

Developing a prototype top-lit up-draft pyrolysis (TLUD-Pyro) stove for improving household energy systems in rural Ethiopia



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Problem and Objectives

- Low fuel efficiency and high emission are the major problems of domestic cooking in Ethiopia. Indoor air pollution causes chronic eye illness and respiratory disease in women and children, resulted in about 60,000 deaths per year.
- This study intends to develop a prototype micro-gasifier stove (TLUD-Pyro) to serve as cooking device and miniature charcoal kilns.

Material and Methods

- Field investigation and literature reviews on cooking stoves in rural Ethiopia was carried out.
- A prototype of TLUD-Pyro stove was designed using SolidWorks CAD software and constructed with ST 12.03 steel. The stove performance was tested with maize cobs as feedstocks. Type K Thermocouples and a balance were used to monitor the temperature and weight loss.

Results

- Stove prototype was developed based on TLUD (Top-lit up-draft) principle.



Fig. 1 TLUD stove prototype assembled at Universität Hohenheim.

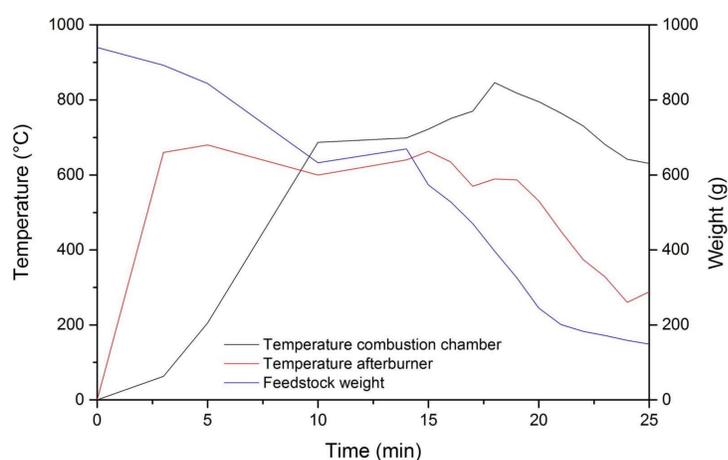


Fig. 2 Temperature development and biomass consumption of the TLUD stove.

- TLUD stove successfully converted 940 g of maize cobs to 149 g (16 %) of biochar after 25 min.
- At the end of the combustion process, 21 g (2 %) of ash remained.

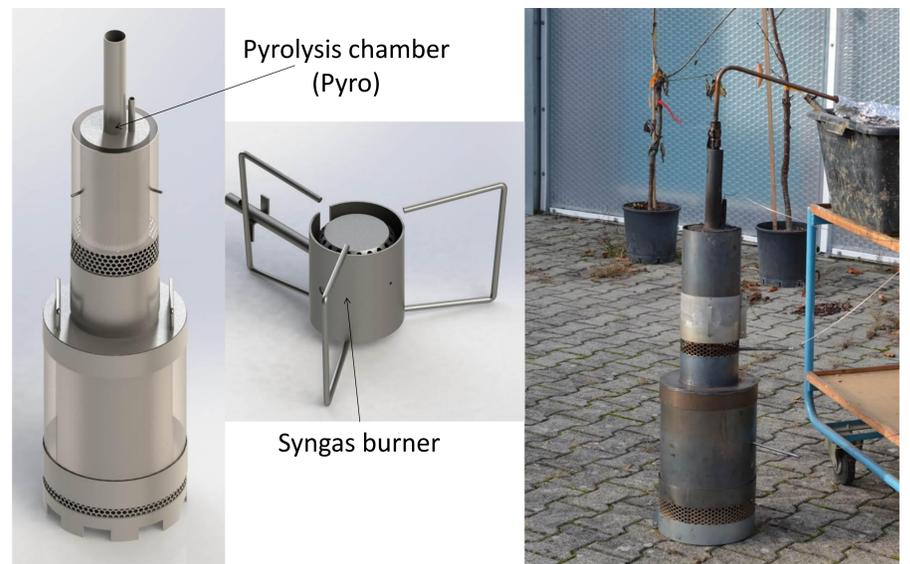


Fig. 3 TLUD-Pyro stove prototype was tested with maize cobs as feedstocks.

- Pyrolysis chamber was attached to the afterburner of the TLUD (TLUD-Pyro). The excess heat from the burner (680 °C) was utilized by the pyrolysis chamber (containing biomass) to produce syngas, biochar, and bio-oil.



Fig. 4 Valuable products obtained from the prototype TLUD-Pyro stove: syngas, biochar, and bio-oil (from left to right).

Conclusion

- TLUD-pyro stove has a huge potential in providing energy for cooking and creating a valuable byproduct such as biochar for soil amendment and carbon sequestration.
- TLUD-Pyro stove needs to be further modified according to local cooking methods, e.g. baking *injera* for the case of Ethiopia.
- Further tests and improvement are required before the dissemination of this technology.