Guide to Designing Retained Heat Cookers

HELPS International
Partnership for Clean Indoor Air

The *Guide to Designing Retained Heat Cookers* was written by Don O'Neal, Vice President of HELPS International and Special Projects Director. Don O'Neal is also the designer of The ONIL Stove and the Stove Project Manager.

The development of the HELPS International Retained Heat Cooker was funded by a grant from the United States Environmental Protection Agency (X831690010) to further the mission of the Partnership for Clean Indoor Air, to improve health, livelihood, and quality of life by reducing exposure to air pollution, primarily among women and children, from household energy use. To learn more about the Partnership for Clean Indoor Air and the HELPS Retained Heat Cooker project in Guatemala visit www.PCIAonline.org.

HELPS International has been working in Guatemala for over 20 years. During this time, HELPS has developed a poverty reduction program that includes the following components: curative health, preventative health, education, construction, economic development, and sustainable household energy. In addition to developing a Retained Heat Cooker, HELPS has a stove manufacture and distribution program in Guatemala that has demonstrated significant reductions in health and environmental problems. Currently, HELPS supplies stoves to 120 non-government organizations (NGOs) in all 22 Departments of Guatemala for their community development projects. The HELPS stove reduces wood usage by 70% and has a chimney that removes emissions from homes. HELPS has an extensive training program both for the user and for the NGOs using the stoves in their community development projects. To find out more visit www.helpsintl.org.

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By Don O'Neal

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Introduction

The technology of using the heat that is retained in a pot of boiling food to finish the cooking cycle has been known for more than 30 years. Historically, a hole in the ground lined with hay for insulation has been used for a "retained heat cooker." Hence the name "haybox" has been used to describe this type of cooking. The use of the term "retained heat cooker" is more descriptive of the general process where other insulating materials may be used, and is therefore used in this document.

Retained heat cooking has been used in developing countries to minimize the use of limited firewood resources. However, success of this process has been somewhat mixed since the materials used for insulation have had varying degrees of effectiveness. The development of a retained heat cooker is an iterative and ongoing process.

The purpose of this Guide is to demonstrate how to effectively design, test, and distribute a retained heat cooker in a field setting. In the following sections, you will learn about the benefits of using this form of improved cooking technology, its typical components, equipment necessary to test its performance, lessons from high performing retained heat cookers, as well as tips on marketing and distributing a retained heat cooker in the field. In the Appendix, you will also find testimonials for one retained heat cooker, the ONIL Cooker, which has demonstrated success in the market and the field in Guatemala.

This Guide serves as an introduction to one type of improved cooking technology that can supplement other cooking practices to reduce indoor air pollution and increase fuel efficiency. For more information on other types of improved cooking technology, visit the Partnership for Clean Indoor Air at www.PCIAonline.org.

Theory of Operation

A retained heat cooker (RHC) is used to efficiently cook foods that require boiling, such as beans and rice. When foods are boiled, energy (typically from a wood fire) is used to bring the food and water to a boiling temperature, 100 °C at sea level. Once boiling temperature has been reached, only enough energy (heat from the stove) is required to simmer the food (keep it just at or below the boiling point). Additional energy only serves to convert water to steam without raising the temperature of the contents of the pot. This additional energy wastes wood and water that may have been carried long distances.

When the pot simmers (remains just at the boiling point), the amount of energy entering the pot balances the energy lost to the atmosphere through conduction, convection, and radiation. Reduction of the energy lost to the atmosphere results in a reduction of energy required to maintain a simmering temperature, hence less fuel is required.

If a perfect insulation were available, the losses could be completely eliminated and the pot would stay at a simmering temperature with no further fuel required. While there is no perfect insulation, there are insulation materials of sufficient quality to keep the contents of the pot at a cooking temperature long enough to complete the cooking cycle. Since practical insulation materials do not completely eliminate losses, the temperature decreases at a rate defined by the quality of the insulation. Fortunately, there are many materials with sufficient insulating properties to reduce losses to such a degree that the food will complete cooking without further fuel usage. This is discussed further in the *Typical RHC Components* section.

