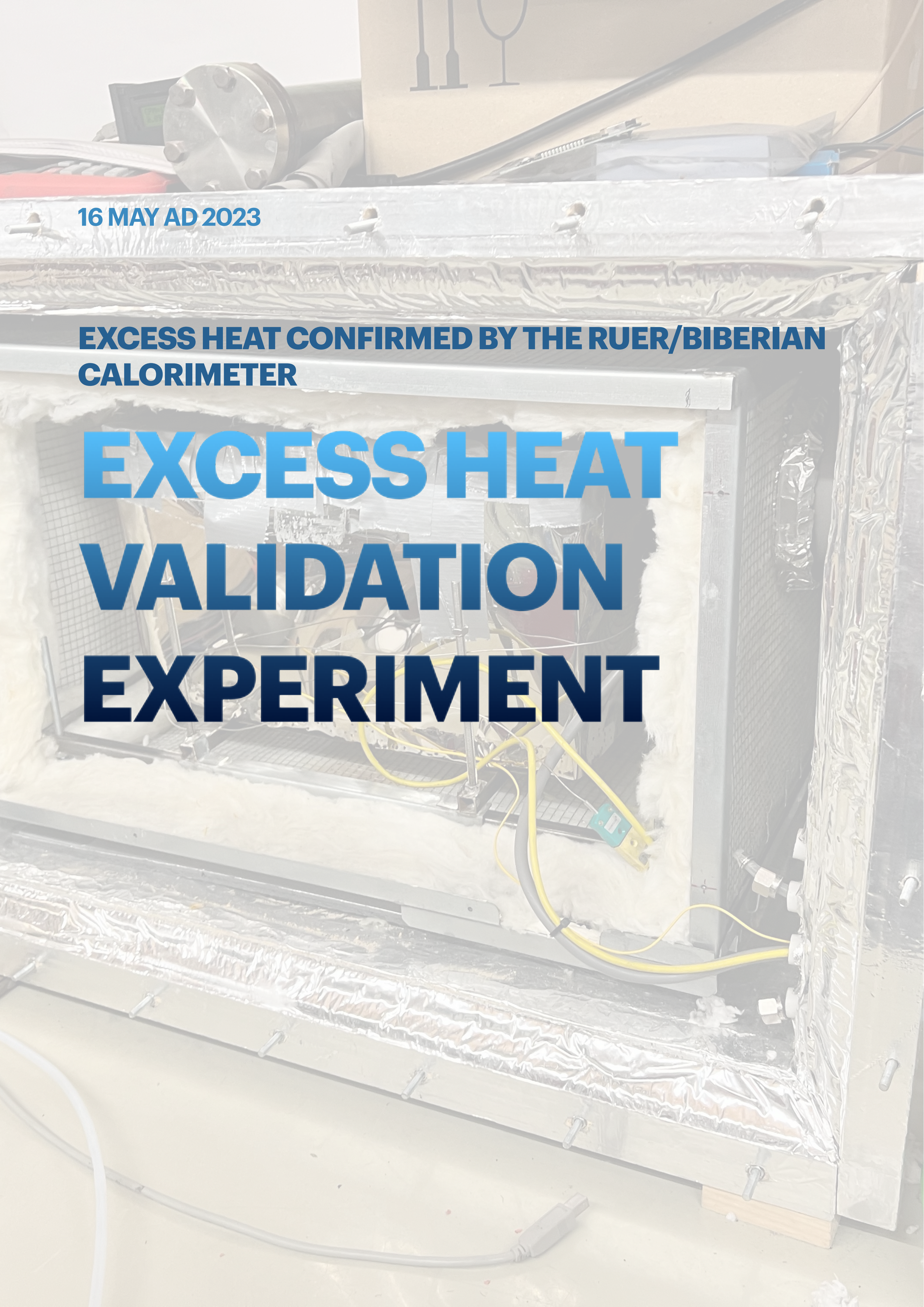

16 MAY AD 2023

EXCESS HEAT CONFIRMED BY THE RUER/BIBERIAN CALORIMETER

EXCESS HEAT VALIDATION EXPERIMENT

Executive Summary of the Mizuno-53 Reactor Validation Experiment

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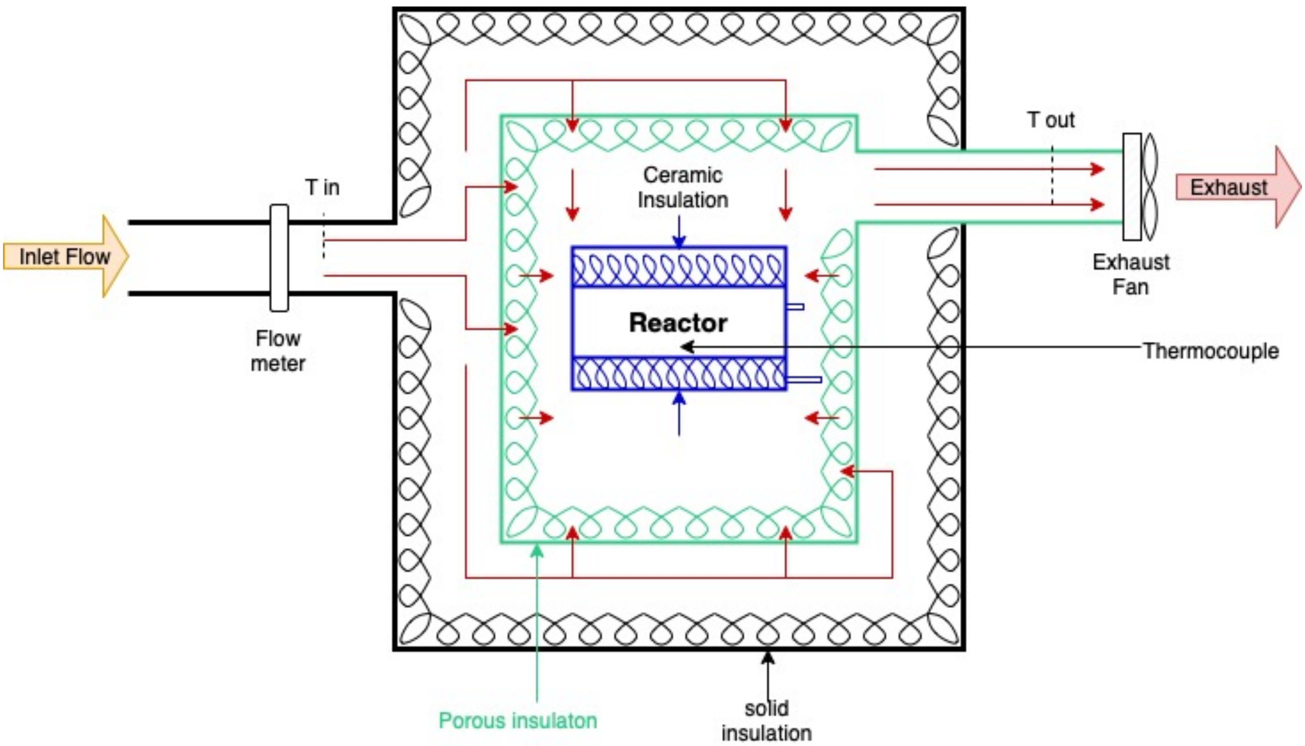
The Ruer/Biberian Calorimeter is an advanced transpiration calorimeter design specifically optimized for detecting excess heat produced in LENR experiments. The calorimeter consists of three layered boxes. The outer box, in dark grey, is



fully insulated with non-porous wood and fiberglass insulation. The second box, in green, is constructed with porous insulation so that air can flow from the external compartment of the calorimeter, evenly from all directions through the porous insulation due to the slight pressure loss across the porous barrier and then out to the effluent pipe and picking up all heat emitted from the inner box, in dark blue, in the process. The innermost box contains the reactor and ceramic wool insulation so it can reach very high temperatures. The reactor is heated via electrical resistance wire wrapped around the reactor. This calorimeter recovers more than 99% of the heat input, which is precisely measured through an intelligent DC power supply.

The heat flow is calculated from air flow meter (max. 3% uncertainty, RS Pro, AVM-09), two K-type thermocouples with calibrated uncertainty of <0.5% for Tin and Tout, input power is supplied via a TDK-Lambda GENH-150-5 intelligent power supply. The specific heat of air is computed from the Tin and ambient RH meter. All data is monitored via continuous data logging system. In the initial few power settings, Pin data is highly stable as it was controlled via a PID feedback control algorithm, but during the experiment the PID control function failed, so we switched to manual constant current control and achieved an approximately +/- 0.5W stability in input power. Due to the time constant of approximately 2.5-3h, this instability is integrated over time so it did not significantly affect the results of these experiments.

All data is recorded to a hard drive on a lap top computer. All raw data filed will be stored on a public folder for full access. The main data points were yellow (Pin), blue (reactor surface temperature), and purple (adjusted Pout).

