Paal Wendelbo and His “Peko Pe”
Top-Lit UpDraft (TLUD) Gasifier Cookstoves

This report is in three parts: pioneer experiences; selection of photographs; and technical specifications of the PP stove. The report is based on e-mail interviews and materials provided by Paal Wendelbo in July 2008 and December to Paul S. Anderson, who has added interpretive content. Mr. Wendelbo has approved the basic content about himself, but Dr. Anderson is responsible for any errors, omissions, and editing.

Part One: Paal Wendelbo, Pioneer of TLUD Gasifier Stoves

In German-occupied Norway (1940-45), small groups of men would slip into the forests for several days at a time as part of the Resistance efforts. Young teenager Paal Wendelbo regularly went with one group. Their cover story was the search for additional food, but they avoided the German patrols as best they could. Their meals were prepared with the smallest of fires and minimal smoke. The men showed Paal how to lay a small pile of very dry small sticks horizontally parallel and with the smallest wood on top. They would light the fires at the top. There were no stove structures or fire containers, just the sticks. The fires did produce a little smoke, but most of the smoke was wonderfully consumed in the steady flames at the top of the fuel pile. The pot was a one-litre tin hanging on a stick extended over the fire.

Paal Wendelbo faced more adversities than just the Nazis. He was not a strong student in school, and even lost several years of schooling during World War II. He later worked in a wide variety of interesting jobs, and eventually became an architect and raised a family. But he divorced and in the 1984 headed alone to Africa to do development work for non-governmental organizations, mainly with disabled people and refugees.

I first worked four years in Zambia and became aware of cookstove issues. I began my serious work with stoves back in Norway in 1988 before my next employment started. I began utilizing the fire technology I learned during the war. The stove was tested at The Technical High School in Norway and Denmark. I made the stove first and the best way to ignite it was from the top using some kerosene, but also with straw there was no problem to ignite on top. Some others tried to ignite the PP stove from underneath, but that gave a lot of smoke. I did not really understand the process; it just happened and it looked nice and useful. I have no training in thermo-technical matters. Several years later I found a cookstove booklet of P. Visser and it was more of a confirmation that I was on to something.

My new contract was with Handicap International in Mozambique dealing with organization and employment for handicap people. I was told before starting “The job has nothing to do with stoves.” Then I had one year in Uganda dealing with stoves, but my friends told me I could join the evening parties only if I did not talk about stoves.

Next came one year in Ghana where his stove work continued only as a personal effort, mainly during extra time in the afternoons. He returned to Uganda for two years to work with stoves and fuel for a Norwegian NGO and a forestry department. He experimented with fuels and found acceptable a variety of dry biomass materials that were commonly discarded. In addition to small pieces of wood, bundles of marsh reeds and even straw burned successfully. The local
refugees in northern Uganda helped pick the name, “Peko Pe” (pronounced “peh-co peh”), which means “problem no.”

After some small jobs in Ethiopia and Kenya and Malawi, in 1995 I had the first real job in refugee-camps in Uganda with the stove and there it was adjusted to take straw as fuel. At the Trade Fair Exhibition in 1995 in Kampala, we had a display stand with the Peko Pe. The Ugandan Minister of Trade identified two particular items of interest for the country: the Peko Pe and some fishing gear. It must have been there I decided not to give up the work with FES (fuel efficient stoves) and dry biomass household fuel. I was then 65 years old, single with nothing to lose, soon to be retired, and no problems.

But that was not correct. There was some misunderstanding between me and the NGO I worked for. At that time I could see the future potentials of the FES with alternative fuels, but the NGO was of another mind-set and I was called back home on the carpet. They let me continue, but on their conditions. I felt I was stopped in my process of developing biomass household energy, and was quite depressed. I continued to work with my stove but not for that NGO.

I got a job for another NGO working for the Forestry Department in Uganda in 1996. But new problems occurred, apparently something to do with the charcoal business and some administrative problems between the Forest Department and the NGO. It looked like household energy for developing countries were not on the table at that time, and not even now. Mostly they had their own stove-program or no program at all.

