

## ACTIVATION AND MILD OXIDATION OF VACUUM PYROLYSIS BIOCHAR

Serge Kaliaguine  
Université Laval  
Canada  
serge.kaliaguine@gch.ulaval.ca  
Raouf Bardestani, Université Laval, Canada

A biochar produced using the Pyrovac vacuum pyrolysis process for a 80% pine-20% spruce + fir biomass feedstock (moisture content of 10% w/w). The pyrolysis was run at a temperature of 475 °C under 100 kPa total pressure with a chips feed flow rate of 14 kg/h. The pyrolysis yield was 25% on a wet basis (Sample 1)

Steam activation was conducted in a flow through reactor (nitrogen flow rate: 188 N ml/min) at 900 °C under steam partial pressure of 53 kPa for 60 min (Sample 1A).

Sample 1A was then submitted to a mild oxidation process in a flow through reactor fed with 164 N ml/min of air at 200 °C under 100 kPa total pressure for 60 min (Sample 1A-O-60).

Sample 1 was also submitted to this mild oxidation process under the same conditions except for the oxidation time which was either 30 min (Sample 1-O-30) or 60 min (Sample 1-O-60).

All samples were analyzed using a variety of techniques including elemental analysis (CHN, oxygen by difference), Boehm titration, BET analysis for surface area and pore size distribution (BJH), point of zero charge, iodine number, methylene blue adsorption isotherm, TGA, TEM, SEM (with EDS) and photoelectron spectroscopy (XPS).

Table 1 reports the Boehm titration results for these samples.

Table 1. Boehm titration of biochar, steam activated biochar and mild oxidation products

Sample	Yield <sup>a</sup> %	Carboxylic mmol/g	Phenolic mmol/g	Lactonic mmol/g	Total acidic mmol/g	Total basic mmol/g
1	25	0.04	0.22	0.18	0.44	0
1A	8	0.08	0.04	0.16	0.28	0.04
1-O-30	22	0.4	0.04	0.56	1.0	0
1-O-60	18	0.84	0.16	0.36	1.36	0
1A-O-60	7.7	0.04	0.16	0.20	0.40	0

<sup>a</sup> wt% based on wet biomass

These results globally indicate that mildly oxidized non-activated vacuum pyrolysis biochar has surface properties compatible with a range of adsorption application processes.