

Gasification in South Africa

Task 33 AIE Bioenergy meeting
Tshiamo Segakweng
CSIR

20/10/2023 08:30 Online

Outline



- Overview of Gasification
- Advantages of Gasification
- Status of Gasification in South Africa
- Challenges and Limitations
- Challenges to Implementation of Gasification Technology in South Africa
- Overcoming Challenges
- Future of Gasification in South Africa
- Comparison with Other Countries
- Gasification pilot plant at CSIR
- Conclusion

Status of Gasification in South Africa

- South Africa has been investing in gasification technology to reduce its reliance on coal and increase its use of natural gas.
- However, the country still relies heavily on coal for electricity generation and has a long way to go in terms of transitioning to a more sustainable energy mix.
- 2x SASOL coal gasifiers
- ESKOM Majuba Underground gasification project
- 1 experimental biomass gasification plant at Melani Village
- CSIR gasifier pilot plant

Current projects



Plants	Location	Technology	Gasifiers	MWth Syngs	Start year	Feedstock /Products
Sasol Synfuels West	South Africa	Lurgi FBDB	40 + 0	7048	1977	Subbit. coal / FT liquids
Sasol Synfuels East	South Africa	Lurgi FBDB	40 + 0	7048	1982	Subbit. coal / FT liquids
MAJUBA UCG	South Africa	UCG	UCG	18	2007	Subbit. coal / FT liquids
Melani village	South Africa	SJBG	1	-	2009	Biomass/ syngas

Challenges and Limitations



- Despite its advantages, gasification also presents some challenges and limitations. One of the main challenges is the high capital cost of gasification plants. Additionally, gasification requires a consistent and reliable feedstock supply, which may be difficult to obtain in some regions. The gasification process also produces tar and other impurities, which can cause operational issues and require additional processing steps.
- Environmental Concerns
- Feedstock Availability
 - The availability and quality of feedstock can be a challenge for gasification projects. In South Africa, the limited availability of suitable feedstock has hindered the growth of the industry.

Challenges to Implementation of Gasification Technology in South Africa



- High capital costs pose a significant hurdle.
- Limited infrastructure hampers implementation.
- Regulatory barriers add complexity to the adoption process.
- Environmental concerns, specifically regarding air pollution and waste management, exist.
- A reduction in coal energy R&D resulted in gasifier investment dropping

Overcoming Challenges



- Collaboration among the government, industry stakeholders, and local communities is essential.
- A comprehensive and sustainable approach to gasification technology is needed to address these challenges successfully.



Future of Gasification in South Africa



- Potential for Gasification Technology in South Africa:
 - Gasification technology can transform the energy and chemical sectors in South Africa.
 - The government aims to generate 18% of the country's energy from renewable sources by 2030.
 - Gasification can help achieve this goal and reduce reliance on fossil fuels.
 - It can utilize South Africa's extensive coal reserves for producing electricity, hydrogen, and liquid fuels.
 - Gasification can reduce the country's carbon footprint, create jobs, and stimulate economic growth.
 - Gasification can assist in reducing waste



Planned projects



- **THEUNISSEN UNDERGROUND COAL GASIFICATION PROJECT, SOUTH AFRICA**
 - Involving the gasification of approximately 5 million tons of coal across an area of 150 hectares and over the course of 20 years, the Theunissen UCG project, is expected to provide 50 MW of baseload electricity to the national grid upon commencement of operations. Located in South Africa's Free State province, the project is being developed by technology company, African Carbon Energy through its principal subsidiary, Africary Holdings, targeting a coal resource of approximately 1 billion tons.
- **STERKFORTEIN COAL PROJECT, SOUTH AFRICA**
 - Strategically situated in an area with indicated coal resources totaling 90.93 million tons, close to a high-tension powerline connecting the Tutuka power station in the Mpumalanga Province to South Africa's national grid, the Sterkfontein Coal Project is a proposed coal mine located 143km south-east of Johannesburg that will target prospects from the Highveld Coalfield. Five coal seams drilled at the coalfield indicated the financial viability of the prospect, with UCG being considered to deliver syngas as a feedstock to the power station, while also serving to increase the coal resources.

Comparison with Other Countries



- Other countries, such as China and India, have made significant progress in transitioning to natural gas and other renewable energy sources. However, South Africa still has a long way to go in terms of reducing its carbon footprint and transitioning to a more sustainable energy mix.
- South Africa has made significant progress in transitioning to natural gas and other renewable energy sources, but it still lags behind other countries like China and India in terms of adoption and implementation.