Advantages of Using a RHC

Since the fire may be extinguished once the pot contents have reached boiling temperature, there are many advantages:

- The cook is freed from tending the fire and is available for other tasks
- Cooking is completed without further fuel usage
- Cooking is completed with minimal use of water
- The pot contents cannot boil dry or scorch
- There are no internal or external emissions due to the simmering phase in the RHC
- The RHC is portable enabling workers to take it with them to the fields

A well-designed RHC provides many additional benefits. It can be used to keep water hot overnight to get a quick start on breakfast or to keep foods hot for a later meal. It is also useful for preparing foods that require very long cooking times, such as unsoaked, dried beans (but presoaking should be encouraged). Food may be simmered over the fire for a period of time, and then placed in the RHC to complete cooking. Alternatively, food may be removed from the RHC, reheated over the fire, and replaced in the RHC.

Typical RHC Components

The Pot—The container for the food that is to be cooked is typically made of metal or clay. Clay pots are sometimes considered less efficient for cooking, because they have a higher thermal mass and readily absorb heat that could be used for cooking. However, clay pots may have an advantage for some cooking tasks with the RHC, because the thermal mass retains heat that continues to cook the food inside the RHC.

Outer Container—The material used in the outer container contributes little to the thermal performance of the RHC if the insulation is adequate. Its primary purpose is to support and contain the insulation and make the RHC easy to handle without damage. In its simplest form (but quite unhandy), it can be a hole in the ground that holds the insulation in place. A woven basket that has tight enough weave to retain the insulation can serve. However, where possible, the following should be considered in choosing the outer container:

- Durability
- Easily moveable
- Moisture, mold, and mildew-resistant
- Ease of cleaning
- Provisions for picking up the unit (handles)
- Room for extra insulation below the pot
- Attractiveness
- Resistant to tipping over
- Safety

Insulation—The purpose of the insulation is to retain the heat of a boiling pot long enough for the contents to complete the cooking cycle without additional heat. There are many choices for insulation and choices will depend on what is available locally. Some choices are:

- Hay
- Straw
- Leaves
- Newspapers
- Corn shucks
- Corrugated card board
- Wool blankets
- Styrofoam and other commercial insulations
- Pumice
- Ash
- Perlite

To be effective, insulation must be dry, resistant to mold and mildew, and must not compact with use. If insulation (such as hay) is not resistant to mold and mildew, there must be an adequate supply, so the insulation can be replaced frequently.

Inner Container—The inner container sits inside the insulation. The pot and its contents are placed inside the inner container which protects the insulation from the pot. It also protects the insulation from any food spills and makes the RHC easy to keep clean. The inner container shares the same needs as the outer container, except it does not need the handles, and has the following additional needs:

- Low thermal mass (draws little heat from the pot as it heats up)
- A lid that is also insulating and has a tight fit
- Protects the insulation from moisture and being compacted by the pot
- Should fit the pot to minimize the air space around the pot

In some RHCs there are no inner containers and the pot is simply embedded in the insulation. This allows the insulation to easily become soiled, thus becoming a health hazard as well as reducing its desirability both aesthetically and thermally. If insulation is used in this way, it should be replaced frequently.

Safety—The assembly of the outer and inner container and the insulation should produce a unit that:

- Does not easily tip over
- Has carrying handles that do not come off
- Is not flammable
- Does not grow mold or mildew
- Is easily cleanable
- Is child-resistant

Types of RHC Projects

The retained heat method of cooking can be used for many types of projects.

- By disseminating do-it-yourself information, families can construct their own RHCs from locally available materials. However, each component of the RHC must be thoroughly understood and taught. The use of inappropriate materials can lead to mold and mildew growing in or on the RHC, creating health hazards.
- RHC promoters can also assist in villages with RHC construction. By being a part of the construction project, a promoter can supply tools and materials that may be otherwise unavailable locally. However, the promoter should try to use locally available tools and materials, if possible, so the project will be sustainable. This hands-on approach also creates trust in the villages and allows the promoter to reinforce construction training with use training and to teach recipes that are appropriate for the local area.
- RHCs can also be built in factories. Mass production allows for a wider choice of materials to be used and for tighter control of quality. Since there is a broader choice of materials, factory produced units will typically have higher performance characteristics. There is also the potential for wider distribution of units since they can be sold through hardware stores and other distribution channels. In some cases, mass produced units may be less expensive.