Heat output is calculated via the following equation:

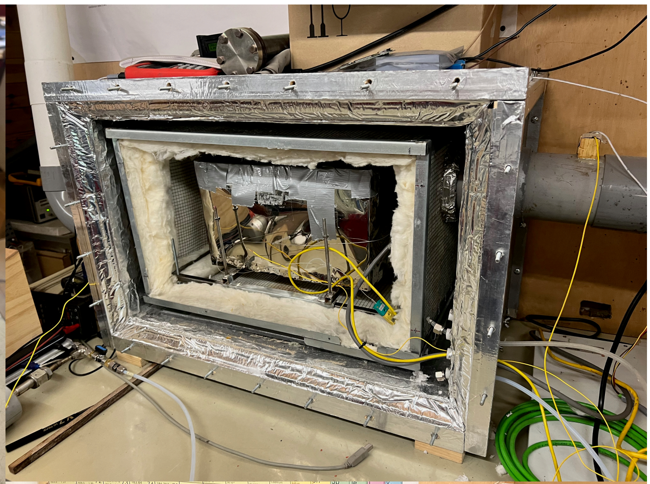
$$h_s = c_p \rho q dt \qquad (1)$$

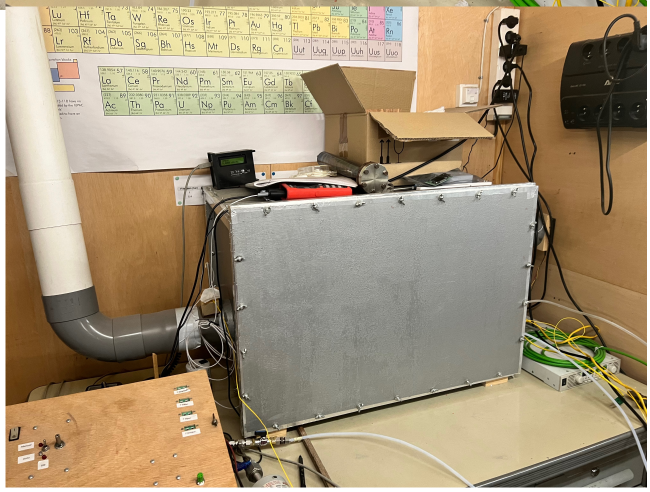
where, h_s = sensible heat (kW)

c_p = specific heat of air (1.006 kJ/kg °C)

