

Coal Gasification for a Self-Reliant India

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Abstract

Syngas, a combination of hydrogen and carbon monoxide can be produced from natural gas and other sources including by gasification of coal, which is more preferable due to low-cost large quantities of coal available in India. Utilisation of coal's chemical characteristics is facilitated by gasification. Synthetic natural gas (SNG), energy fuels (methanol and ethanol), ammonia for fertilisers, and petrochemicals can all be made from syngas produced from coal gasification. This way coal is put to better productive use thereby minimising the problem of pollution.

Introduction

Dependence on imports for crude oil (~85%) and natural gas (~45%) exposes India to supply insecurity and price volatility to meet its energy demand. India has rich reserves of coal which can be capitalized to insulate itself from global volatility. However, this needs to be done in a sustainable way as the entire world including India is gradually transitioning away from coal towards cleaner fuels. The one country that has been able to transition from natural gas to coal for much of its economic activities (ammonia/urea, methanol and ethylene glycol, etc.) is China. With its large-scale coal gasification projects, China has been able to insulate itself from global disruptions in the oil and gas supply chain.

Gasification is the partial oxidation (not complete combustion) of a carbonaceous material (such as coal) in an oxygen-lean environment producing Syngas (Hydrogen, H_2 + Carbon Monoxide, CO). In complete combustion, the entire energy of the carbonaceous material would have been released as heat energy thereby also generating carbon dioxide. However, in

gasification, the energy is converted into CO which is a very crucial chemicals intermediate as well as a fuel source. The CO can be used for making hydrogen thereby also generating carbon dioxide. However, this generated carbon dioxide can be separated and captured in cheaper way and utilized for other industrial purposes.

CO is an intermediate for many bulk chemicals which in turn are used for making numerous downstream products. As India is currently dependent on imported natural gas, syngas manufacturing in India is not globally competitive. Hence, a large number of these bulk chemicals is required to be imported into India.

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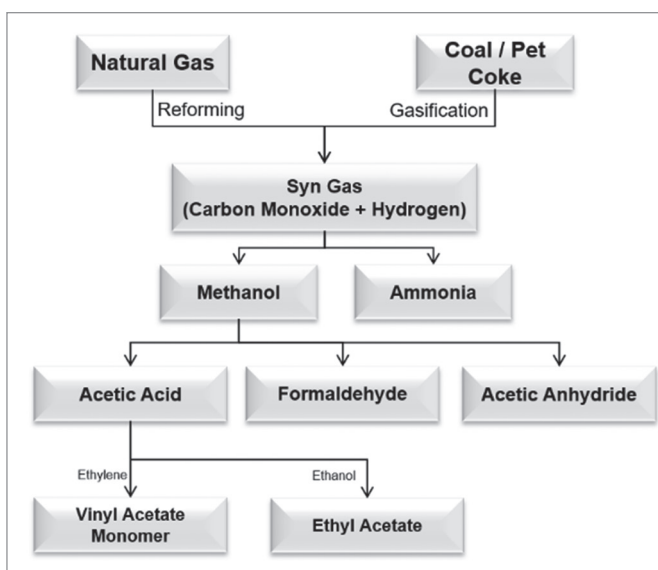


Fig 1. Syngas Downstream Major Chemicals

Hence, Coal Gasification technology can provide India a leverage in manufacturing competitive syngas, which in turn will make India competitive in many C1 chemicals (methanol and downstream) and ammonia.

Challenges

Looking at this opportunity, the government of India has taken an initiative for utilizing coal through coal gasification and achieve 100 million tons of coal gasification by year 2030. However, the journey for this milestone has a major challenge due to the quality of domestic coal.

Domestically available coal is mostly of low grade with high ash content, which varies from 35 to 45 per cent. Coal in other parts of the world have a much lower ash content of around 15 per cent. Most existing global technologies for coal gasification are proven for ash content below 30%.

Currently, there are two gasification plants running in India. Jindal Steel and Power Ltd. (JSPL) had set up India's first coal gasification-based direct reduced iron (DRI) and steel production plant at Angul, Odisha and is based on Lurgi's Fixed Bed Dry Bottom (FBDB) technology and can operate with ash content up to 35%. Reliance Industries has setup a Petcoke gasification in 2019 using Entrained Flow technology. This technology is best suited for coal with <25% ash content which Reliance is able to easily source from its inhouse coker plant in the refinery at Jamnagar, Gujarat.

Indigenous Developments

Significant R&D work has been in progress to develop coal based gasification plants suitable for domestic coal (>35% ash content) in India:

Bharat Heavy Electricals Limited (BHEL) has developed an indigenous technology based on the fluidized bed gasification technology which is suitable for high ash Indian coals. The 0.25 tpd capacity pilot plant, indigenously designed, developed and installed by BHEL, is currently producing methanol with purity of more than 99% from high ash Indian coals. This conversion of high ash Indian coals to methanol through the coal gasification route, is the first of its kind technology demonstration in India. Scaling it up to will accelerate India's journey towards self-reliance in major bulk chemicals.

IOCL has patented a gasification technology based on which a pilot plant has been set up for co-gasification of coal, pet-coke and bio-mass. It has also signed an agreement with L&T for production of gasifiers based on its patented "Integrated Gasification" concept.

Coal Gasification Projects

Given India's energy security and opportunity for capitalization of indigenous resources, there are several coal to gasification plants under implementation:

Talcher Fertilizer, Orissa: Currently implementing a 2.5 million tons coal gasification unit along with ammonia and urea plants with an estimated investment of INR 13,000 crore. It is expected to get commissioned by Sep'24.

Dankuni Coal Complex, West Bengal: Currently implementing a 2.3 million tons coal gasification unit along with Methanol plants with an estimated investment of INR 5,800 cr. It is expected to get commissioned by Jan'25.

Western Coalfields Limited (WCL) has floated a notice inviting tenders for private partnership in a project to make ammonium nitrate via coal gasification in Chandrapur, Maharashtra.

Central Coalfields Limited (CCL) has identified a suitable plot in Ranchi, Jharkhand to produce ammonium nitrate via coal gasification route.

Government Support

The government is encouraging development of coal gasification projects in India, wherein provision has been made for 50% rebate in revenue share for all future commercial coal block auctions for the coal used in gasification purpose provided the coal quantity used for gasification is at least 10% of total coal production. Further, a separate auction window under Non-Regulated Sector (NRS) sector has been created for making coal available for new coal gasification plants.

Given the need to capitalize indigenous resources for energy security, it is crucial for the government to promote coal gasification projects. These projects require huge capex and have large impact on India's economy. Thus, coal gasification should get the recognition of "New Business Opportunity" as well as of "Infrastructure sector". The government should ensure uninterrupted supply of uniform composition coal. There is a need for a policy framework for coal allocation in same line as power sector along with long term linkages.

These government policy frameworks along with commercialization of low-grade coal gasification technologies is crucial to achieve government's target of 100 million tons coal gasification by year 2030.

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