In 1996 I established my own firm, Low-tech Energy Development, and visited all the refugee camps around The Big Lakes at that time. All had different problems, but common was fuel shortage for cooking. I thought the Peko Pe would be accepted because it [and other TLUDs] can use a wide variety of fuels. In Mozambique loose cashew shells and maize-cobs were working well. In Ethiopia briquettes from cow dung and straw were made the diameter of the stove with a 2” hole in the middle; they worked well. The same was done with weeds and paper. Some wood-briquettes are expanding during the burning process, and would lift up the top-lid, so we simply reduced slightly the amount of fuel. In Burundi/Tanzania the PP worked well with peat that was bad and smoky in other stoves. In Uganda in the mid-1990s, I adjusted my stove to thatching straw (hyperrenia rufa) and papyrus, which were the only realistic alternatives to firewood and charcoal. We cut the straw and papyrus in eight-inch (20 cm) lengths and, using a simple form made of bricks, created bundles of about 500 grams of dry straw, tied it with sisal rope, ready to insert vertically into the PP stove [see photos]. Removing the binding, the straw expanded in the cylinder and was easy to ignite on top and was burning with clear blue-yellow smokeless flame for about 20 minutes and the straw continue glowing without collapse another 20-30 minutes so the food continue boiling. We used the PP stove with straw as fuel at our camp for about 1 ½ years every day three times a day and the cook liked it, easy to ignite and flexible in use.

I had 3 jobs in Africa for my firm, and lost a lot of money. I am not a businessman. The funny thing was, the Peko Pe was working well with all types of fuel, but nobody wanted it. There was a video send by NRK( Norwegian Broadcast Corporation) in 1996. They said it
was highest response they have had for such a program. But there was no response from the NGOs.

We also had some problems. At a hospital we used three PP gasifier units in a large stove and the food were cooking too fast, interrupting the work at the kitchen. The charcoal and firewood dealers did not like the PP stove and told people men would lose their manpower by eating food cooked at that stove, and that it was a stove for lazy women, who did not need to go for firewood into the forest. Some problems were administrative. The policy of UNCHR was to give the stoves free to the refugees; we tried to create jobs and wanted the stoves and fuel to be sold by craftsmen. The stoves given free were not used, the stoves paid for were used. Different NGOs at the camp had their own stove and fuel program and at a meeting about cookstove problems we were told by the representative of UNHCR that the PP stove did not fit to the local culture because one could not tell folktales around it.

Approximately 5000 Peko Pe (or PP) stoves were produced and in use in eastern Africa by 1999. That year, at nearly 70 years of age, Wendelbo was stricken by cerebral malaria, suffered additional damage from its treatment, and retired to Norway. In 2006 he briefly re-visited Zambia, and in 2009 a new project is starting in that country with a Wendelbo TLUD cookstove.

I never stopped working with the PP, but I stopped trying to make some business on it. I continued the efforts to make it better with different types of fuels. I think I can say I have been working and thinking about this stove and the fuels almost every day for the last twenty years.

Historical note: In totally unrelated work, gasification expert Thomas B. Reed originated in 1985 his conceptual design of what is now called the TLUD (top-lit updraft) gasifier cookstoves. Reed worked with forced air for about a year and proved the concept, and then spent ten years with natural draft, resulting in the 1996 publication by Thomas Reed and Ronal Larson. The Reed-Larson stove never went into production, and Reed switched his efforts back to fan-forced TLUD gasifiers. In 2001 he met Paul Anderson who then began his TLUD work for a natural draft cookstove. Anderson was eventually successful with a stove that won a clean combustion award at Stove Camp 2005. It became the “Champion Stove.” By the end of 2008, none of Anderson’s many TLUD models had advanced beyond production of more than 25 units. Reed and Anderson and virtually all of several hundred “Stovers” on the Stoves Listserv were unaware of the work and accomplishments by Wendelbo. And Wendelbo was unaware of the Reed, Anderson and others until late 2007 when he was informed about the Hedon website. Eventually he and Anderson made contact in mid-2008. The physical and functional characteristics of Wendelbo’s Peko Pe and Anderson’s Champion cookstoves are highly similar considering their creation totally independent of each other. The “concentrator disk” for the mixing of secondary air and the combustible gases is the most distinctive shared feature, and their sizes are larger than the TLUDs with forced air. Wendelbo and Anderson have agreed to collaborate on efforts for further improved models. A Peko Pe replica was made by Anderson and Sebastian Africano and tested for emissions at Stove Camp 2008; the tests indicated very clean emissions typical of all TLUD cookstoves. A Wendelbo-Anderson natural draft TLUD is in production in Chennai, India, as of January 2009.

Paal Wendelbo certainly deserves his place and recognition as a true pioneer in the development of cookstoves utilizing the top-lit updraft (TLUD) pyrolytic gasification technology. We look forward to learning more from him and his vast TLUD experience.
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Part 2: Photographs of Wendelbo’s “Peko Pe” TLUD: 1988 - 2008

The following collection of photographs, comments and diagrams show the Peko-Pe (“peh-co pay”) (PP) TLUD-ND developed by Paal Wendelbo of Arendal, Norway. Designs continue to be refined, and those shown here are not the most recent derivatives of Wendelbo’s work.