The Design Process

There are several specific phases relating to the design of an RHC. Each phase has a specific objective. These include:

- ***Research***
  The objective of research is to determine what others have done and what the results were for these prior works.
- ***Conceptual Design***
  The concept for the design must be defined using all the parameters discussed in the next sections.
- ***Prototyping and Laboratory Testing***
  Once the project concept is well defined, prototypes are constructed in accordance with the concepts. The prototypes are typically tested in a laboratory environment. The goal of laboratory testing is to determine if the design meets the objectives and to establish performance specifications. It is important to ensure that production items do not deviate from the performance objectives and specifications that have been designed into the product.
- ***Field Testing***
  This is the first real customer-based test of the design. Without exception, there will be things that the users will find that could be done better or new features that could be incorporated with minimum cost that would result in a better product.
- ***Design Review***
  Following a successful field test, there will be a need for a design review and for changes to be made in order to incorporate what has been learned during the field test.
- ***Pilot Production***
  At this phase, a limited number of production

units will be constructed and distributed to actual customers and their feedback collected and evaluated.

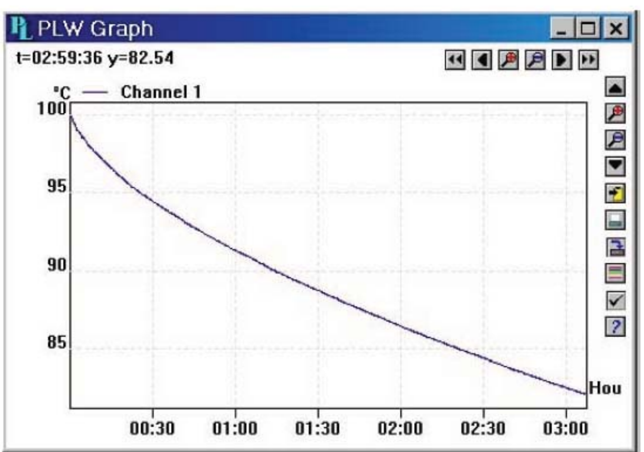
- *Hard Production*
  This is the scaling-up phase. It cannot be over emphasized that all aspects of the project must be scaled-up at the same time. It does not do any good to scale-up production if distribution or marketing lags behind.

Comparative Examples

When starting an RHC design, it is helpful to compare any new design with examples that have previously produced good results. Below are three examples that can be used for comparisons. Note that all three graphs show temperature data from a five-liter pot of water. The local altitude of these tests was 800 feet. After three hours in the RHC, each pot of water had a temperature between 80-85°C. All were plotted with a temperature analyzer (Pico TC-08).

Figure 1 shows a test RHC made using a wood basket for the outer container. The insulation is four layers of a wool blanket. There is no

Figure 1 - RHC made with wood basket

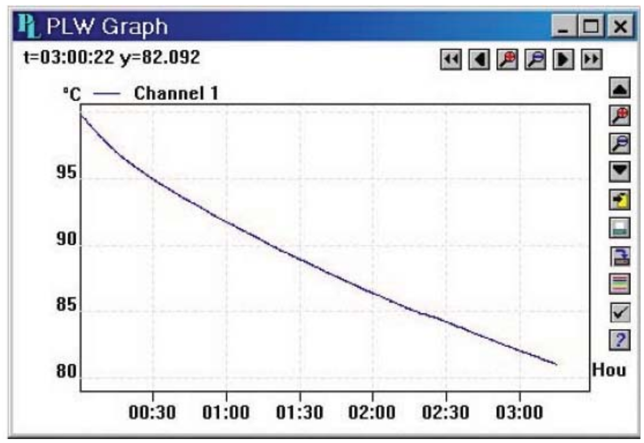


inner container and the pot with 5 liters of water is embedded in the insulation.

There is an insignificant loss in temperature as the transfer is made from the stove to the RHC. Since there is no inner container, some cooling results from heat loss into the wool blanket. From a thermal standpoint, this RHC could be expected to produce good, but not excellent results. However, in actual use the wool would become soiled and require frequent washing. Also, wet wool has a bad odor, which would be unacceptable to many cooks. While this is a good example for comparing with newer designs, it would not be recommended for field use.

