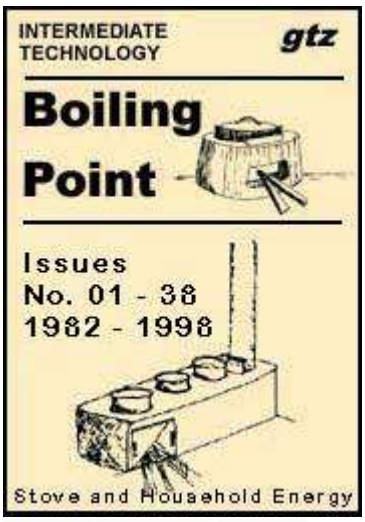

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Biogas Properties, Stoves and Lamps

Reproduced from the GTZ/SEP booklet "Dissemination **of** Biogas Plants **in** the **Rural** Areas **of** Kenya - 1987"

Biogas Appliances

In principle, biogas can be used **in** the same way as any other combustible gas. It has a calorific value **of** approximately 21.5 MJ/m³ . It must be borne **in** mind, however, that the composition **of** biogas - and, as a result, both its calorific value and its combustion behaviour - vary within a certain range.

The biogas produced **in** the Meru plants (N. E. Kenya) is used for cooking and lighting. It could also be burnt to operate a gas-powered refrigerator or a chicken incubator or warmer. A gas pressure **of** between 5 and 20 cm water column is required for cooking. Lamps require a pressure **of** about 10 cm water column, which can be achieved with the larger gasholders now being installed on the Meru

plants. Like other family plants, the Meru units do not produce enough gas to operate engines, e.g. generators.

The members **of** the Special Energy Programme (SEP) biogas team are well aware **of** the fact that the availability **of** reliable biogas appliances for cooking and lighting is essential for the success **of** the entire programme. Not only do the biogas appliances have to be reliable and safe; they must also be cheap, easy to operate and capable **of** meeting the users' cooking and lighting needs **in** a way that is generally compatible with the prevailing local customs and practices. Moreover, the design **of** the devices should be such that the members **of** the target group find them basically attractive and aesthetically pleasing, as it is very important for the success **of** the dissemination activities that biogas be seen by the users as having a certain prestige value that enhances their status **in** the local community.

A family that has acquired aMeru plant will usually require at least one biogas cooker and one biogas lamp. Frequently, a user will initially install one cooker and one lamp and, after a short time, request a second cooker and a second lamp - and **in** some cases, even two additional lamps.

Biogas Cookers

Both propane and butane (bottle gases) have a higher calorific value and a higher combustion speed than biogas. As a result, standard commercial propane or butane burners cannot be used with biogas unless they have been modified **in** certain ways. The gas injector jet and the mixing chamber must be enlarged, and the number **of** burner jets as well as their cross-section - must be increased. The dimensions **of** the air inlet should be such that a biogas-air ratio **of** approx. 1:4.5 is maintained.

Taking into account not only the different calorific values **of** biogas, fuelwood and charcoal, but also the varying end-**use** efficiencies **of** biogas cookers' and open fires and jikos, it can be assumed that 1 m^3 **of** biogas will substitute for up to 5.6 kg **of** wood or as much as 1.7 kg **of** charcoal.

The KIE biogas cooker consists **of** a round burner mounted **in** a rectangular frame constructed **of** angle iron that has a pot support **in** each corner.

Two versions can be supplied: a single and a double-burner model. The retail price (19&7 prices) **of** the KIE biogas cooker is about KSh 450. for the single - burner model and KSh 750. for the double-burner version. The unit works fairly well and has a specific biogas consumption per burner **of** not more than 450 litres/hour.

In 1986, the biogas field workers **of** the SEP/Kenya developed a new biogas cooker design. As the prototype was produced **in** a metal workshop **in** Meru District, the unit is called the "Mew biogas cooker". The Meru cooker consists **of** a metal liner, a ceramic insert and the burner. The metal liner is either round or square and has either three or four pot supports. Alternatively, it may be equipped with a separate metal ring which serves as a potholder. The appearance **of** the round model is quite similar to that **of** a jiko.

The ceramic insert can be purchased from Kenyan potteries. It was originally developed as a component **of** improved fuelwood-saving cookstoves **in** the framework **of** the SEP/Kenya's stove dissemination programme, which is being implemented **in** co-operation with the women's organisation Maendeleo ya Wanawake (MyW).

The burner consists **of** four 1" metal pipe elbows that have been welded together; following welding, a total **of** about 50 jets are drilled **in** the burner **in** two rows. The air inflow can be regulated by means **of** a simple air control sleeve. The gas pipe is opened and closed with a 0.5" gate valve.

The Meru biogas cooker has several advantages:

It reminds potential users **of** a jiko, a quite common and well-known stove design that is already **in** widespread **use in rural** Kenya, and is thus a "familiar" appliance that is not rejected by the target group on the basis **of** its outward appearance.

It is heavy and is therefore not likely to tip over when cooks are preparing dishes that require considerable stirring, e.g. ugali or githeri.

Use of the ceramic insert, which serves to insulate the pot and conserve heat, results **in** higher energy efficiency, and thus shorter cooking times.

All components can be produced **in** local workshops using locally available materials. The retail price **of** the Meru biogas cooker is not more than about KSh 500., and it has a specific biogas consumption **of** 600 litres/hour. The SEP intends to disseminate the technical know-how required to produce this cooker among artisans **in** other districts as well, thus facilitating its adoption **in** all the biogas programme's target regions.

