

TLUD Gasifier Cookstove Developments in 2007

Paul S. Anderson, Ph.D.
Biomass Energy Consultant
psanders@ilstu.edu

A presentation to the ETHOS Conference
25 – 27 January 2008, Kirkland, WA

Abstract/Summary

Advancements in TLUD (Top-Lit UpDraft) Gasifier Cookstoves during 2007:

- A. Production and sales/installations: Approx. 150,000 units.
 - 1. The Woodgas Campstove by Reed et al. begins production in India with export to America, including 100% stainless steel construction.
 - 2. The Chinese TLUD by Daxu is recognized for having the lowest emissions among eight tested Chinese cookstoves, receives government support, passes 25,000 stoves produced, and receives an Ashden award for Enterprise.
 - 3. The British Petroleum TLUD by IISc–Bangalore has probably reached 100,000 installed units, but few details are released.
- B. Research, development and prototypes: Abundant innovations.
 - 4. The Magh-CM1 by Reddy has several new designs.
 - 5. The MJ Rice Husk Gas Stove by Belonio et al. in Indonesia finalizes its prototypes, to begin production early in 2008.
 - 6. The Lapsi Candy Processor TLUD by IISc-Bangalore is for a cottage industry in Nepal.
 - 7. The Juntos B3 TLUD by Anderson in India and the USA utilizes small fans in a low-cost design that incorporates important aspects of air control and a well-known stainless steel stovetop appearance.
 - 8. The TLUD unit by GERES in Cambodia
- C. Additional notes:
 - 9. Preparation of the TLUD Handbook by Anderson is in a Draft edition.

Production and sales/installations:

- Approximately 200,000 TLUD gasifier cookstoves are produced in 2007.
- India and China are the leading locations.

Reed's Woodgas Campstove



- Now produced in India with 100% stainless steel construction.
- Price: US\$55.
- Many hundreds have been sold.

Daxu TLUD Cookstove - China



-Winner of an Ashden Award for Enterprise in 2007.

-Winner of low emission among 8 Chinese cookstoves.

-Natural draft TLUD.

-Over 25,000 produced, perhaps 100,000.

-Price US\$140; many with subsidy sold for \$6 to \$26.



BP TLUD by IISc-Bangalore



- Mentioned at PCIA-III in Bangalore, but very little information is released.
- Approximately 150,000 units installed in India in 2007.
- Uses BP-made pellet fuel.
- Control of fan-forced air.
- No information on price.



Research, development and prototypes

- Innovative solutions to TLUD issues are abundant.
- Asia dominates the TLUD activities.

Reddy's Magh-CM1 Cookstove



- One of several prototype designs
- Ceramic base
- Made in India
- Information on Stoves REPP Website



Minang Jordanindo Approtech

THE FINAL PROTO-TYPE MODELS OF MJ RICE HUSK GASIFIER STOVE

by

Alexis Belonio, Djoewito Atmowidjojo, and Bony Minang

PT Minang Jordanindo Approtech

Jakarta Selatan, Indonesia

Email: mjapprotech@yahoo.com

Seven slides are provided by the authors for an edited presentation in the ETHOS 2008 Conference, Seattle, WA. A more complete report can be found at the Stoves REPP Website by February 2008.

The MJ Rice Husk Gas Stove

- The MJ Rice Husk Gas Stove is an improved version of the Rice Husk Gas Stove developed in the Philippines in 2005 by Belonio.
- Gaseous fuel with luminous *bluish pink* color flame is produced by burning rice husk with limited amount of air.
- A small computer fan supplies the air into the bed of burning rice husk.



Belonio's Prototype – January 2008

Anticipated price: US\$ 25 in SS or \$12 in mild steel



Major assemblies of the MJ Rice Husk stove:

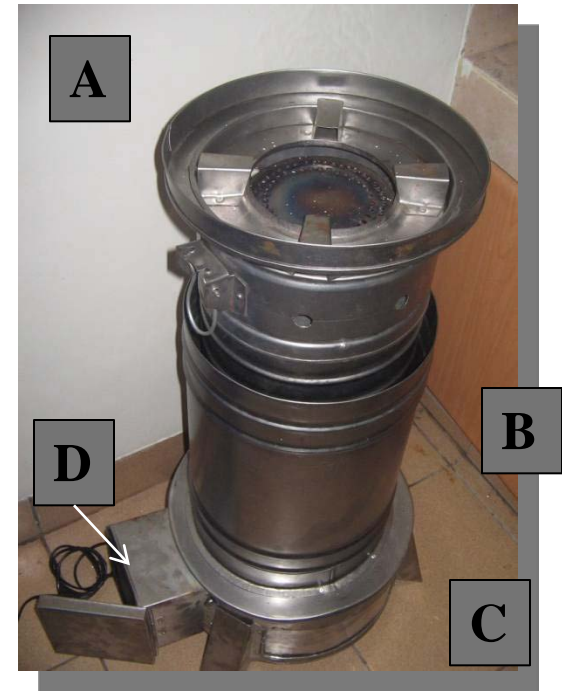
A. Burner Assembly – Where the gaseous fuel is burned that can supply the necessary heat for cooking

