CARBONIZATION TESTS FOR ENERGY RECOVERY OF WASTE INSULATION ELECTRIC CABLE

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Abstract

Biochars were produced at different **temperatures**, namely **300, 350 and 400 °C**. For the production of biochar, **waste lignocellulosic biomass (WLB) and waste insulation electrical cable (WIEC)** were used. The produced biochars were submitted to a **washing process with water heated to 95 °C ± 5 °C** and characterized. The biochars after being washed, passed through an **activation process with 2N KOH**, were also characterized. All biochars were **characterized** by **elemental analysis, thermogravimetric analysis, calorific value, chlorine removal, amount of ash, bulk density and surface area**. With the characterizations it was possible to conclude that the increase in temperature from 300 to 400 °C causes the produced biochars to present a lower amount of oxygen, lower percentage of volatile matter, higher calorific value, greater removal of chlorine, greater amount of ash. The activation process increases the surface area of biochars as the production temperature increases.

MATERIALS AND METHODS

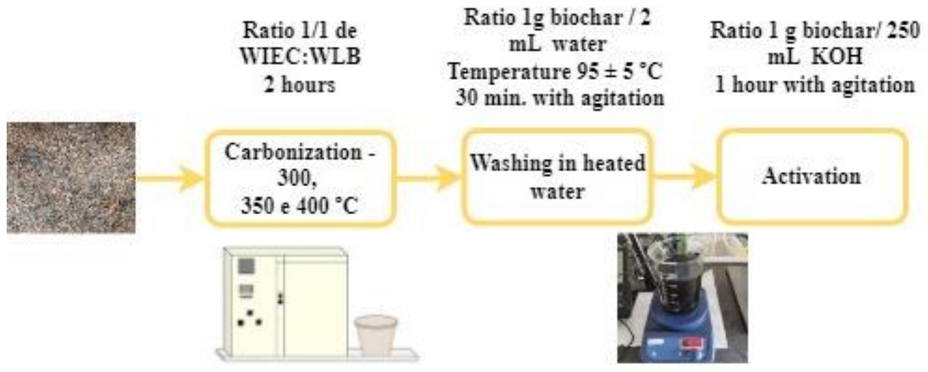

Figure 1: Process flowchart

The conditions of the different biochars according to the processes described above.

Table 1: Process conditions

Samples	Temperature	Characteristics
B300	300	The biochars were produced at different temperatures.
B350	350	
B400	400	
B300-L	300	The biochars were washed in hot water, filtered zand dried.
B350-L	350	
B400-L	400	
B300-A	300	The biochars washed in hot water, filtered and dried were submitted to an activation process with 2N KOH.
B350-A	350	
B400-A	400	

RESULTS AND DISCUSSION

Temperature is one of the main factors that affect the biochar structure and physicochemical properties. The various temperatures affect the decomposition, formation and transformation of biomass (Funke et al., 2010). With higher temperatures, there is a favoring of free radical reactions such as decarboxylation, decarbonylation, dehydration, aromatization, intermolecular rearrangement, among others (A. Kumar et al., 2020).

Table 2: Chemical characterization of the different biochars

Parameters	WIEC/ WLB	B300	B350	B400	B300-L	B350-L	B400-L	B300-A	B350-A	B400-A
C	52,3	40,77	42,64	43,95	42,38	43,06	43,14	41,59	35,22	47,44
H	2,5	4,02	3,74	2,83	2,81	3,33	3,76	4,34	3,56	5,12
N	0,2	5,08	4,24	4,01	12,9	11,38	10,41	0,9	0,85	0,51
S	<d.l.	<d.l.	<d.l.	<d.l.	<d.l.	<d.l.	<d.l.	<d.l.	<d.l.	<d.l.
O	42,7	6,87	10,28	15,36	8,51	8,63	8,69	16,17	21,87	10,43
HHV (MJ/kg)	21,23	18,15	18,27	18,45	19,6	19,67	19,71	-	-	-
LHV (MJ/kg)	19,88	15,98	16,25	16,92	18,08	17,87	17,68	-	-	-

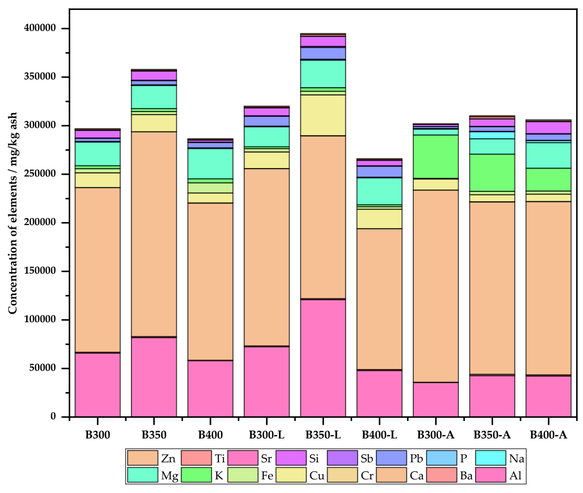

Figure 2: Element concentration of different biochars expressed in mg/kg of ash.