Gasification plant at CSIR



- The pilot fluidized bed combustor/gasifier in Building 23.
- It can operate in gasification mode to produce synthesis gas (H_2 , CO) or in combustion mode.
- Technical specifications are detailed in Table 1.
- Figure 1 provides an image of the test rig.
- Schematics of the gasifier and combustor configurations are shown in Figure 2 and Figure 3.
- Currently undergoing refurbishment for gasification of biomass and waste in corporation with an external client
- Skills transfer

Specifications of fluidised bed combustor/gasifier



Operating pressure	0 barg
Bed dimensions	0.2m × 0.2m (square)
Freeboard dimensions	0.4m × 0.4m (square)
Furnace height	4m (2 m bed & 2 m)
Fluidised bed height	< 1.3m
Coal feed rate	15–35 kg/h
Thermal rating	140 kW
Coal particle size (d_{50})	1.0–6.0 mm
Coal CV	10–25 MJ/kg
Air flowrate	15–30 Nm ³ /h
Oxygen flowrate	4–10 kg/h
Steam flowrate	10–25 kg/h
Bed temperature	850–1 000 °C
Air, oxygen and steam temperature	200–300 °C
Fluidising velocity	1.2–2.5 m/s

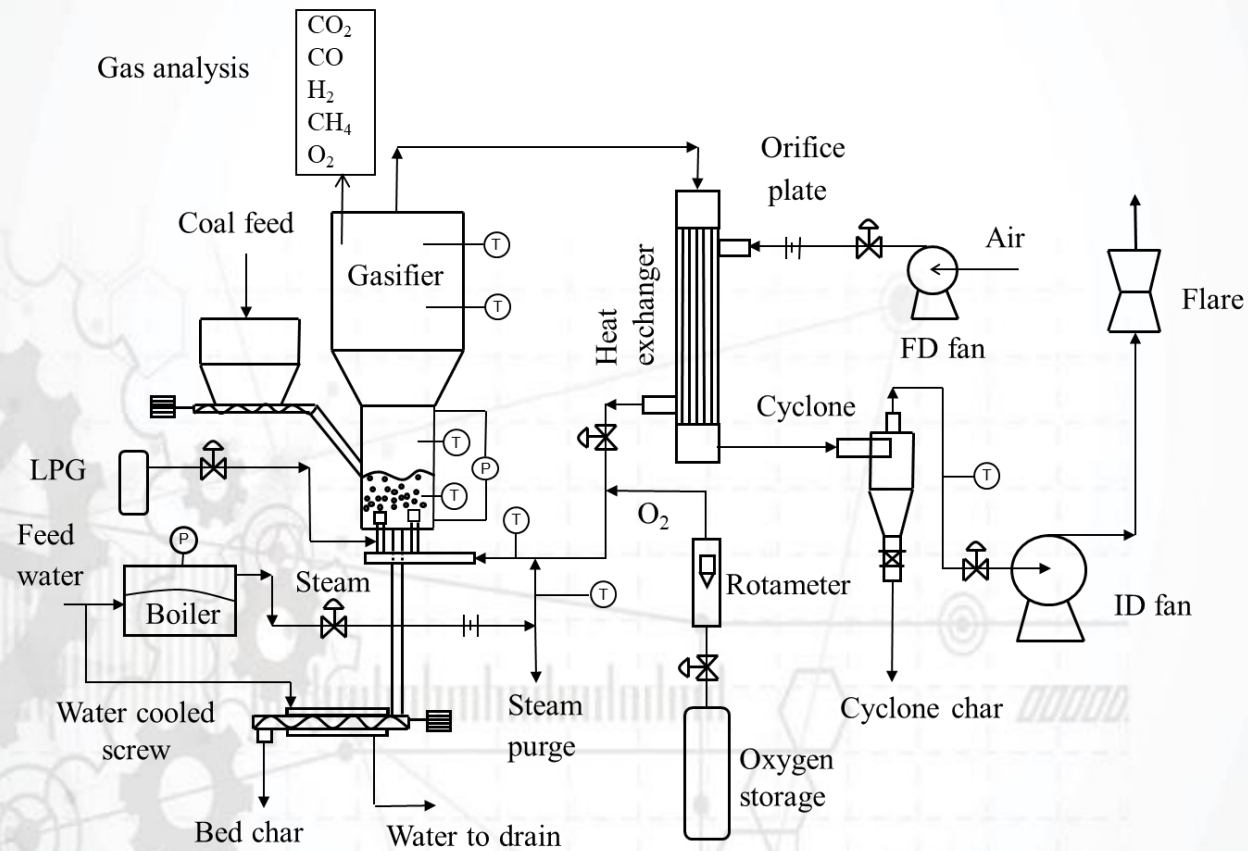
Fluidised bed combustor/gasifier

75
YEAR
ANNIVERSARY

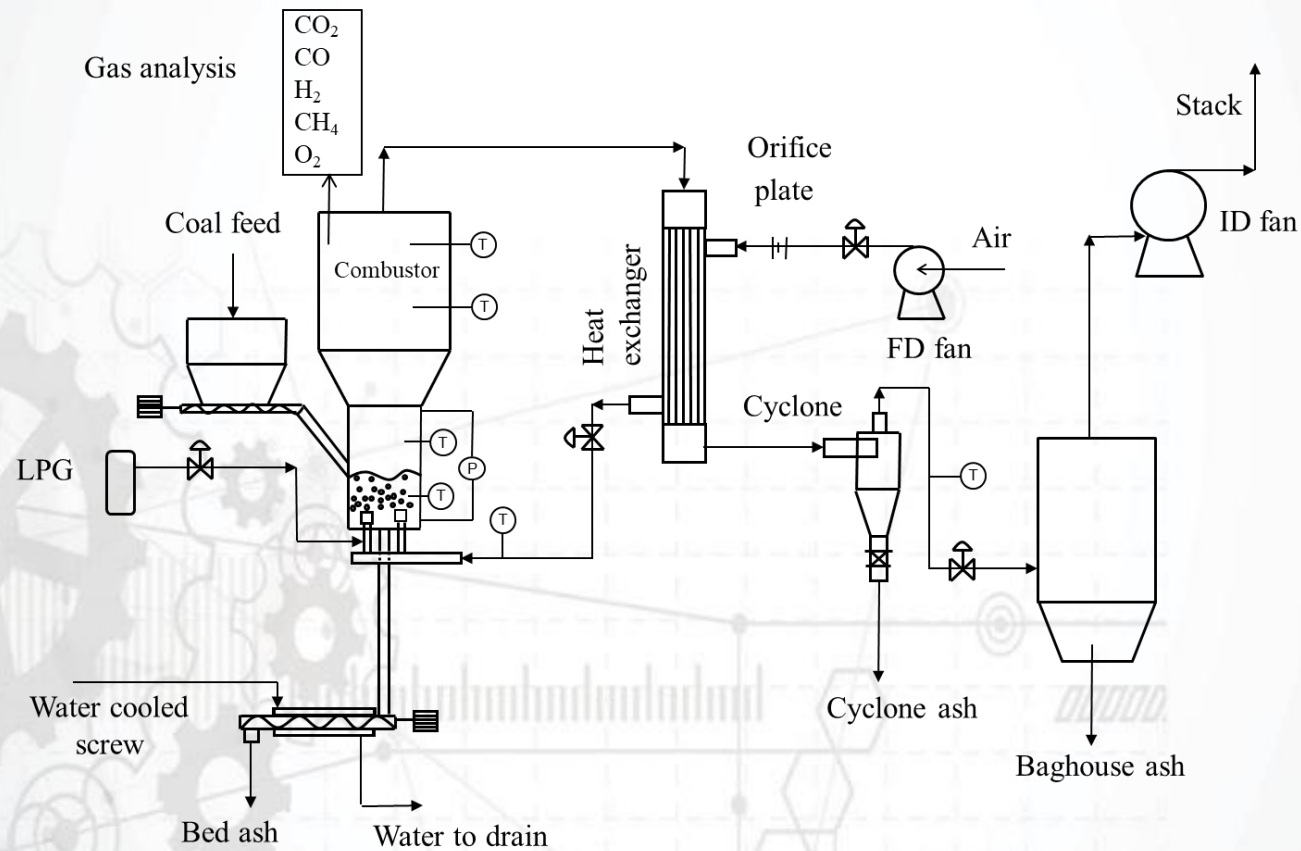


N
r.

Schematic of fluidised bed in gasifier configuration



Schematic of fluidised bed in combustor configuration



Concluding Points



- Gasification is a promising technology for converting waste into valuable products, like energy and chemicals.
- South Africa has made significant progress, particularly in the coal-to-liquids sector.
- Challenges, including high capital costs and infrastructure limitations, remain to be addressed.
- Despite these challenges, gasification holds potential to enhance energy security and reduce emissions.
- Ongoing research and development could solidify gasification as a key technology for sustainable waste management and energy production in South Africa.



END