Figure 2 shows an RHC made with a cardboard box for the outer housing. A wooden box would have produced similar

Figure 2 - RHC made with a cardboard box

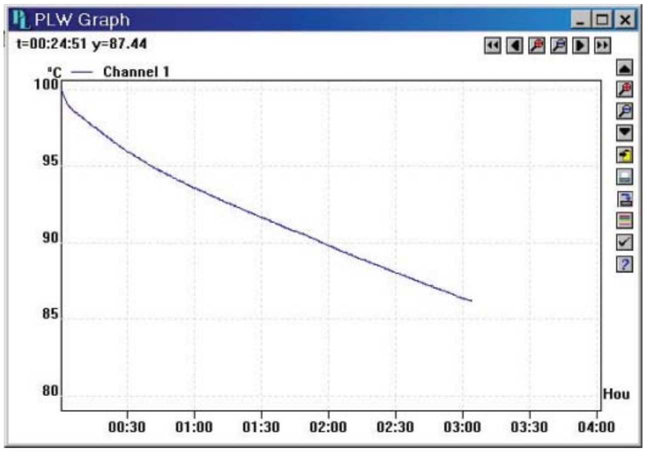


results (results not shown). The insulation is three layers of three-quarter inch thick foam wallboard insulation. There is no inner container and the pot is placed in the open space provided by the layers of insulation. The lack of an inner container allows any spilled foods to get between the insulation layers where it would be hard to clean. While the thermal characteristics are fair, it would not have a very long life in practical field use.

The RHC being manufactured by HELPS International is shown in Figure 3 (page 5). It has been designed for commercial sales through hardware stores and non-governmental organizations (NGOs) for their community development programs. It was designed to be produced in a factory environment using production tooling.

The thermal mass of the inner container slightly cools the pot in the first three minutes, but the excellent insulation

Figure 3 - RHC manufactured by HELPS International



makes up for the extra loss of an inner container. After three hours, the 5 liters of water is above 87°C. This could be expected to produce excellent results. The durability of this RHC structure will withstand extended field use.

Both the inner and outer containers are made of easy to clean polyethylene. The use of plastic welding techniques is used to produce a double walled, rigid unit. The two-inch space between the two walls is filled with Styrofoam beads.

Styrofoam beads were the best insulation tested and were also the cheapest (a byproduct of another product). Styrofoam is soft and requires that it be protected with a housing inside and out. Testing indicated that a round housing was superior to a square one since the round pot would fit snugly inside. To make it the best possible fit, a special pot was designed and manufactured for this RHC application. The pot is supplied with the RHC. Also it is suggested in training that a cloth be used around the pot to fill the air space between the pot and the inner container. A cloth was used in the test that is represented on this page. The inner container has a lid that is also insulated and provides a good seal.

Design Instrumentation

A valuable tool in the design of an RHC is a temperature analyzer that can continuously plot the temperature loss of a known amount of boiling water placed in the RHC.

The temperature curves in the graphs in this Guide were produced with a Pico brand temperature analyzer Model TC-08 with type K (Chromel/Alumel) thermocouples. The Pico temperature analyzer can simultaneously record and plot data from eight type K thermocouples. It can be used with any computer with a universal serial bus (USB) interface. More information on this temperature analyzer can be found at www.picotech.com/thermocouple.html.

The specific thermocouple suggested for use with the analyzer is a Pico SE00 Type K thermocouple (exposed wire, PTFE insulated). At time of publication, the Pico TC-08 analyzer costs approximately $450 and the SE00 type K thermocouple costs approximately $10 each. It is desirable to have at least three thermocouples for use with the analyzer. These three thermocouples will typically record the temperature of the pot contents, ambient temperature, and outside surface of the RHC.

It is important that the thermocouple measuring the temperature of the contents of the pot is located in a consistent location and that it does not contact the side of the pot. It is suggested that a wire fixture (see Photo 1) be made to hold the thermocouple tip about one inch above the bottom of the pot and in the center.

