AARON STOVE IN NIGER
BIOMASS GASIFICATION OF AGRICULTURAL RESIDUES TO SAVE FIREWOOD

Increasing the efficiency of heat utilization and a clean combustion can be obtained through biomass gasification. The AARON stove in Niger is the result of a specific and innovative work realized in the framework of an European Union project, to develop a biomass supply chain based on agricultural residues, and a stove adapted to use them. At present, the AARON stove and pellet production have passed the experimental phase and passed into a first market diffusion.

This gasification stove, thanks to its efficiency, saves a big amount of energy: with only 1.2 - 1.5 kilograms of biomass from agricultural waste, it is possible to cook for a family, saving the equivalent of the normal consumption of the three stones fire that goes from 5 to 7 kilograms of wood per day.

The biomass of agricultural origin, or from trees pruning, is unused at present in Niger and it is simply dispersed. With the pellet making process and its use in the AARON stove, these materials that have been ignored so far are becoming an important resource. Each gasification stove working with agricultural wastes, saves about 2.1 tons of wood per year, reducing the pressure on natural resources.

In addition, the bio-char resulting from the gasification process will be added as amendment in the agricultural soils, and will improve the physical and chemical properties of soils, and their ability to retain water.

The AARON stove was developed considering the following criteria: Avoid wood consumption; Work with reduced consumption of biomass; Ensure portability; Ensure stability and ease of use; Safety in usage, specifically in protecting the user against the risk of burns; Resistant to corrosion with normal maintenance; Composed of a reduced number of parts with ease of assembly / disassembly; Ease of emptying combustion waste; Have a reasonable operating time; Allow preparing food for 6-7 people, the average family in Niger; Flexibility of use : able to cook, fry and / or heat; Ability to recover the combustion waste (bio-char) to heat, cook or use in agriculture as a soil additive.

AARON stove uses biomass only in the form of pellets, in order to optimally perform gasification. The fuel for the stove can therefore come from different types of biomass: stalks of millet, sorghum, straw, crop residues in general, peanut shells, residues from plants pruning.

Pellet samples made of millet have been analyzed for density and calorific value. The density of the material is 1,17 g/cm3, and the calorific value has been measured equal to 2.494 kcal/kg. The calorific value of millet pellet is lower than pellets made of wood that normally contain more than 4.000 kcal/kg. However, 1,4 kg of pellets made of millet are sufficient to prepare the normal meal for the average Nigerian family, while the wood quantity necessary with the three stones fire is close to 5 kg.

The production of pellets goes through different phases: Search and harvest of residues; Transport to a processing centre; Passage in the hammer mill to grind biomass; Humidity control of product in powder and eventually correction; Passage through the pellet machine; Pellets drying and Bagging.

The official document SDRP *Stratégie de Développement Accéléré et de Réduction de la Pauvreté* of the Nigerian Government indicates that almost all households (96.4%) use wood / coal as the main fuel for cooking. This contributes to deforestation increasingly marked in the country. The National Institute of Statistics data indicates that in Niger the average consumption per household is 5.8 kg of wood per day. The three stones fire (here set up using three bricks) is still largely used, in rural areas as well as in towns. It is a highly inefficient open fire that uses only 15% of the heating value of the wood fuel. As 85% of the heating value is lost, those three stones fires need a huge amount of wood fuel in comparison to the real necessity.

The project to design the AARON stove has been coordinated by the NGO *Terre Solidali* in collaboration with the NGO AcSSA *Action pour la Sécurité et la Souveraineté Alimentaires du Niger* and the RESEDA Federation of Niamey (Niger). Different prototypes have been built and tested and adapted to conditions in Niger, with respect to the type of available biomass, the shape of pots, the cooking time and the power of the combustion fire. The gasification stove was based on a previous work of the Brace Research Institute of Montreal. The stove has been optimized during over 150 tests, carried out in collaboration with the University of Turin (Italy). To define the performance of the stove, the method described by Baldwin F. Samuel in “Biomass stoves: Engineering Design, Development, and Dissemination” was used.

During the AARON stove design, users find quite remarkable how it is possible to cook for a family with only a small quantity of pellets made of agricultural waste. The stove is now being disseminated in Niger with the support of different local, national and international actors.

To know more

Aaron Stove presentation

Aaron stove presentation in Feeding Knowledge website

http://www.energiesdurablesniger.org/