Mid-term energy solution possible

The CSIR has identified a suite of four South African coals that could alleviate the growing energy demand on a mid-term basis. Through an integrated gasification combined cycle these coals could be used for fuelling power stations and operate for three or four decades - towards the middle of this century – to alleviate harmful greenhouse effects.

These selected coals are currently used as fuel for the Lethabo (New Vaal coal), Matla, Matimba (Grootegeluk coal) and Duvha power stations and are typical of South African power station feed coal.

The electricity demand in South Africa is increasing at a rate of 1 000 MW per year. While there is increasing pressure to adopt non-fossil fuel electricity-generating technologies, the abundant reserves and low cost of coal makes it the preferred energy source to meet increasing demands for the foreseeable future. It is also foreseen that coal generation is likely to provide for 80-90% of this demand.

The challenge in the future is to enhance both the efficiency and environmental acceptability of coal use by adopting clean coal technologies (CCTs). CCTs are defined as "technologies designed to enhance both the efficiency and the environmental acceptability of coal extraction, preparation and use".

In a research study into the gasification characteristics of South African power station coals, the energy and processes research group of the CSIR has identified integrated gasification combined cycle (IGCC) as a potential CCT that could be applied in South Africa to initially achieve low CO_2 emission and ultimately get near-zero emissions of greenhouse gases, which are likely to be a requirement for electricity producers towards the middle of the 21st century.

IGCC also holds the advantage of reduced water consumption and the potential for co-production of liquid and gaseous fuels and chemicals.

Fine coal gasification is a key enabling technology for the implementation of IGCC plants. Fluidised-bed gasification is being evaluated by the CSIR as a potential fine coal gasification process for incorporation into future IGCC plants.

An equilibrium model has been developed by the CSIR that is based on mass balances, energy balances, water gas shift equilibrium and hydro-gasification equilibrium. A method was developed to predict the fixed carbon conversion in the gasifier based on the vitrinite random reflectance. This method was selected since the pilot plant results show a good correlation between vitrinite random reflectance and fixed carbon conversion.

The study found that fluidised-bed gasifiers can utilise fine, high ash-content South African coals and therefore are a potential candidate technology for IGCC power stations.

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