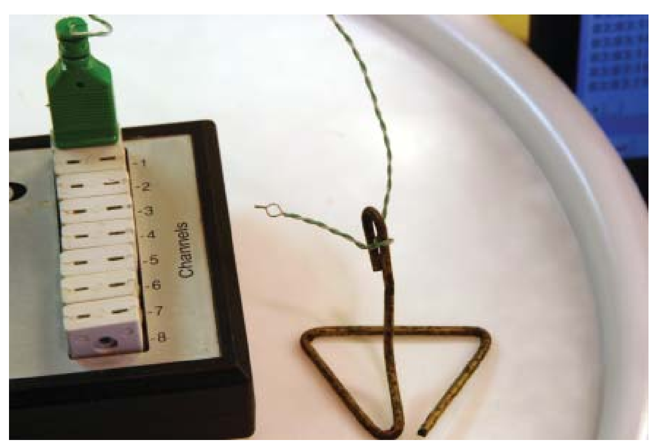


Photo 1 - Thermocouple Support

The recommended Pico analyzer sampling rate should be at least one sample per second to capture the small but rapid change in temperature that occurs as the pot is transferred to the RHC.

The Pico temperature analyzer also allows notes to be attached to each graph. The notes are saved in the same file as the graph and serve as a permanent record of what each graph represents.

The use of this analyzer or its equivalent in the design of a RHC cannot be over emphasized since valuable design information can be interpreted from the shape of the temperature curves.

RHC Performance Objectives

A simple way to compare the performance of two or more designs, using only a thermometer, is to place a pot containing 5 liters of boiling water into the RHCs and evaluate their temperatures after 3 hours. A good RHC will still have a temperature of 80°C after 3 hours and an excellent design will have a temperature greater than 85°C. Even if a design does not meet these values, it will still produce a significant health benefit (through reduced smoke), wood savings, and will free the cook for other more productive tasks.

Much more information can be obtained by using the Pico temperature analyzer to plot the temperature loss. The temperature curve will help analyze not only the amount of heat loss, but will also help isolate where the heat loss occurs.

There are several factors that contribute to RHC performance. By analyzing the temperature curve generated by the Pico temperature analyzer, the contribution of each factor to the heat loss can be determined. These factors include:

- Boiling temperature at the altitude where the RHC is being tested. There is little that the designer can do about this other than to understand that it will vary with the area of use and to test at altitudes that can be reasonably expected for use.
- The cook's ability to rapidly transfer the pot to the RHC. It is also important that a lid is on the the pot before and during the time the pot is being transferred to the RHC. This keeps in as much steam and heat as possible. This, along with the local boiling temperature (which varies with altitude), determines the starting temperature of the pot when it is placed in the unit. This is an important training factor when the RHC is introduced.
- The thermal mass of the material inside the RHC (i.e., this affects the amount of heat that is taken from the pot and its contents to heat the inside structure of the RHC that protects the insulation). This causes a loss of temperature as heat is transferred to the inside structure of the RHC. This occurs rapidly at first and decreases as the inside structure heats up. This generally occurs in the first thirty minutes that the pot is in the RHC. The temperature decay for the pot contents will decrease rapidly during the period that the inside structure is consuming heat from the pot (see curved line of graph figures). When the inside structure is heated, the temperature curve will become near linear (see straight line on graph figures).
- Once the inside structure is heated, a gradual loss of temperature occurs as heat is transferred through the insulation to the environment. The quality of the insulation and seal of the RHC lid will determine the slope of the temperature loss curve. In order to determine the amount of heat loss that can be contributed to the seal of the RHC lid, a second curve should be run with the pot placed in a sealed container (such as a large, heat-resistant "turkey bag" that has a twist tie) prior to placing it in the RHC to eliminate steam loss during the test. A poor seal can be a major factor in heat loss. This is not to suggest that the sealed container ("turkey bag") be a part of an operational RHC but is used only to evaluate the losses assocated with a poor seal.

A continuous plot of the temperature will give the designer more information than just measuring the temperature after 3 hours.

