

BIOCHAR IN RESIDUAL ASH FROM GASIFIER COOKSTOVES

Henrik Kofoed Nielsen, University of Agder, Norway
 Henrik.Kofoed.Nielsen@uia.no
 Erlend Rosaceae, University of Agder, Norway

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Biomass based cooking with open fire is still used by more than three billion people worldwide [1]. Open fires normally produce ash, which contains both pure ash and some unburned carbon or biochar. The possible agricultural advantages by biochar as a soil amendment, has increasingly been discussed the last decade [2]. There exist many different types of cookstoves suited for simultaneously cooking and biochar production. Top Lit Up Draft (TLUD) – Natural Draft stoves are tested in several countries but represent a risk for condensation of pyrolysis gases on the charcoal during the combustion phases. In the present study two different TLUD stoves were tested according to the laboratory-based Water Boiling Test (WBT) with two different fuels: wood chips of oak, *Quercus petraea*, and standard 6 mm wood pellets. Two of the main goals were to evaluate cooking efficiency and biochar production including suitability as a soil amendment. After the WBT, the combustion continued until the flames disappeared and the remaining biochar was then quenched, cooled and put into plastic bags and sealed for later analysis. The biochar yield and corresponding cooking efficiency are shown in figure 1. The biochar yield is lower for higher efficiencies and in general around 19-23 % based on the biomass input. The biochar was analyzed and some of the major findings are shown in table 1. PCB and heavy metal content were in all cases low.

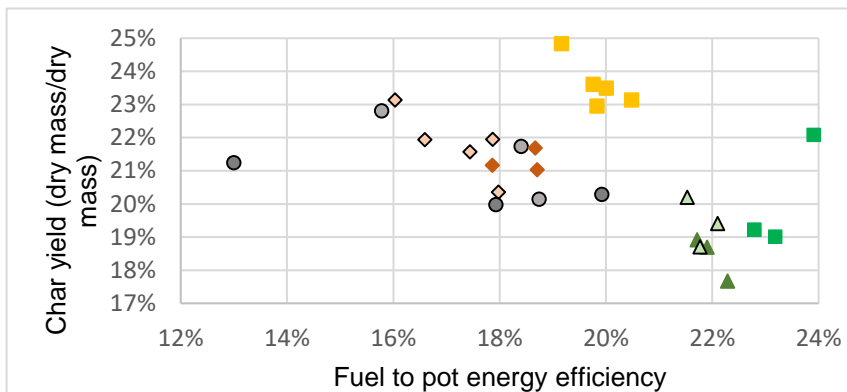


Figure 1. Cooking efficiency and biochar yield with different combinations of fuel and cookstove. Same type data point means equal combination.

Table 1. Selected characteristics of biochar from wood pellets and wood chips. Dry basis, db and molar ratio, mr. HHV is Higher Heating Value.

Feed stock	C	H/C _{org}	O/C	HHV	Furans	16 EPA-PAH
Unit	[%] _{db}	[-] _{mr}	[-] _{mr}	[MJ/kg] _{db}	[ng/kg] _{db}	[mg/kg] _{db}
Wood chips	84.5	0.33	0.063	31.0	1.45	10.9
Wood pellets	87.2	0.39	0.053	32.7	<0.92	9.8
Limit value	>50	<0.7	<0.4	-		<12
Standard	EBC	EBC	EBC	-	WHO(2005) PCDD/F TEQ	EBC Basic

EBC: European Biochar Certificate [3]

The two wood-based fuels resulted in a biochar yield of about 20 %_{db}. The biochar quality is fulfilling the requirements of EBC except for PAH, which in two of in total six samples exceeded the limitation for EBC basic grade biochar.

- [1] C. Birzer, P. Medwell, G. MacFarlane, M. Read, J. Wilkey, M. Higgins, T. West, A biochar-producing, dung-burning cookstove for humanitarian purposes. *Procedia engineering*, 78 (2014) 243-249.
- [2] P. Quicker and K. Weber (eds.), *Biokohle: Herstellung, Eigenschaften und Verwendung von Biomassekarbonisaten*, Wiesbaden: Springer Vieweg, (2016): 178-179, 284-311, 352
- [3] EBC (2012) 'European Biochar Certificate - Guidelines for a Sustainable Production of Biochar. European Biochar Foundation (EBC), Version 8E of 1st January 2019