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ATMOSPHERIC PRESSURE MW PLASMA FOR WASTE CARBON TREATMENT

L. Leštinská[1*], V. Martišovitš[1], M. Zahoran[2] and Z. Machala[1]

[1] *Division of Environmental Physics, Department of Astronomy, Earth Physics and Meteorology,*

[2] *Department of Experimental Physics, Comenius University, Mlynská dolina, Bratislava 842 48, Slovakia*

1. INTRODUCTION

Microwave (MW) torches are typically used to produce equilibrium plasmas for various industrial or environmental applications. We use Litmas Red MW torch (2.45 GHz, 3 kW), which is able to generate plasma at atmospheric pressure in a state close to LTE. Such plasma in nitrogen was tested for waste carbon treatment. The treated carbon was a product of pyrolysis of used tyres [1]. Its benefication is needed to eliminate the volatile components causing its bad smell, and to make it reusable for other applications, such as a colouring agent for plastic materials or an adsorbent.

2. EXPERIMENTS AND RESULTS

In the first approach, the waste carbon sample was placed on a stainless steel plate in the plasma plume about 1 cm above the nozzle (Fig. 1a). The carbon samples were heated for 5 or 10 minutes in nitrogen plasma of 13 l/min flow rate and 1.4 kW generator power.

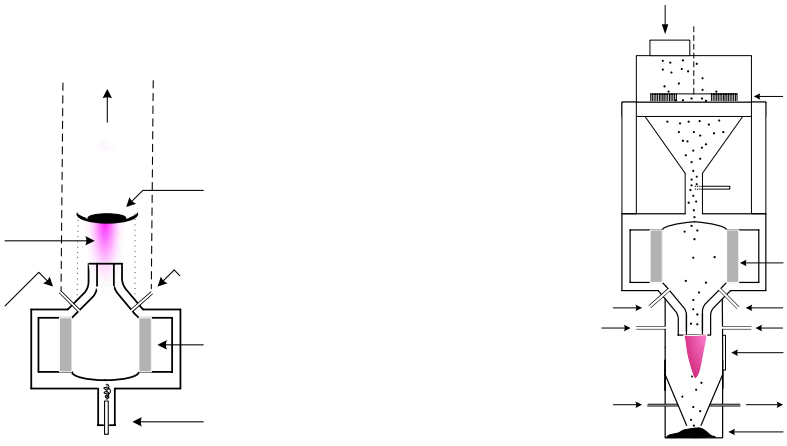

FIGURE 1: MW plasma treatment of waste carbon samples on the supporting plate (a) and in the plasma chamber (b).

* Electronic address: lestinska@gmail.com

In the second approach (Fig. 1b), which is still being developed, the waste carbon samples are continuously inserted directly into the plasma chamber, where the temperature is considerably higher compared to the first approach. In this arrangement, the treated carbon is also in direct contact with radicals and active species generated in the plasma. The whole system, including the plasma plume, is turned upside down to enable the collection of the treated carbon powder below the plasma chamber. It also enables on-line emission spectroscopic analysis.

The diagnostics of carbon samples was performed by gravimetry, SEM equipped with WDX element analyzer, and FTIR spectroscopy. The plasma treatment causes a mass loss (up to 48%), a composition and a structure change of the waste carbon. Some volatile substances, mostly aliphatic and aromatic hydrocarbons and their –OH and ether derivates were released from the carbon, which was confirmed by FTIR spectra (Fig. 2). An apparent reduction of CH_2, C-O-C, -OH, and aromatic C-H functional groups was observed.

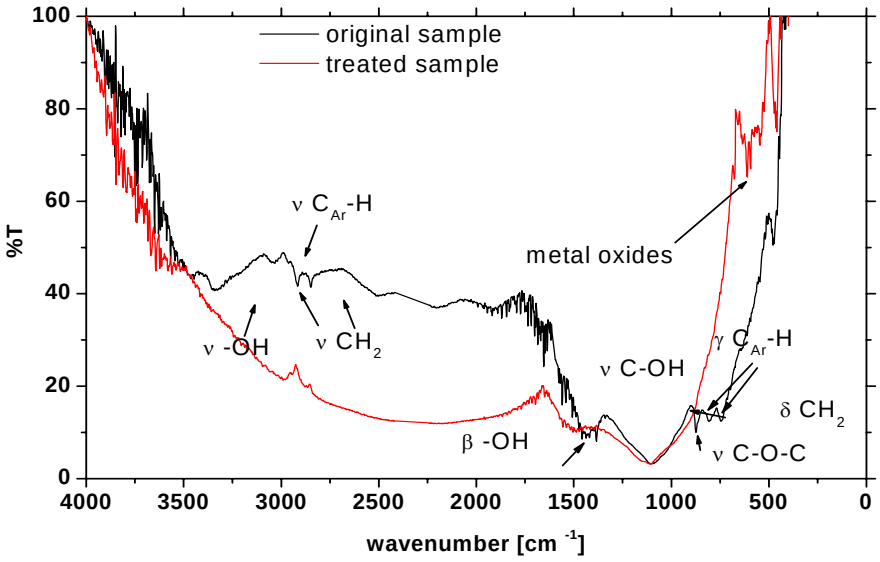

FIGURE 2: FTIR spectra of carbon samples.

The treated carbon has substantially improved its properties and could be used as colouring agent. Its potential use as an active carbon could be interesting due to the porous structure.

ACKNOWLEDGMENTS

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