A LAB-SCALE MICROWAVE SYSTEM FOR EXPERIMENTS OF HIGH TEMPERATURE WASTE PYROLYSIS

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The reactor designed and assembled at *Università degli Studi di Palermo* - presented here - was conceived to explore high unit power input, high temperature reductive processes. Its main field of use therefore is likely to be the *destruction* of liquid waste fed as an aerosol; or of VOCs; or of granular waste making a fluidized bed. If required, a 3-phase system including a solid catalyst could also be set up. These waste should be free of low-melting or boiling metals. Incidentally, a literature review shows that the compounds taken as benchmark in thermal VOC destruction are trichloroethylene, benzene and toluene.

At lower unit power rates this MW-based system lends itself also to recovering useful fractions from complex waste like WEEE (Waste of Electrical and Electronic Equipment), through pyrolysis and gasification. In this application the metals are expected to remain in the *char*, available for easier leach out and recovery later.

At the highest power input rates the system can generate a non-thermal plasma. Actually, a common way to get at it is applying a sufficiently strong electric field to ensure the discharge of a neutral gas; due to their light mass, electrons are selectively accelerated by the field and gain high energies while the heavier ions remain relatively cold through energy exchange with the background gas.

The pilot system designed, set up and tested at University of Palermo is based on Microwave (MW) instead. Its core consists of 2 rectangular waveguides with flanges, fastened in series, in which a quartz reactor can be placed and receive a MW flux from a standard *magnetron* rated at 1 100 W. The power input is 800 W, adjustable in 5 steps; the frequency is the customary 2 450 MHz, that is about 20 times the RFs used by several of the Authors who have also experienced plasma generation through MW.

The system was made as a *single-mode cavity* that can be tuned turning 2 end pistons and 3 stubs placed in the waveguides. The antenna inlet and the hole for the quartz reactor were placed after a “resonant modes” study. A single- (or mono-) mode cavity is a resonant cavity in which no MW reflection occurs except – in the case - those due to the interfering presence of the sample. The advantage is that it can generate a much higher intensity of EM field than the multi-mode cavity.

The Authors made themselves sure that EM field does not exceed 4 V/m anywhere in the lab surrounding area. The setup cost less than 6 000 euro for the materials only.

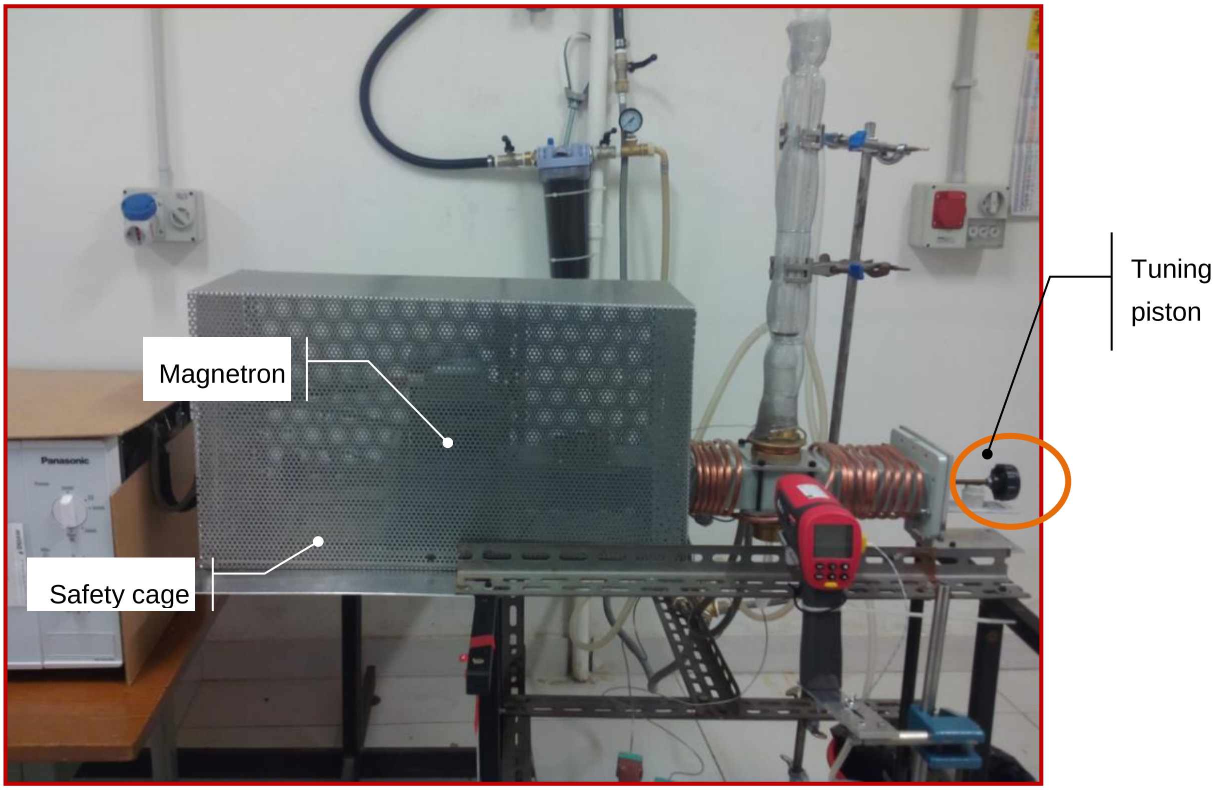

Figure 1. *The high power input microwave system set up at University of Palermo*

The following Figure 2 is a photography of the plasma cloud generated in Helium in 10 s from the switching on, around the quartz crucible containing a *blank* of granular graphite, at about 800 °C and atmospheric pressure.

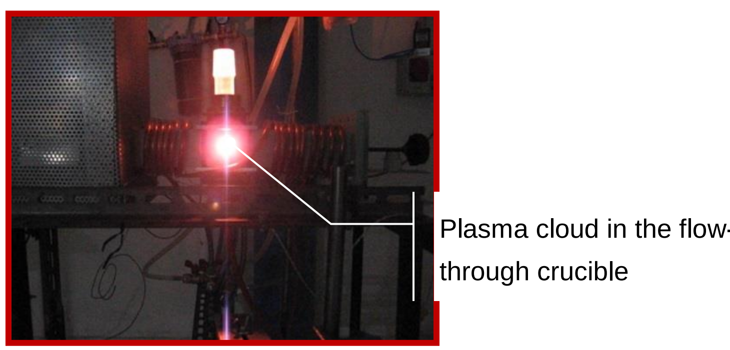

Figure 2. *Onset of a plasma cloud in vey first trial of the system set at 250 W. The gas was Helium.*

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