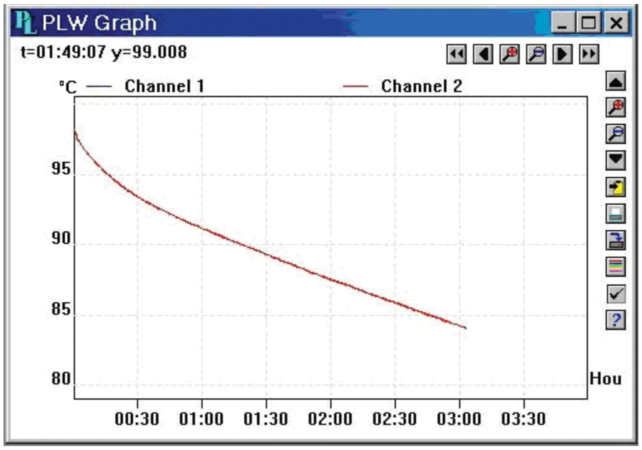


Figure 4 - Typical RHC curve

In Figure 4, the starting temperature of about 98°C for the pot contents placed in the RHC was a function of the boiling point at the local altitude and the cook's ability to rapidly transfer the pot from the stove to the RHC. During the first 15-20 minutes (the curved section of the line), the temperature decreased rapidly at first then slowed as the thermal mass of the material inside the RHC became heated. Once the thermal mass was heated, the more gradual decay (the straight linear section) was a function of the quality of the insulation and seal of the RHC. The RHC tested here could be expected to produce very good results since the temperature is at the high end of the 80-85°C range after 3 hours.

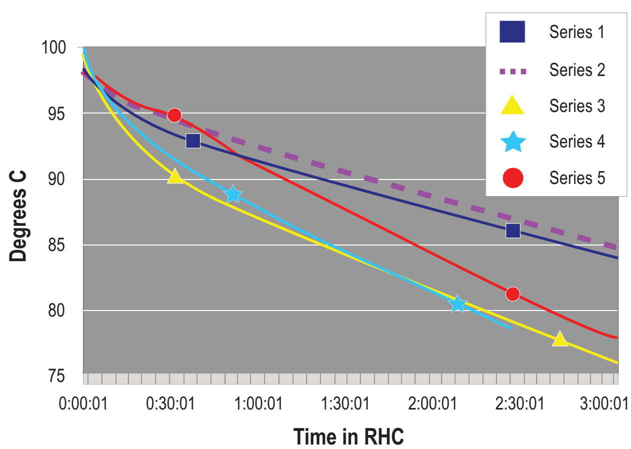


Figure 5 - Comparison of various RHC properties

Figure 5 shows various internal materials and insulations (e.g. wood basket, cardboard box). Note that in the two lowest curves the yellow unit (triangle line) has higher thermal mass (its temperature drops faster at first) but better insulation (as indicated by the slopes of the near linear portion of the curves) than the light blue curve (star line). This type of information can be a valuable design tool and would be overlooked from only evaluating the three-hour temperature.

Pre-boiling Considerations

In order for the RHC to be effective, the pot must be left on the stove until the contents are at boiling temperature throughout. Depending on what is being cooked, the time can vary from a few minutes to a half hour or longer.

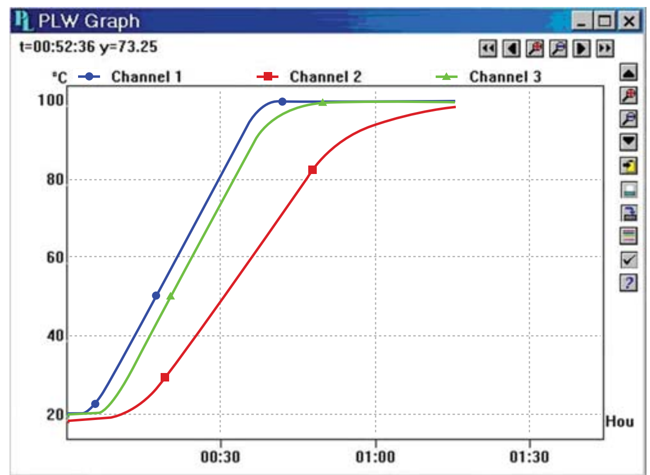


Figure 6 - Internal temperature lag of food in RHC

In Figure 6, the blue curve (circle line) shows the temperature of the water in a pot as it goes from room temperature to boiling temperature. The red curve (square line) is a plot of the inside temperature of a medium sized potato being boiled in the pot. The green curve (triangle line) shows the internal temperature of a one-inch cube cut from a potato.

In conclusion, the pot should not be removed from the stove as soon as the water starts to boil. Instead, it should be left on the stove until the internal temperature of the food has reached boiling. If the food is in large pieces, it is recommended to continue to boil the food at least 10-15 minutes longer. Additional time should be added as required for variations of boiling temperature as a result of the local altitude.