The Man and His Tools:

Photo 1: Paal Wendelbo with the first stove he brought to Africa in 1988. In recent years in Norway I use the PP at my workshop during wintertime for heating. And there is no chimney, but good ventilation. If there are sour eyes or smoke I try to find out why. Every week I am baking bread on my oven with no chimney on PP with wood chips as fuel. During summertime we are preparing meals on the PP outside in the garden, grilling, frying with wok and boiling potatoes. Some times we have some students from Africa who want to see and test the system. They try to cook their traditional food and are giving good feedback. When cutting down trees for firewood all the branches are chopped on a small 2hp electric woodchipper and that will be enough for the whole season.

Photo 2: The old Stover watching the flames. Some tourists who pass the place I work at with my stoves were whispering “He was standing like that last year we came here too”.

Photo 3: Tools used in Norway. Even fewer were used in my Africa work.
Early Work in Uganda (about 1988 – 95.)

Prepared bundles of reed fuel.

Photos 4, 5, 6 and 7.
Photo 8: PP stove factory in Uganda about 1990.

Photo 9: Ugandan women bringing reeds for fuel.

Photo 10: Reeds bound and cut for insertion into PP stoves.

Photo 13: A Peko Pe TLUD in China about 2004. Note the size of the wood fuel under the hand-axe.

Note: Please see the next section of this document, Part Three, for design specifications and diagrams of this version of Peko Pe (PP) gasifiers.
The Peko Pe TLUD Gasifier Cookstove as Produced by Local Tinsmiths in Adjumani Refugee Camp in Northern Uganda in 1995

[Some differences from the unit described in the 2008 diagrams.]

| Outside cylinder: | 270 x 210 mm  (10.5 x 8.3 inch, h x d)  
Galvanized sheet 0.7 mm |
|--------------------|------------------------------------------------------------------|
| Combustion chamber:| 190 x 185 mm  (7.5 x 7.3 inch)  
Oil barrel sheet 0.8 mm  
5 holes of 7 mm in bottom plate |
| Concentrator disk (ring): | Center hole 105 mm  (4 inch) |

Combustion chamber: 
11 holes of 10 mm in side row 
6 holes of 10 mm in middle row 
6 holes of 7 mm in bottom row

Outside cylinder: 
12 exhaust holes 20 x 30 mm 
Distance from disk (ring) to pot 55 mm 
(This section was later eliminated, replaced by 4 support posts that serve as spacers. See diagrams.)

Operation: 
350 grams of chopped wood burning with smokeless flame for 44 minutes with 600-710 °C temperatures.

Some smoke and sore eyes after 30 minutes, probably because of distance between top-lid and pot being too short, or too small exhaust holes (a problem corrected by the above mentioned alteration of the pot-support).
Part Three: Diagrams and Specifications for Paal Wendelbo’s 2008 Version of the Peko Pe TLUD Gasifier Cookstove:

Overview

Attention. The drawings are not in scale.

The cooking stand has to be fixed to the top lid and formed by hand after fixed.

The Peko Pe stove

Overview

Drawing no. 01

P W Copyright: Lowtech Household Energy
Outside cylinder
0.5 mm stainless steel or
0.8 mm black iron sheets

Attention. The drawings
are not in scale.

Inside cylinder
0.8 mm black iron sheets

The Peko Pe stove
08/05/08
Outside and inside cylinder
Drawing no. 02
P W Copyright: Lowtech Household Energy
Mounting

Top cover to remain on top of the spacers with 10 mm 2nd airflow underneath.

Bottom to be placed on the lowest bolt.

4,2 x 13 mm

4,2 x 40 mm screw

Bottom-plate

4,2 x 40 mm

Secondary air intake

Secondary air intake

Attention. The drawings are not in scale.

The Peko Pe stove
Mounting
Drawing no. 03
PW Copyright: Lowtech Household Energy
The Peko Pe Stove 08/05/08
Energy unit
Drawing no. 04
Top-lid, bottom, spacer/foot
P W Copyright: Lowtech Household Energy

Attention. The drawings are not in scale.
The Peko Pe stove 08/05/08
Cooking stand
Drawing no. 05
P W Copyright: Lowtech Household Energy
Handle

Attention: The drawings are not in scale
Stiring stick
Ca 250
6mm bar

Grid for cooking
8mm bar

Attention. The drawings are not in scale.

The Peko Pe stove
08/05/08
Stiring stick  Grid for cooking
Sheet gutting list.
Drawing no. 07
P W Copyright: Lowtech Household Energy
Measurement to be adjusted to the pots.

Pot holder

The Peko Pe Stove
08.05.08
Pot holder
Drawing no. 08
P W Copyright: Lowtech Household Energy
Attention. The drawings are not in scale.

Grid to be used for pellets as fuel

Bottom plate

Flip to lock the grid.

The Peko Pe Stove 08.05.08
Grid for pellets fuel
Drawing no. 09
P W Copyright: Lowtech Household Energy