ρ = density of air (adjusted for ambient temperature/humidity),

q = air volume flow (m^3/s),





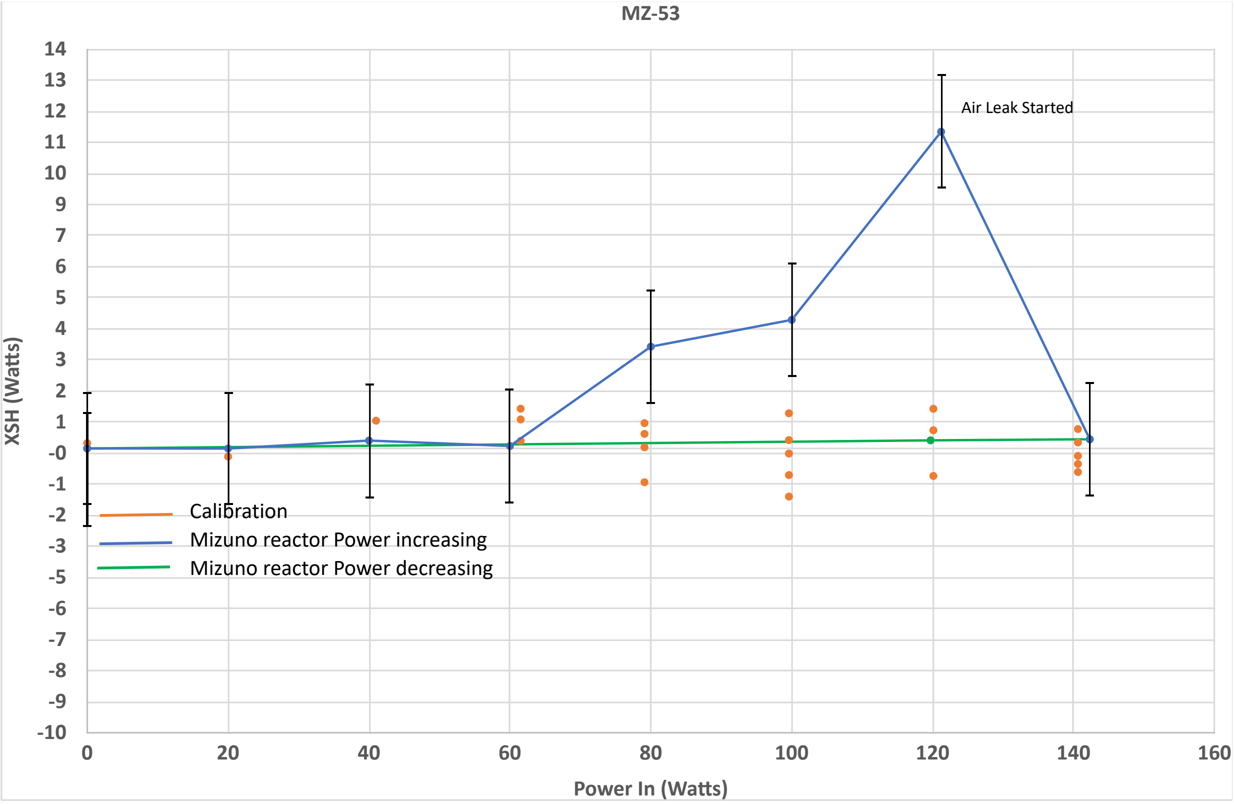
EXPERIMENTAL METHODS

EXPERIMENTAL SET-UP

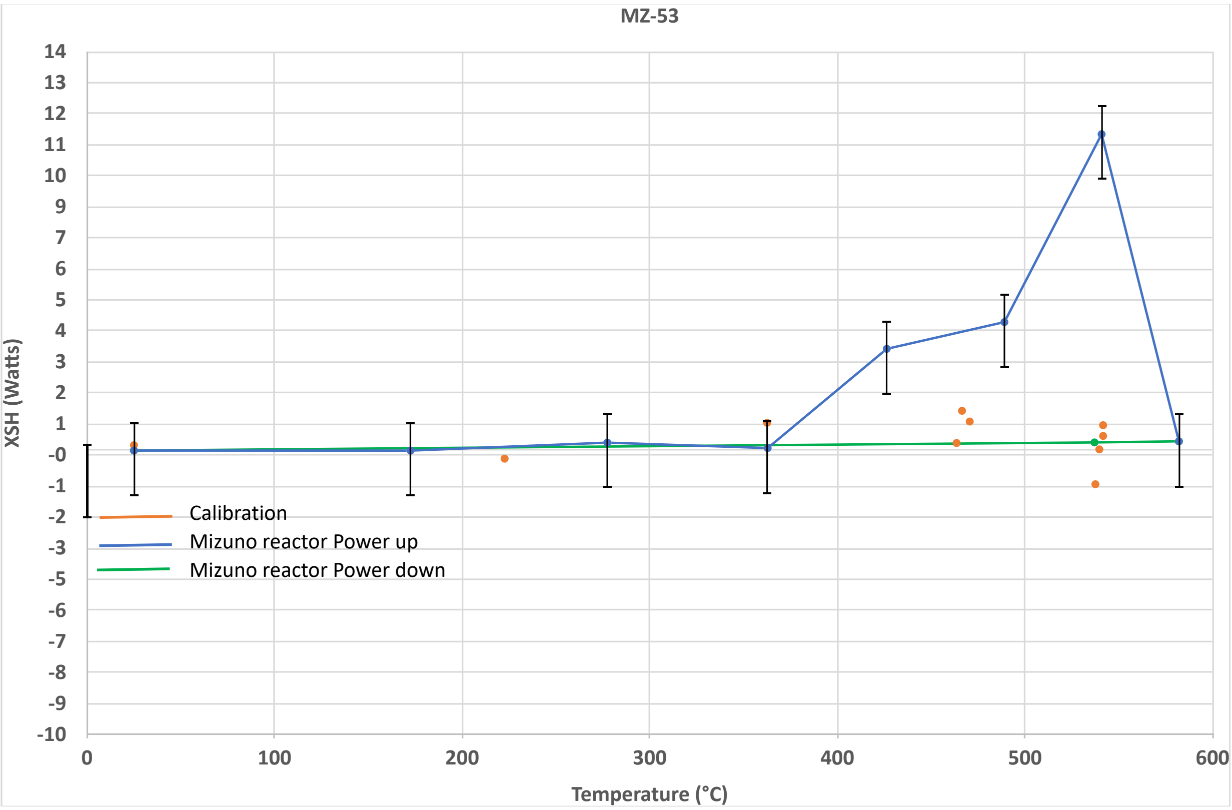
The Mizuno MZ-53 reactor is a stainless steel hollow vessel sealed by welding and contains a 6mm Stainless 304 tube 70mm in diameter and 300 mm in length. After activation a Swagelock stopper is installed and reactor interior is kept in reducing conditions with addition of hydrogen at low pressure (~5000 Pa) at RT. A resistance wire heater is wrapped around the reactor and then two 25mm which layers of ceramic wool insulation are wrapped around the reactor and the entire assembly is sealed with duct tape and placed within the calorimeter and the heater wires are connected to the TDK-Lambda DC power supply. The power in (Pin) data is recorded via RS-485 serial data connection to the data logger system and the parameters are recorded at a rate of 1 Hz into CSV files.