Furthermore, this test also shows the savings in cooking time by cutting the food into small parts prior to boiling.

Marketing and Distribution

Product Introduction

The introduction of an RHC project should be well thought out and tailored to the community and culture in which the project will be implemented. However, it can be expected that at first the communities will be skeptical that an RHC will perform as stated. This can best be overcome with demonstrations rather than just with a verbal pitch or written data sheets. The introduction can also benefit by working with an NGO that is already well known and trusted in the village.

Also, within most villages there are cooks (usually women) that are natural leaders that can be first educated on the benefits of the RHC. By demonstrating the RHC benefits to them, they can in turn communicate the benefits to others.

Training and Support

User training is extremely important to the success of an RHC project. Even the best designed RHC will yield poor results if the operator is not efficient in getting the pot immediately into the RHC and getting the RHC lid in place, or, if the RHC is opened during cooking, which will let the steam out and cold air in the unit. Typically a cook will open a cooking pot to inspect progress and to stir the contents. The cook should be trained that if for any reason the RHC is opened, the pot should be placed back on the stove and brought back to a boil and then replaced into the unit.

Many recipes need to be modified for cooking in an RHC. Therefore, in any RHC project it is highly recommended that local food preparation be researched, recipes converted, and training provided that incorporates the new cooking techniques (See *Table 1 - Suggested Cooking Times for the HELPS International RHC*).

The project should be supported with periodic visits to make sure that the cooks understand the use of the RHC, and they are using it in an appropriate way. Many times the cooks will find other beneficial ways to use the RHC that had not been thought of previously. These should be documented and included in future training and support.

Table 1 - Suggested Cooking Time for HELPS International RHC

Type of food	Time to boil on stove	Time in retained heat cooker	Total time
Beans	1 hour, 30 minutes	3 hours	4 hours, 30 minutes
Chicken stew	20 minutes	35 minutes	55 minutes
Beef stew	1 hour, 10 minutes	50 minutes	2 hours
Vegetable stew	10 minutes	30 minutes	40 minutes
Rice	8 minutes	25 minutes	33 minutes
Pasta	5 minutes	20 minutes	25 minutes

Awareness Building

In rural villages, information is often distributed by:

- ***Radio***
  In many rural villages the radio is the main way that outside information is introduced to the village. Many of the villagers do have radios and listen not only for entertainment, but to receive announcements of personal and public types of information.

- ***Village to Village***
  There is typically a strong flow of information from nearby villages. A successful project in one village will influence its introduction and success in nearby villages. Likewise, an unsuccessful project will be well known in nearby villages.

- ***Local NGOs***
  In most rural villages there are already NGOs that have been working with the villagers for many years and have established trust. Members of these NGOs, if educated on the benefits of the RHC, can be excellent channels for awareness within the villages. In order to educate the NGOs in an efficient manner, seminars with many NGOs can be held and demonstrations given. Once these NGOs know and understand the benefits, they can influence many villages in a very effective way.

Appendix

Testimonials From the Field on the ONIL Cooker

HELPS engineer Miguel Granados received the following comments during his follow up visits to three villages that had field-tested RHC projects. These comments have been translated from Spanish.

On our first visits to Santa Avelina, Santo Domingo Xenacoj and Brisas del Moca we found out that 50% of the ladies grind their frijoles on a stone while the other 50% like to eat them whole in their broth. We also heard the ladies speak enthusiastically about the ONIL Cooker, for example:

Doña Ana Chamay, Santa Avelina, Quiche—*"I leave my frijoles all night in the ONIL Cooker and they are cooked just the way I like them in the morning."*

Miguel's comment—*Doña Ana reported that she starts cooking her frijoles in the evening and by 7 pm they are put in the ONIL Cooker after 1½ hours on the fire. She lets the frijoles finish cooking in the ONIL Cooker over night liberating time and firewood. In the morning the beans are cooked and ready to serve. She reported that normally it would take her 4 hours on the fire to cook the frijoles.*

Doña Susana Cordova, Santa Avelina, Quiche—*"I don't know if this ONIL Cooker is working, I can't feel it getting hot on the outside like the one I had before."*

Miguel's comment—*This was an important statement for our investigation because it proves that our new insulation material worked better. The new material permitted less heat to escape and made the ONIL Cooker more efficient.*

