Innovations with biogas production and storage. What is thought 'normal' is changing fast.

The mainstream and 'normal' methods of biogas production generally are limited to larger industrial scale above-ground digesters and residue holding tanks, and for smaller scale systems the widespread use of below-ground brick, stone or reinforced concrete digesters. But innovative people are showing that there is also an array of other feasible options, some of which are showing the potential for a real expansion of uses and applications for biomass. It is clear that some long-accepted rules for biogas need to be abandoned, or at least reviewed to embrace these new developments.

Examples of such innovation can be found at several sites around the outskirts of Nairobi, Kenya. These include use of above-ground bladders made of sewn PVC-coated material (as used for truck load covers) performing to high efficiency as biogas digesters, and claimed to be producing up to 1 m^3 of gas/day per m^3 of volume or capacity, and demonstrating that life spans well in excess of 10 years are quite feasible, provided suitable grades of this UV radiation-proofed material are used. The normal bladder volumes for sale by this one company are 2.5 m^3 (providing enough biogas for daily cooking needs for a family of up to 8 members) or 5 m^3 (suitable for daily cooking gas supply for up to 15 members). The 'factory door' retail cost of these digesters is US$760 for the larger version or $610 for the smaller version. This price includes digester fittings and delivery piping. The price also includes a zip-up cover supported by hoops that provides some added temperature regulation for cooler sites, and good UV protection (for hotter sites another cover is needed to provide increased shade while allowing airflow). The many advantages of these systems include that the installation requires no excavation, digestion of the putrescible fraction of feedstock is almost total, and the pressure supply is quite adequate and stable.

The company (Biogas International. www.biogas.co.ke) also produces smaller-sized systems suited to lower gas needs or waste supply volume, and larger systems suited to farm sites where some extra gas volumes are wanted for electricity generation or to run machinery like grinders and feed cutters. In fact far larger systems can be made from this material and the company also makes three commercial size models.

At the same site the company was pressurizing dry biogas to about 150 bar or 2250 psi (pounds per square inch) using an Italian-made compressor designed for compressing natural gas. The compressed biogas was being trialed in special high pressure cylinders containing 50 kg of compressed gas for supply to households, and for a vehicle fuel for motor rickshaws (using a smaller 25 kg net biogas content high pressure cylinder beneath the driver seat). This use of biogas as a vehicle fuel is simply a conversion of the fully proven and accepted CNG system used in India.

At this company's research and development site, the Eco Resource center, the intention was to become completely energy self-sufficient, with biogas used not only as the only cooking fuel and for all water heating, but also for electricity, fueling a spray painting compressor, providing heat for fruit drying and brooding day-old chickens, and for any other purpose requiring energy. The initial electricity generation is by a biogas-fuelled 5 kW genset. This is said to use about 1 cubic meter of biogas an hour.

The company manager reports that they have already sold about 1500 units in Kenya and 400 in Rwanda, and that the Rwandan government is now ordering another 200 and is adopting this design as their standard. They say that to stimulate the takeup of these biogas digesters the Rwandan government is now providing a subsidy to farmers of up to 70% of the capital cost.

At the other site visited a similar level of innovation was apparent, and again this had pushed the boundaries of what is thought of as normal for biogas use. This site was a slaughter house killing about 200 cattle a day and putting all effluent into two 126 m3 digesters (this volume was no longer adequate and only 40-50% of biogas was being captured). The biogas was extracted, stored in two 100 m3 gas-tight treated fabric bags, and used to supply 70% of the fuel need for a diesel motor genset rated at 20 kW (when running about 30% of the genset fuel by energy is diesel. The company aims to convert to a genset running solely on biogas). Again the company aim was to be energy self-sufficient, and this included all electricity needs, the 80-90 C hot water supply for the slaughterhouse processing hygiene (knife washing, etc.), as well as for production of compressed bottled biogas for use in workers' hostels and for cooking gas in the surrounding community.

The initial assistance to this company had come from KIRDI (the Kenya Industrial Research and Development Institute). However much of the later development, particularly of the compression of the biogas in small LPG-type pressure cylinders, was by the innovative approach and creative drive of some of the principals of the company. The company had initially developed its biogas compression system using car wheels for storage, with the biogas able to be pressurized to up to 50 psi within the tube and tyre, and demonstrating that even this provided enough cooking gas for a family for several days.

The company was investing considerable time in training of staff and local householders in the use of biogas as a cooking fuel. The initial biogas facility was proving to be inadequate for a greater flow of highly dilute infeed, and construction of extra digester volume was being planned to lift the capture and utilization of biogas. This business was also a strong advocate of use of the residue as a soil fertiliser to help rehabilitate and reforest the Masai homelands. The company was promoting the use of the digester residue as a seed coating and reported that this gave tree seedlings the necessary nutrient for good initial growth even in quite nutrient-depleted sites.

Much of what was driving the whole innovative approach was to reduce the need for charcoal as a cooking fuel, which was seen to have resulted in an obvious over-felling of trees across the Masai rangelands. This had been as a result of the decline for the Masai of their traditional sources of income from cattle rearing as drier seasonal conditions had meant poorer grazing and less productivity from the same area. The decline of seasonal rainfall has been attributed to over-clearing of forests in the river catchments. This cutting of woodlands lower in the catchment for production of charcoal was only worsening the overall situation and meaning worse erosion, greater wind speed at ground level, faster evaporation of surface moisture from rainfall, a greater fluctuation in grass growth, and less productivity from cattle – leading to more cutting of woodlands for charcoal production – and so on. Re-establishment of woodlands is clearly a rational move, but this requires both an alternative fuel to charcoal and an alternative income source than charcoal production for the Masai cattle herders.

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