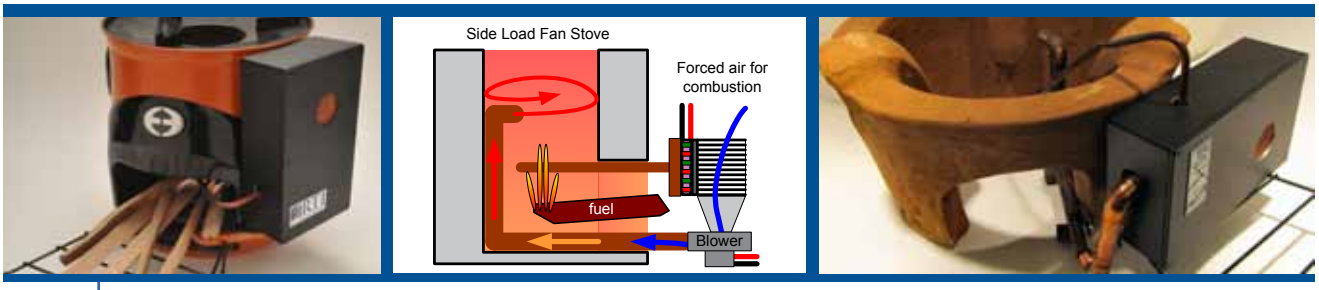
Enhancing Cookstove Performance Using RTI's Thermoelectric Air Injection Insert



RTI International has developed an enhanced insert for biomass cookstoves to improve combustion efficiency and reduce harmful emissions. As opposed to a new stove design, this add-on approach provides controlled, supplemental air injection to improve the combustion of an existing stove. This allows the many thousand inefficient cookstoves already in use to be upgraded. In initial tests of RTI's approach applied to a "rocket" stove design, particulate emissions were reduced by more than 85% as compared to the traditional three-stone fire used in many countries.

Inefficient and Toxic Cookstoves: A Global Health Problem

In many developing countries, inefficient biomass cookstoves are used indoors in unventilated conditions, directly exposing people to toxic gases and particulate matter. These toxicants are hazardous to human health and the environment.

By reducing exposure to these toxic materials, a more efficient and cleaner burning stove would significantly improve the health and safety of people who use wood or other biomass material for cooking fuel.

Improving Fan-Powered Stoves with Thermoelectrics

Fan-powered biomass stoves generate less particulate matter and carbon monoxide than stoves without forced airflow. However, some fan-powered stove designs require additional, external power. Even in places with available electricity, the added burden of providing electric power to the stove may limit its effectiveness and, therefore, lower the likelihood of adoption and use.

To circumvent this problem, RTI integrated a thermoelectric device that converts waste heat to electricity to power the fan. This approach captures the advantages of fan-powered stove designs (lower emissions), does not compromise the usability of the stove, and could actually generate excess electricity to power a light or radio, charge a cell phone, or meet other needs.

These combined advantages could enhance the adoption of the stove in some countries.

Demonstrating the Performance Advantage of RTI's Cookstove Insert

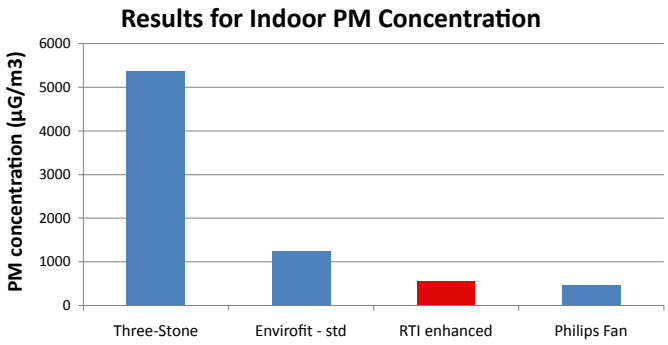
RTI developed an add-on to the commercial Envirofit® G-3300 stove. The air injection insert reduced black carbon concentrations by 70% and reduced particulate matter emissions by 55%. This represents an overall reduction in particulate matter emissions of more than 85% as compared to the traditional three-stone fire.

Enabling Enhancements to Local Cookstoves

The RTI concept of an add-on insert could be applied to cookstoves currently used around the world, effectively reducing emissions and exposures without requiring people to change their methods of cooking or their basic equipment.

The advantages of RTI's enhanced stove add-on are significant:

- The add-on can be integrated into existing stoves that are already accepted and used, increasing the likelihood of adoption and proper use.
- Unlike an all-new stove, an add-on to an existing stove would not *increase* emissions. In some studies, people who received improved stoves used them in conjunction with their old stove, effectively increasing harmful exposure levels.
- The add-on weighs far less than a new stove, significantly lowering the cost of distribution as compared to an all-new stove design.
- A stove add-on would not disrupt the local economy by competing against businesses that fabricate and sell native stoves.
- Excess power from the stove could be made available to the user, potentially enhancing the adoption of the stove in some countries.
- Design improvements to the insert could be provided as simple and low-cost upgrades.



With the RTI insert, emissions from a commercial cookstove were significantly lower than emissions from the traditional three-stone fire.

Advancing the State of the Art

The next steps for development of the RTI technology include adapting the enhanced insert for use in a range of locally produced stove types and engineering additional performance enhancements.

RTI and the U.S. Centers for Disease Control and Prevention (CDC) are currently partnering to adapt the RTI stove add-on for the Kenyan Upesi Jiko stove and test its performance in the field against an unmodified Jiko stove. This program represents a first step in transitioning the technology for use in local cookstoves to improve health outcomes. Future efforts will expand the number and types of stoves for integration.

Additional development of the technology should lead to even greater efficiencies, and will include

- Improving control over the combustion cycle
- Integration of "smart" design features that enhance ease of use for start-up and simmering by appropriately modulating the flow based on the burn cycle temperature.

These improvements will both enhance the value of the technology for the end users and reduce harmful emissions caused by inefficient combustion.

RTI is committed to pursuing this new stove-enhancing technology as a means of helping address the broad challenges associated with biomass cookstove use in the developing world.

More Information

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