CHARACTERIZATION OF BIOCHAR FROM PEKO PE GASIFIER COOKSTOVES

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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 contain both pure ash and some unburned carbon. Cookstoves like the Peko Pe in figure 1 has the possibility to produce biochar, if the combustion is quenched before complete burnt-out.

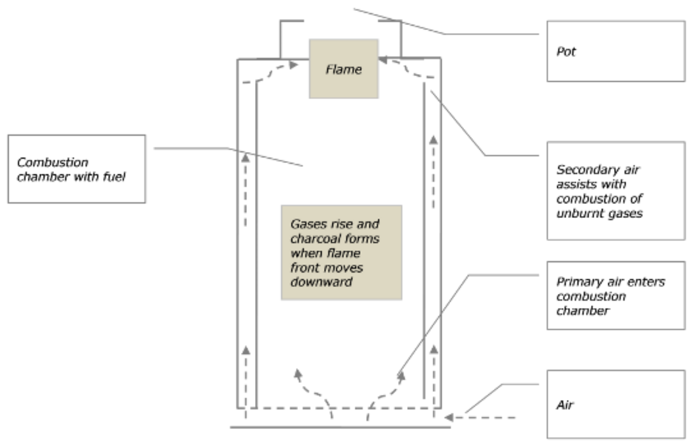

Figure 1 – Peko Pe cookstove principle
http://www.aaaa.no/home-energy/peko-pe.htm

PEKO PE belongs to the TLUD-ND (Top Lit Up Draft – Natural Draft) category of clean burning stoves. The PEKO PE principle, shown in figure 1 was invented by Paal Wendelbo nearly 30 years ago in Norway. The principle has later been improved first by Wendelbo and after his death by different relief organizations too. Wendelbo was awarded prizes for his clean burning and low fuel stoves. Wendelbos main goals were to utilize all fuel and keep low emissions from ignition to burnout. This is very good versus fuel consumption but results in a low production of residual biochar. On the other hand, this biochar might have an improved quality as soil amendment. In this project, we so far only analysed the residual biochar for carbon content.

Two different cookstoves based on the Peko Pe design were tested according to the Water Boiling Test, WBT. This is a laboratory-based test that can be used to measure how efficiently a stove uses fuel to heat water in a cooking pot and the quantity of emissions produced while cooking. Protocols for WBT are developed by Global Alliance for Clean Cookstoves (http://cleancookstoves.org). We used their cold-start, high power phase protocol, where the combustion is smothered when boiling starts. In our case we concluded our efficiency measurement when boiling starts, but with continued flame combustion even during weighing. After recording of measurements, the combustion continued until the flames disappeared. The remaining charcoal was then quenched, cooled and put into plastic bags and sealed for later analysis. Fuels were oak, *Quercus petrea* and standard 6 mm wood pellets, WP from UMAS, Norway. Analysis were carried out on an elemental analyser C, H and N, PerkinElmer 2400 Series II System and a thermogravimetric analyser (TGA) Mettler Toledo TGA/DSC1 for moisture and ash content. The results are shown in table 1.

Table 1. Analysis of fuels and residual biochar from two cookstoves. Numbers are on dry basis. Numbers in brackets are standard deviation of the mean.

Element	Carbon	Hydrogen	Nitrogen	Oxygen	Ash
Oak	48.9	6.0	0.20	43.5	1.4
Pellets, WP*)	49.8	6.7	0.05	43.5	0.4
Peko Pe1 oak	82.6 (2.8)	2.5 (0.2)	1.1 (1.5)	11.6 (1.8)	2.2 (0.3)
Peko Pe2 oak	86.4 (3.3)	2.1 (0.2)	0.2 (0.4)	9.5 (3.1)	1.8 (0.2)
Peko Pe1 WP	85.7 (0.9	2.2 (0.4)	0.9 (1.0)	9.6 (1.7)	1.7 (0.2)
Peko Pe2 WP	86.4 (1.1)	2.4 (0.1)	0.8 (1.2)	8.4 (1.0)	2.0 (0.4)

*) Average value for normal wood pellets, WP

All residual biochar shoved a promising high and quite even content of carbon for both fuels and both cookstoves. The carbon content level here is coincident with carbonization temperatures above 300°C [2].

[1] Birzer, Medwell, MacFarlane, Read, Wilkey, Higgens & West (2014): A biochar-producing, dung-burning cookstove for humanitarian purposes. Procedia engineering, 78: 243-249.
[2] Brenes (ed.) (2006): Biomass and bioenergy, new research. Nova science publishers, New York: p. 111