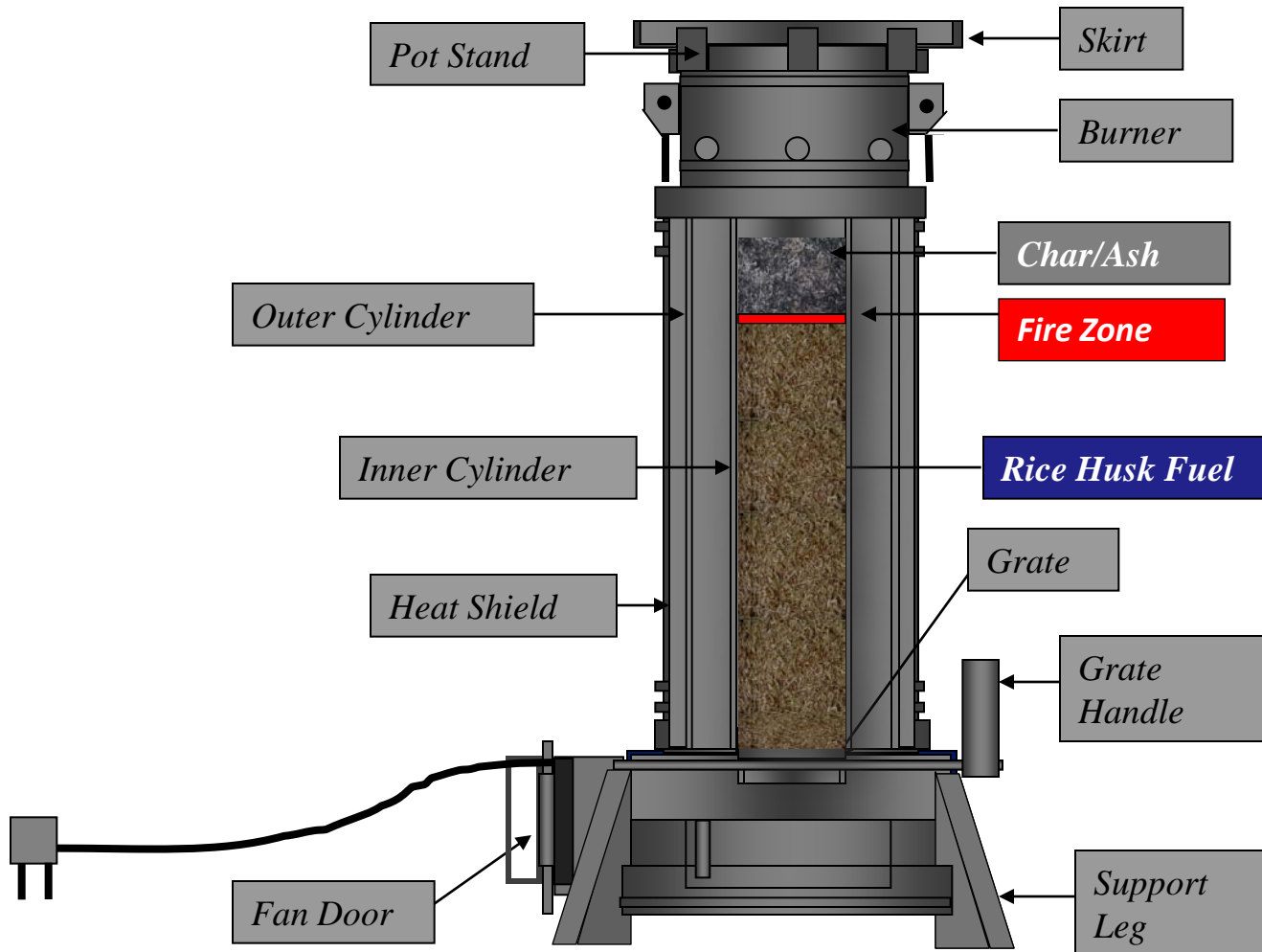
B. Reactor Assembly – Where the rice husk is burned with limited amount of air (30-40% of the stoichiometric air) to produce combustible gases, primarily of CO and H₂.