Santa Avelina, Cotzal, Quiche

Doña Maria Juana Sanjaj Garcia, Santo Domingo Xenacoj, Sacatepequez—*"The ONIL Cooker helps me a lot in my business of selling tortillas."*

Miguel's comment—*Doña Maria used the RHC to store 240 tortillas to keep them hot and soft for 3 hours, enough time to sell all the tortillas for a meal. Previously, when Doña Maria prepared tortillas to sell, she wasted firewood keeping the fire going in order to sell the tortillas hot.*

Doña Rosa Eustaquia Chile, Santo Domingo Xenacoj, Sacatepequez—*"I used to get up during the night and start a fire to prepare oatmeal for my baby; with the ONIL Cooker, I can keep oatmeal hot to use all night."*

Miguel's comment—*Doña Rosa used to have to get up at 1 AM to start her fire to cook an oatmeal drink for her baby. Now, with her ONIL Cooker, she is able to prepare the drink at 7 PM and have it ready to serve at any time up to 6:30 AM. This saves her time and she can get more sleep!*

Doña Maria Dominga Tun Aquino, Santo Domingo Xenacoj, Sacatepequez— "By 11 AM and we have finished preparing lunch. I now have time to do other things."

Miguel's comment—*This was a very nice experience because starting at 9 AM, Doña Maria was able to finish preparing lunch by 11 AM. She prepared corn for her tortillas, a vegetable soup and white rice, all using the ONIL Cooker. From 11 AM on, the stove was hot and available for other uses if needed. She saved fire wood and time with the ONIL Cooker and had 1½ hours to do other activities!!*

Cooker in Santo Domingo Xenacoj, Chimaltenango

Doña Antonia, Rio Bravo, Suchitepequez— "The coffee is still hot in the morning!"

Miguel's comment—*Doña Tona has 5 children to take care of, the oldest is 7 years old. It is a custom on the Guatemalan south coast to get up very early to go to work, taking advantage of the cooler morning temperatures. Doña Tona would get up early every day to light her wood stove to boil water for her husbands coffee, but with the ONIL Cooker, she prepares the coffee the night before, and when she gets up, the coffee is still 72°C, hot enough to burn your mouth. This helped Doña Tona sleep a bit more in the morning; the ONIL Cooker liberated time.*

Recieving RHC in Brisas del Moca, Suchitepequez

General opinion, Santo Domingo Xenacoj, Sacatepequez—"We all heat water [at night] for bathing in the mornings."

Miguel's comment—*This was the answer of all people questioned in Santo Domingo. The ONIL Cooker helps them keep water warm overnight to have ready to use for their morning bath. The mornings in Santo Domingo are cold and the tap water is very cold.*

The main conclusion of the field tests is that the ONIL Cookers saved fuel and/or time. It was rewarding to see that the women used their creativity in using the ONIL Cooker in new ways to help them save time and fuel in their daily needs.

Miguel Granados,
Engineer

Indoor Air Pollution from Home Cooking and Heating

Indoor air pollution causes significant health problems for the nearly 3 billion people worldwide that rely on traditional biomass fuels for their cooking and heating needs. Over the last 30 years, awareness of the environmental and social costs of using traditional fuels and stoves and knowledge about how to reduce emissions from these stoves has grown. Yet the improved stoves currently available to poorer customers do not always represent best practice or an understanding of design based on modern engineering. The knowledge required to design cleaner burning stoves exists in centers of excellence in several locations around the world. Providing this information to those involved in promoting improved stoves is a necessary first step to reducing indoor air pollution exposure for stove users.

About the Partnership for Clean Indoor Air

The Partnership for Clean Indoor Air was launched by the U.S. Environmental Protection Agency (EPA) and other leading partners at the World Summit on Sustainable Development in 2002 to improve health, livelihood, and quality of life by reducing exposure to indoor air pollution, primarily among women and children, from household energy use. Currently, over 130 organizations are working together to increase the use of clean, reliable, affordable, efficient, and safe home cooking and heating practices that reduce people's exposure to indoor air pollution in developing countries. For more information, or to join the Partnership, visit www.PCIAonline.org.

Helps INTERNATIONAL

EPA United States Environmental Protection Agency

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