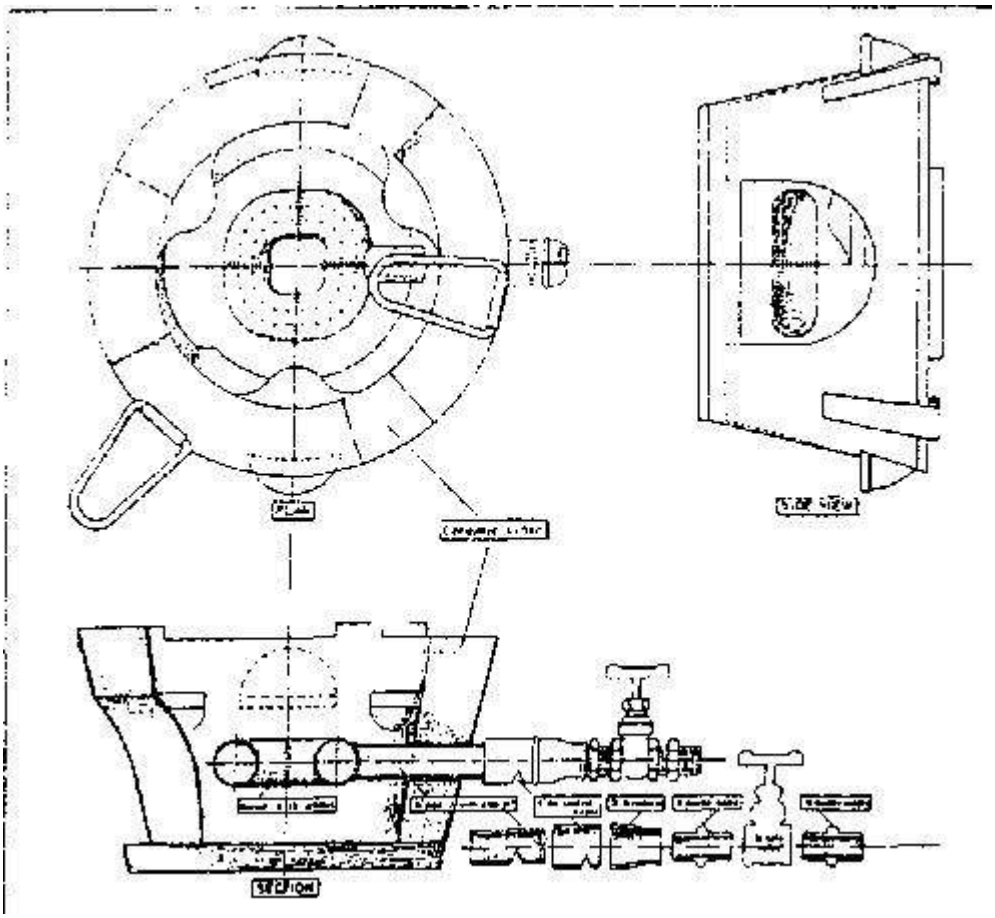

Fig 3 - Meru Biogas Cooker

Biogas Lamps

The lighting efficiency **of** biogas lamps is generally quite low, averaging between 3% and 5%. Nonetheless, a good biogas lamp can illuminate a room far better than a wick kerosene lamp, and produces a light intensity comparable to that which can be obtained with a pressure kerosene lamp or an electric light bulb **in** the power range **of** 25-75 W.

Many parts **of rural** Kenya still have no access to electric power. **In** such areas, biogas makes it possible for farm households to improve their work areas for longer periods every day. This **in** turn

enhances the overall quality **of** farm families' lives, for example by enabling women to do their housework - and children to do their school work - during the evening hours (after 6.30 pm) under good lighting conditions.

High-quality, "modern" household lighting is also a status symbol among **rural** people and, as a result, biogas lamps contribute significantly to the attractiveness **of** the biogas technology among the relevant target groups.

KIE began development work on biogas lamps **in** 1984, and the first model produced by the firm was based on a standard commercial LPG lamp that had been modified for biogas operation. Unfortunately, however, this prototype did not perform satisfactorily because **of** the nature and scope **of** the modifications that had been undertaken. Consequently, another lamp was developed.

To date, more than 120 lamps **of** this second type have been produced and distributed, and a number have also been supplied to users **in** Tanzania. The lamps have performed satisfactorily. Some users have complained about flickering, or noted that the light was yellow rather than white, or that black spots had developed on the mantle. However, such problems are not attributable to design flaws **in** the lamp, but rather to insufficient gas pressure **in** the biogas plant or to the presence **of** water **in** the gas piping.

Recently it was decided to modify this design **in** order to eliminate certain manufacturing problems which had had an adverse effect on the overall quality **of** the output:

The mixing chamber was assembled from three separate parts. The bores were not **of** a uniform diameter, which meant that **in** some cases the gas did not flow properly and extensive threading was required to join the parts.

In some lamps the injector jet was not **in** line with the axis **of** the mixing chamber. Unfortunately, the new KIE lamp is not yet on the market. However, with demand for biogas lamps increasing rapidly **in** Kenya, and **in** view **of** the crucial role **of** improved domestic lighting **in** promoting the dissemination **of** the technology, it is important to ensure that adequate supplies **of** these suitable appliances are available to consumers. With this **in** mind, the SEP/Kenya initiated the importation **of** Brazilian "Jackwal" brand biogas lamps. The importation and distribution **of** the units is now being handled by private merchants.

Like other gas or pressure lamps, the "Jackwal" lamp employs a gas mantle. The lampshade reflects the light downwards and the lamp-glass helps maintain the operating temperature at the required high level. Both the gas and the air inlet can be regulated. The specific biogas consumption **of** the "Jackwal" lamp works out at about 100 litres/hour. Its retail price **in** Nairobi is KSh 820. The new KIE design should be every bit as good as the "Jackwal" lamp - if not better - and it is not expected to be any more expensive than the Brazilian import.


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