

A biomass gasification project in the rural Eastern Cape

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There is increasing interest in renewable energy technologies throughout the world, as they diminish our carbon footprint, and address concerns with the adverse environmental consequences of fossil fuel combustion. Gasification of biomass is an old concept that is regaining popularity, as wood-based feedstock is suitable for use. The South African rural poor are numerous, and they are either located too far from the electricity grid or cannot afford alternatives such as paraffin or liquefied petroleum gas. Most of these rural populations have access to renewable biomass resources that can be used to complement their energy needs. The University of Fort Hare and Eskom, the national electricity utility, have been involved in a biomass gasification pilot project at Melani village, 13 km north of the university's main campus in Alice, in the Eastern Cape province.

Gasification of biomass is the heat-conversion, in a retort, of wood, charcoal, sawdust or other available biomass into an energy-rich gaseous product that is called producer gas. Producer gas is a mixture of carbon monoxide, hydrogen, methane, carbon dioxide, nitrogen and water vapour. This producer gas has a thermal energy value of approximately 6 MJ/kg, and is suitable for heating, mechanical work, and electricity generation. An engine that runs on producer gas can either generate electricity by driving an alternator, or it can supply direct power to other mechanical equipment, such as agricultural or industrial machinery, including pumps, saws, and grain-mills. Producer gas, and the 'scrubber liquors' formed as by-products, can also be used in the manufacture of methanol, ammonia, and other chemicals.

A community survey was undertaken before the installation of the gasifier, which established that approximately 70 per cent of villagers of working age in Melani are unemployed. This has been attributed to the severe skills-shortage among them. Most households subsist on

government grants such as old-age pensions and child-support payments. A local sawmill is the main employer of people in the village, appointing staff both on a full-time as well as a part-time basis. Part-time staff are contracted for only six months of the year. The sawmill's main waste material is sawdust, cut-offs, bark, shavings and reject timber. This is usually incinerated without energy capture, as its accumulation creates a growing fire-hazard at the site.

The core objectives of the pilot project have been to implement a biomass-based renewable energy system that will generate sufficient electricity to support rural economic development initiatives, as well as supplement the energy requirements of the local sawmill. The project has also aimed at the creation of small-scale agribusinesses. Apart from providing the community with electricity, the initiative is intended to alleviate socio-environmental problems experienced in Melani village as a consequence of smoke that currently arises from burning waste sawdust from the sawmill. Smoke from poorly-controlled burning of sawdust can be dense, offensively acrid, and will contain health-hazardous materials such as tars and ash. Gasifier emissions, in contrast, are invisible, and are relatively innocuous.

The principal feedstock for our gasifier consists of the mill's excess off-cuts, sawdust and shavings. The available mass is approximately 250 tonnes per day, which could generate about 4800 kWh of electricity using our gasifier system that consumes about 150 kg of waste wood per hour running a 200-kW generator at 75% capacity.

Comprehensive process data capture has been essential for evaluation of the plant's performance, and a data acquisition system was installed for this purpose. Non-dispersive infrared (NDIR) gas sensors (for CO, CH₄ and CO₂) were fitted, and connected to a computer-interfaced data logger. A gas-sampling pump was connected between the retort and the gas inlet side of the NDIR. Each gas sensor is protected by a particulate filter, located upstream, to trap aerosols and particulates before they enter and contaminate the gas cells.

Ten previously unemployed people have been contracted and trained as gasifier operators. The draft business plan indicates that employee numbers could be doubled through establishment of small business enterprises. Those activities identified in the business plan will need new skills, requiring funding for skills-development. The electricity generated from the producer gas will be available to a bakery and a grain mill, and business plans for these two enterprises have been completed. Their funding will be provided by the Eskom Development Foundation, and we expect that this project will make various indirect contributions to the local community's economic uplift. In time, it may even be possible to sell surplus electricity to the Eskom grid. □



Fig. 1. The experimental gasifier installation at Melani village. The tall tower on the left is the reactor where gasification takes place, the low circular tank on the right is a sawdust filter, and the vertical tower in the centre of the picture is a gas scrubber.

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