C. Char Chamber Assembly – Where the char from the reactor is discharged and is allowed to cool prior to disposal.

D. Fan Assembly – Where the fan is installed to supply the air for gasification of rice husks.

E. Grate Assembly – The component that holds the bed of rice husk in place during gasification and facilitates the discharge of char after each operation.





Cut-Away View of the Stove

Principles of Operation

- (1) Burning of rice husk starts at the top portion of the reactor
- (2) Limited amount of air is introduced from the bottom using a small fan
- (3) Combustible gases are produced as the fire zone moves down the reactor
- (4) Once the fire zone reaches the lowest portion of the reactor, no more combustible gases are produced.
- (5) The power output of the gasifier is a function of the diameter, while the time to produce gas is dependent on the height of the reactor.



With Drum-Type Burner

With Plate-Type Burner

With Open-Type Burner

Different Models of MJ Rice Husk Gas Stove

Performance Specifications

| Model | MJRHGS – 15 x 60 |
|----------------------------------|-----------------------------------|
| Reactor Diameter and Height | 15 cm Φ x 60 cm H |
| Weight of Fuel per Load | 1 kg |
| Operating Time | 30-40 min |
| Fuel Consumption Rate | 1.43 to 1.65 kg/hr |
| Specific Gasification Rate | 81.5 to 97.1 kg/hr-m ² |
| Time to Boil 1.5 liters of Water | 7 to 12 |
| Power Output | 1.4 to 1.9 kW |
| Thermal Efficiency | 23 to 37% |
| % Weight of Char Produced | 30 to 38% |

IISc-CGPL Lapsi Candy TLUD



- For Nepal, w/ ARECOP support
- Fuel capacity 6 kg dried lapsi seed in 1 batch for 2 hours to boil water from 85 kg of fruit pulp.
- 2 prototype units tested, 5 more on order in January 2008.
- Directional control of air
- No price info available.

Report is at: http://www.arecop.org/regional/reg_detail.php?recordID=11

Anderson's Sanghi Stove Body



- A modified LPG stainless steel stovetop from India.
- With added
 - Bottom plate,
 - Support sides/legs,
 - Chimney option,
 - Insulation,
 - Fuel-feeder/fire-viewer.
- Price estimates:
 - US\$ 8 for single-burner unit
 - \$12 for two-burner unit (not shown)
 - \$ 2 for pot support only



Anderson's Juntos B3 TLUD Gasifier with Fan-forced Air



- Essentially free-standing from the stove structure.
- Three concentric cans.
- Insulated.
- Replaceable inner chamber.
- Appropriate for factory or tinsmith production.
- Four ways to control crucial air flows.
- Price estimates:
 - Fan and controller: US\$ 5.
 - Two gasifier canisters: \$ 6.
 - Replacement chamber: \$ 1.

Juntos B3



NERD Sri Lanka TLUD Cookstove



- Designed by Punchibanda around 2000.
- Not commercially available.
- Seen by Belonio in 2003.

ARTI's Agni TLUD Cookstove



- Natural Draft TLUD.
- Based on the principles of Anderson's Champion Stove of 2005.
- Produced in India.
- Approx. 30 units produced
- Price: Over US\$ 50, by special order only.

Comparisons

- Of the seven TLUDs shown with forced air, only the Juntos B3 can
 - Be refueled easily without moving the pot.
 - Use the same fan for more than one gasifier canister, permitting continual operation.

Additional Notes About TLUDs:

- TLUDs can utilize a **far wider range of biomass fuel** types than can the “stick-wood” cookstoves.
- TLUDs consistently have **significantly lower emissions** of CO and particulates than do other most other biomass cookstoves.
- TLUDs are **“gas burners”** that produce their own supply of gas on demand via pyrolysis and char gasification of biomass, creating charcoal as an optional by-product.
- TLUDs can provide **continuous heat** when using two fuel containers.

TLUD Handbook – Draft Edition

[December 2007]

- The “TLUD Handbook” is literally a work-in-progress.
- It is released with the understanding that much expansion and corrections are needed in future editions.

Brief Television Coverage

- In December 2007, the “Science Channel” of the “Discovery Channel” aired a series called “Invention Nation” on national cable television.
- One six-minute segment was about a TLUD gasifier by Anderson for camp-style cooking, similar to the Juntos B gasifier of 2004.
- That segment is available for viewing on “YouTube” [Search for: Invention Nation]