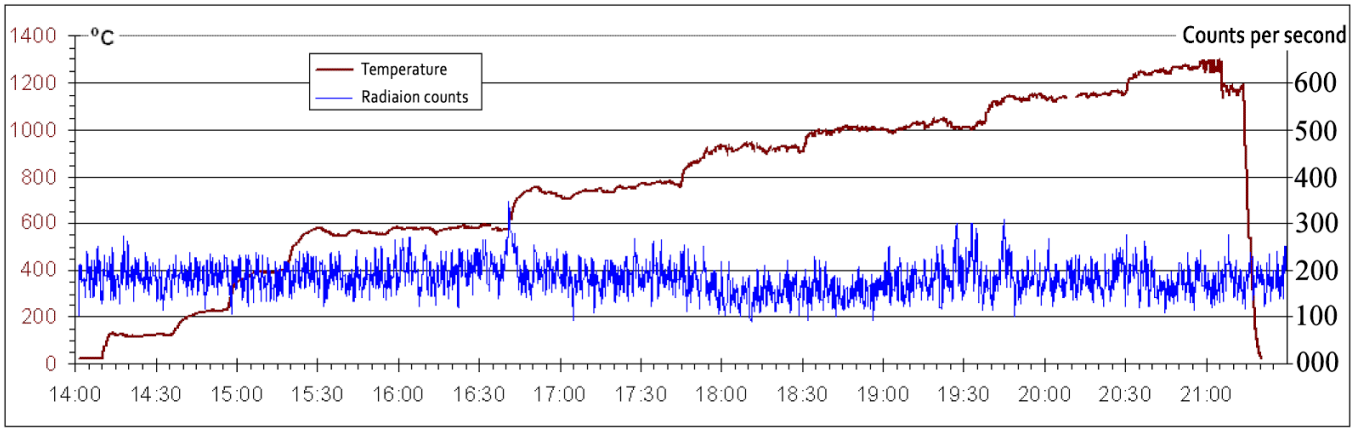
From right to left: Power supply for heaters, Geiger counter display, ampmeter, thermocouple amplifier, reactor temperature display, computer data logger, digital voltmeter.

At the right side: Reactor in the calorimeter. On the top: Geiger detector СИ-8Б, on the side surface; - (radiation) dosemeter ДК-02.

A laptop computer is used for data logging of the reactor temperature and Geiger counter.

Slide #16

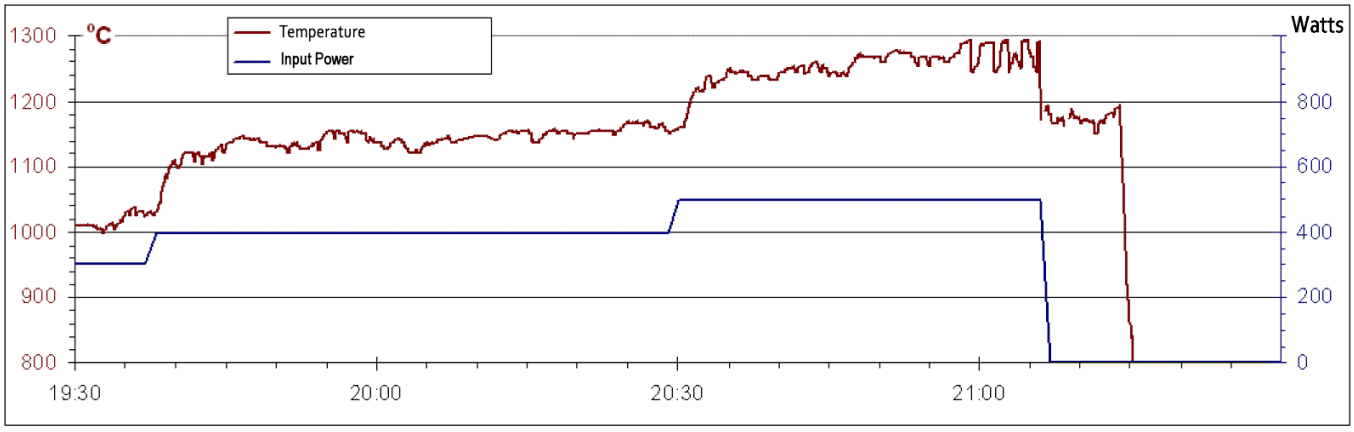
Temperature change during the heating (Courtesy of A. Parkhomov).



The power of electrical heater has been changed by steps from 25 w to 500 w. After 4 hours the temperature reached 1000^0C. The plot shows the temperature measured by the thermocouple and the counter rate of Geiger counter СИ-8Б, that is able to detect alpha, beta, gamma and X-rays. It is apparent that the radiation is almost as the background. A small negligible increase is observed around the temperature of 600^0 and 1000^0C. Further test will show is this occasional or not.
The dosemeter ДК-02 did not find a radiation exceeding the measurement error (5 mP)

Slide #17

Temperature vs heating power (Courtesy of A. Parkhomov)



The plot shows the temperature change vs the electrical heating power around the 300, 400 and 500 VA. One may see that the temperature rises at constant heating power. This is evident especially at the last heating power section (500 VA). During the last heating power section some temperature oscillations are observed. This section terminated due to interruption of the electrical heating power because of a burning of the heater. After that the temperature stays at the level near to 1200^0C for 8 minutes and then it begins to fall sharply. This means that for this time duration (8 min) a heat at the level of a kilowatt is produced inside of the reactor without electrical heating.
In this way the plots shows, that the reactor is capable to generate a significant heat power that is greater than the electrical heating.

Slide #18

Estimate of released energy as heat (Courtesy of A. Parkhomov).

Average temperature	^{0}C	970	1150	1290
Duration of different input power sections	minutes	38	50	40
Electrical heater input power	VA	300	394	498
Cumulative heater energy input	J	684000	1182000	1195200
Weight of vaporized water	Kg	0.2	0.8	1.2
Energy spent for vaporization of water	J	452000	1808000	2712000
Heat leakage rate through thermal insulation	W	155	155	155
Cumulative heat loss through thermal insulation	J	353400	465000	372000
Cumulative net energy	J	805400	2273000	3084000
Output/input energy ratio (COP)		1.18	1.92	2.58

At temperature of 1150^{0}C and 1200-1300^{0}C the heat released by the reactor exceeds significantly the consumed energy. During the total working time (about 90 min) the excess heat energy produced by the reactor is about 3 MjJ or 0.83 KWH energy.

http://www.wolframalpha.com/input/?i=energy+to+heat+1.2+kg+of+water+to+100+celsius

Conclusion (by A. Parkhomov): The replication test of the High-temperature E-cat reactor of Rossi loaded with a mixture of nickel and Lithium-aluminum-hydride shows that at temperature of 10000C and greater this device really produces greater output energy than the input one.

Alexander G. Parkhomov (Image courtesy of Researchgate.net)

Note by translator Stoyan Sarg: The initial heating power and temperature before reaching 1000^{0}C is not shown in the plot of slide #16. Is it taken into account for the accumulated energy? If not a much longer test is needed for estimation of the COP.