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Biogas plants in the Ivory Coast

by Nicolai Hees

The decisive factor **in** the construction **of** large-scale biogas plants at the Ferkessedougou Cattle Fattening Station was the dramatic increase **in** energy costs at the end **of** the 1970s, which had a negative effect on the balance sheet **of** the overall cattle-fattening and meat-refrigeration project. As the project was not linked up to the Ivory Coast electricity grid until September 1986, the electric power needed had to be generated by diesel power units consuming 310,000 litres **of** diesel oil per year. The solution to the search for alternatives clearly lay **in** the direction **of** converting the ample supplies **of** cattle dung into biogas.

The construction **of** the region's first large-scale biogas plant aroused interest **in** the project area for this power source, so that an extension **of** the project (1984-1986) saw not only the construction **of** a second large-scale plant but also the beginning **of** a dissemination programme for family biogas plants. **In** January 1987 the project was handed over to the counterpart organization SODEPRA (Societe pour le Developpement des Production Animales).

The large-scale biogas plants at the Cattle Fattening Station

The Cattle Fattening Station is **in** the north **of** the Ivory Coast, 20 kilometres south **of** the town **of** Ferkessedougou. Some 3000 animals are kept here all the year round **in** 29 feedlots. The animals are bought as lean stock from the Sahel Zone, and after a three-month period **of** fattening with fodder grass and agro-industrial byproducts (molasses, cottonseed) they are slaughtered **in** the project's own abbatoir and sold as high-quality meat **in** the urban areas.

In the autumn **of** 1981, OEKOTOP Ltd., Berlin, was commissioned by the Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) to plan and produce a prototype biogas plant. This installation consists **of** a non-lined earth pit with a volume **of** 400 m³ covered by an expanding rubber membrane kept leak-proof by being submerged **in** a water-filled perimeter channel. The plant has been **in** operation since spring 1982 with relatively few hitches, and produces 230 m³ **of** biogas a day. The gas generates electricity via a 15 kW generator.

The low-cost construction methods used **in** this plant have made the electricity generating costs with biogas 50 per cent lower than those for diesel-generated electricity.

On the basis **of** the positive experience gained with the prototype installation, a second, improved large-scale biogas plant with a digestion-tank volume **of** 810 m³ was built by OEKOTOP **in** the course **of** an extension project phase. The plant generates 450 m³ **Of** biogas per day, which is conveyed via a gas pipeline to the abbatoir two kilometres away. There it is used, on the one hand, **in** the burner **of** a steam sterilizer (replacing the **use of** diesel oil) and, on the other, to generate electricity via a 28 kW generating set with an electrical output **of** 32 kW. The heat from the generator motor is also used to provide the abbatoir with hot water.

At present the two large-scale biogas plants **in** operation **use** the dung **of** 700 head **of** cattle **in** 12 feedlots for the production **of** biogas. During the dry season, the fullydigested cattle dung is temporarily kept **in** storage basins before being sprayed onto the forage crop fields as semi-liquid manure from a pressurized container during the main growth period (rainy season).

The total annual biogas production is thus **in** the region **of** 240,000 m³, which has saved the purchase **of** 194,000 kWh **of** electricity from the national grid and 50,000 litres **of** diesel oil.

The profitability calculation shows that the second large-scale biogas plant alone, which was put into operation **in** autumn 1986, has improved liquidity **of** the Cattle Fattening Station by 9.9 million F CFA (64,700 DM) per year. The dynamic amortization period **of** the second large-scale biogas plant is about five years; the plant has a useful life **of** 15 years.

The construction and dissemination **of** family biogas plants

The construction **of** the large-scale biogas plant at the Cattle Fattening Station aroused interest **in** biogas plants and stimulated demand for them among local herds-men and farmers. **In** response to this, six small pilot plants were on the pattern **of** the large-scale plant initially built and tested on the premises **of** the Cattle Fattening Station for the herdsman's families working and living there.

The development **of** a dissemination programme for small-scale plants **in** the second phase **of** the project (1984-1986) was intended as a contribution towards the low-cost provision **of** energy and as a substitute for firewood **in** the project region (around Korhogo and Ferké), which has already been deforested to a large extent and where there is a great risk **of** erosion. It became apparent that, as well as the **use of** the gas for cooking, biogas lamps also play a particularly important role **in** dissemination and acceptance. Socio-cultural and socio-economic surveys carried out within the framework **of** the dissemination programme thus showed that factors that cannot be or can only with difficulty be evaluated **in** monetary terms, such as light **in** the evenings or work saved by not having to go gathering firewood, were often decisive for the decision to construct a biogas plant.