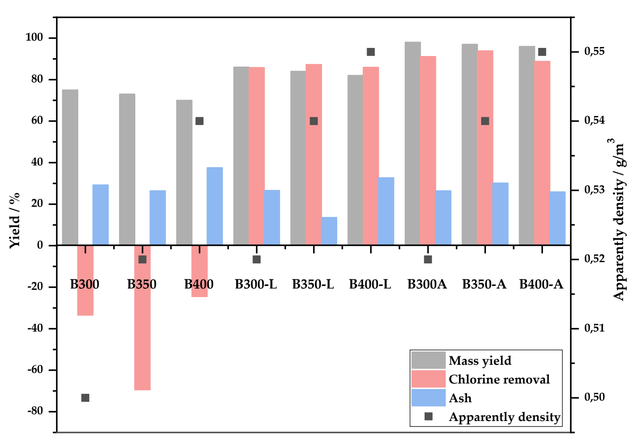

Figure 3: Mass yield, chlorine removal, ash and bulk density for different biochars.

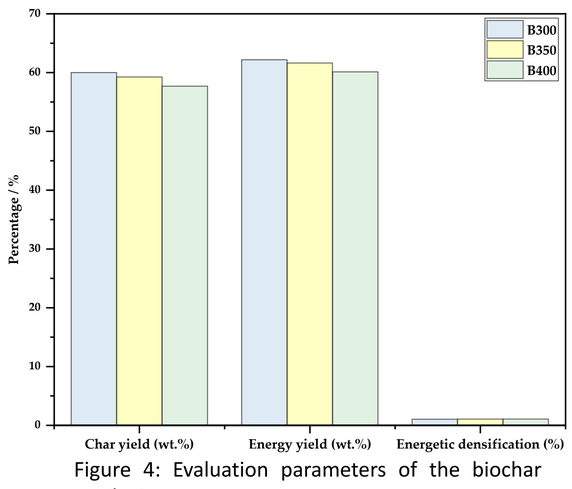

Figure 4: Evaluation parameters of the biochar production process.

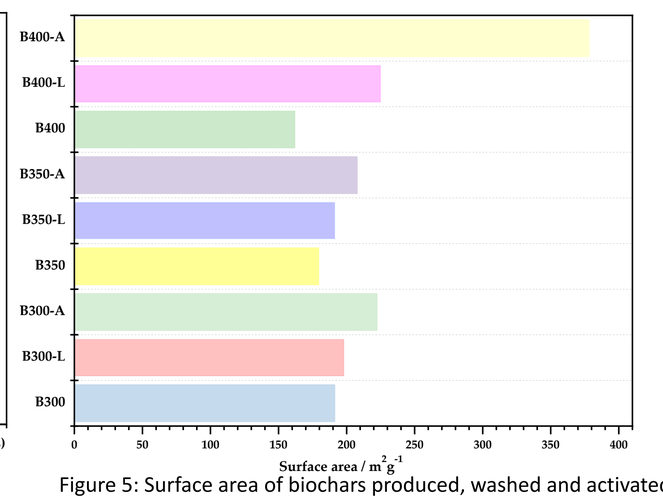

Figure 5: Surface area of biochars produced, washed and activated.

Conclusion

The characteristics of biochars produced at temperatures of 300, 350 and 400 ºC are strongly influenced by the production temperature and subsequently by the washing and activation treatments. This was indicated by the different physicochemical properties that the biochars presented. The carbon present in the mixture and in the biochars were similar, differing mainamount of volatile matter of biochars was lower as the temperature of biochar production increased from 300 to 400 ºC.

- The maly in the percentage of oxygen, which was lower, and in the ash, which increased as the temperature increased. These yield of biochars was not influenced by temperature increase. Ranging between 70-75%.
- Chlorine removal for the biochars that were washed and activated was above 80%, demonstrating the efficiency of carbonization as a pre-treatment for thermochemical processes to remove chlorinated compounds.
- In the analysis of the surface of the biochar, the differences between the temperatures are more noticeable when the biochar is washed. When the activation is carried out, it is possible to observe that the biochar produced at 300 and 350 ºC is very similar, with the charcoal produced at 400 ºC having a larger area.

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