EXPERIMENTAL PROTOCOL

The power was set at 20W and we waited at least five time constants before increasing Pin in 20W increments up to 140W. Total time from start to finish was approximately 12h to stabilize and higher power settings took less time to equilibrate. At 120W input, the reactor temperature peaked at 540°C and the excess heat (XSH) peaked at an



Excess Heat (XSH, Power Out - Power In) vs. Input Power



Excess Heat (XSH, Power Out - Power In) vs. Reactor Temp adjusted level of 11.2W, but then the XSH slowly started to fall over time. This is usually an indication of a slow leak. The reactor contained a high voltage passthrough with a ceramic core. The thermal coefficient of expansion is different for metal and ceramic components, so it is possible the slow leak began to develop as the reactor temperature began to exceed 550°C. In the past we have seen this same pattern when an activated reactor develops a slow leak. We intend to perform a leak test on the device to confirm this hypothesis and additional reactors are now under construction that do not contain the pass through, so that we can further test XSH at higher temperatures.

Interestingly, after the reactor reached 580°C at 140W Pin, the XSH finally reached close to zero, within a 1W margin of error. Subsequently, we then repeated 120W, 100W, and 80W and the calorimeter output was within 1W of zero at all four of these data points, showing the high precision and reliability of the results using this calorimeter, and supports the hypothesis that there were not any calibration drifts before and after the excess heat was confirmed.

DISCUSSION

The Ruer/Biberian transpiration calorimeter used in this experiment was incredibly precise and could reach zero with an error of less than 1W in power settings with the inactive reactor. System uncertainty, calculated from published accuracy data from the equipment manufacturers gave a final absolute uncertainty of <10% in XSH. However, the uncanny precision of the calorimetric data (typically <1%) is because this equipment is obviously very stable over time. When readings are stable temporally and do not drift, the calibration process will tend to cancel out absolute errors and the measurements become relative, assuming the input power is accurately measured. Therefore, the calibrated error of this calorimeter consistently showed <1W error absolute, which gives high confidence that the 11.2W of XSH observed was real and not due to any kind of systemic error or instrumental drift. The calorimeter gave reliable zero readings both below and above the peak XSH as well as before and after the peak XSH was observed. It would be prudent to continue experiments with other calorimeters to eliminate the possibility of systemic error and such experiments are now planned.

XSH, after peaking at 11.2W (132.2W output with 121W input@540°C), started to slowly decline over a period of about 2 days until it finally reached zero. Leak tests will be performed on the test reactor to confirm the leak hypothesis. Additional reactors also will be tested within the next 30 days.

The Mizuno reactor is interesting from several perspectives. Firstly, since the reactor is simply a heat amplifier, it does not need high COPs to become commercially viable. If electrical pulses or laser power is required in the process, high COPs are necessary to reach commercial viability since the efficiency of those processes are typically 30% or less. Heat to heat conversions can immediately save fuel in conventional power stations or many other industrial processes, even with a relatively low COP.

Thirdly, given the <<2W uncertainty in the observed measurements, the 11.2W XSH result is highly convincing and represents the highest level of XSH ever recorded with this equipment over a history of 53 total experiments.

CONCLUSIONS

These are still handmade early-stage prototypes and we are already reaching record levels of XSH recorded with this device. We plan further experiments to further characterize the reaction and confirm higher levels of XSH.

According to Mizuno, this reactor contains no precious metals and hence would be inexpensive to manufacture and mass produce. As someone who has done LENR research for more than 35 years, these results, while still having much room for additional improvement, still represent the most convincing XSH results ever seen to-date.

We are looking forward to running additional experiments with even more robust experimental protocols and hoping to record higher power levels in the near future.

Signed by:

Jean-Paul Biberian, PhD 17 May, 2023

Ret. Professor Aix Marseilles Univ.