Up to now 34 family installations have been built and a further 6 are under construction. The dissemination potential **in** the project region is estimated at between 300 and 400 plants.

The type **of** installation developed and tested for dissemination has a digestion-tank volume **of** 11 m³ and a gas storage volume **of** 3 m³. The digestion tank consists **of** a pit lined with wire mesh and cement plaster covered by a sheet **of** PE foil that serves as a gas holder. All the necessary building materials, including the PE foil and the gas cooker, can be obtained on the local market. **In** future it is also intended to produce the gas lamps as part **of** the project.

If regularly charged, the family installation produces enough gas for the daily cooking needs **of** 6-8 people and for one gas lamp.

The cost **of** a family biogas installation with a digestion-tank volume **of** 11 m³ is about 126,000 F CFA (820 DM), including transport and manpower costs. If the firewood replaced by the biogas had previously had to be bought, the installation would pay for itself within three years.

To ensure the long-term dissemination **of** family biogas installations, and, also to guarantee maintenance and repair service, a three-person biogas team has been trained, consisting **of** a technician, a mason and a woman advisor who can train the women **in** cooking with biogas and provide information on the operation and maintenance **of** the lamps and stoves. From January 1987 onwards, the counterpart organization, the Société pour le Développement des Productions Animales (SODEPRA) took full responsibility for the biogas team, providing them with finance as the "Service Biogaz".

Reduction **of** the hydrogen sulphide **in** the biogas

In addition to these activities, experiments to reduce the hydrogen sulphide (H2S) **in** the biogas were carried out. The H2S content **of** biogas has an extremely corrosive effect on installation equipment and gas burners, thus shortening their lives. By introducing small amounts **of** air amounting to between 3 and 5 volume per cent into the gas space, systematic experiments showed that the H2S content **of** the biogas can be reduced by up to 95% per cent. A detailed report on the measurements and experiments carried out is available from OEKOTOP, Binger Str. 25a, D-1000 Berlin 33.

Abstract

Two biogas plants with a total annual gas production **of** about 240,000 m³ are providing the Cattle Fattening Station at Ferkessedougou, **in** the north **of** the Ivory Coast, with electric power. This can replace 194,000 kWh **of** electricity from the national grid and the purchase **of** 50,000 litres **of** diesel oil for operating the generators. The construction and operation **of** these large-scale plants aroused the interest **of** farmers **in** the surrounding area, and' **in** the meantime 34 family biogas plants have been constructed. Attempts were also made to reduce the amount **of** hydrogen sulphide contained **in** the biogas. The introduction **of** small amounts **of** air into the gas space has been shown capable **of** reducing the hydrogen sulphide content by up to 95 percent.

Resume

Deux installations au biogaz avec une production de gaz de 240.000 m³ par an alimentent en électricité le centre d'élevage bovin de Ferkessedougou au nord de la Cote-d'lvoire. On peut ainsi remplacer 194.000 kWh d'électricité du réseau public et l'achat de 50.000 I de fuel pour les générateurs. La construction et le fonctionnement de ces installations suscitèrent l'intérêt des fermiers de environs. Entretemps, 34 installations domestiques au biogaz ont été construites. Par ailleurs, on a essaye de réduire la quantité d'hydrogene sulfure contenue dans le biogaz. On a constate qu'un apport modeste d'air dans le volume de ganz permet de réduire la teneur en hydrogène sulfure de 95%.

Extracto

Dos plantas de biogas con una produccion total de 240.000 m³ de gas anuales, en cifras redondas, abastecen de energía eléctrica la estacion de engorde de ganado vacuno de Ferkessedougou, en el norte de Costa de Marfil. Esto permite suprimir el consumo de 194.000 kWh de la red publica y la combra de 50.000 litros de gasóleo pare los generadores. La construcción y la explotación de estas grandes instalaciones despertaron el interes de los agricultores vecinos y entretanto ya se hen instalado otras 34 plantas de biogas familiares. Asimismo se ha buscado una forma de reducir el contenido de sulfuro de hidrogeno en el biogas, comprobandose que con la introducción de poquerias cantidades de aire en la camera de gas es posible reducir hasta un 95 % el porcentaje de sulfuro de hidrogeno.

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