Coal Gasification

Cleanly converting coal, petroleum coke and biomass into high-value products and power

Air Products Syngas Solutions™ formerly:
- Shell Coal Gasification Process (SCGP)
- GE Energy's gasification technology

Air Products Gasification Process (GP) at a glance

Customer driver

Access to coal, petcoke or biomass; lack of access to oil and gas along with high or volatile prices; sustainable operations (emissions)

Solution

The Air Products Gasification Process, which can convert a wide range of coals, including petcoke and biomass, into syngas

Value delivered

High-value products or power with low emissions

Proof point

Dozens of gasifiers in operation and several more due to start up in the near future

What differentiates us?

- Air Products Syngas Solutions offers a Technology license, equipment and engineering, and engineering service as well as a "Sale of Gas" model where Air Products builds, owns and operates the syngas production facility.
- Our coal gasification experience dates back to the early 1970s; more than 200 Air Products gasification reactors have been developed or are in the planning stage for both the dry-feed and slurry-feed designs.
- We continuously improve our technologies through research and development and by incorporating lessons learned into our master designs.
- Air Products gasification units successfully process a wide range of solid fuels including various types of coal (from lignite to anthracite), petroleum coke (petcoke) and biomass blends.
- Our designs offer performance advantages by helping to minimize oxygen and freshwater consumption and enhance syngas yield.
- Because Air Products is both a gasification technology owner and an operator, we have extensive experience in gasifier start-up, operation and maintenance.

The world's growing appetite for energy and chemicals is increasing the demand for clean coal, particularly in countries with indigenous reserves or access to low cost imports. However, depletion of the highest quality deposits and increasingly restrictive emission regulations require operators to use lower quality coal in environmentally acceptable ways.

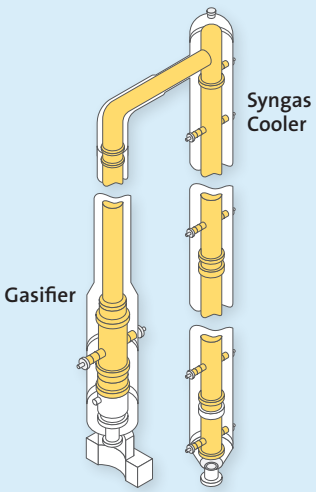
We offer the Air Products Gasification Process (GP) in four product configurations (shown below) that can convert a wide range of coal types to synthesis gas (syngas) for:

- Integrated gasification combined cycle (IGCC) power generation with optional carbon dioxide capture
- High-value chemical production
- Synthetic hydrocarbon (fuels) production
- Hydrogen production

Air Products Syngas Solutions provides operational support and business and project-execution services from design and engineering to commissioning and start-up. We can also help with master planning and training.

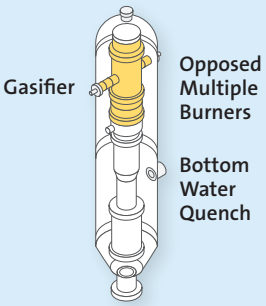
The right process for the right project

Dry-feed systems use an inert carrier gas to transport dry, pulverized coal into a multi-injector, water-walled gasifier. Our slurry-feed systems generate a high-pressure, coal-water slurry to convey the coal to a single injector, refractory lined gasifier, where oxygen is injected with the slurry stream to produce raw syngas. The raw syngas can be cooled using either a quench design, which rapidly cools the syngas, or a radiant syngas cooler design to generate high-quality steam from the high-temperature syngas. A full assortment of gasification technologies and knowledge of downstream syngas processing is our advantage. Let Air Products guide you to choose what is right for your project.



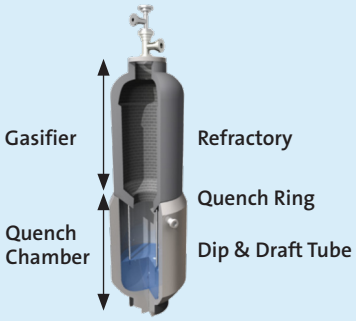
Air Products GP Dry-Feed Syngas Cooled

This dry-feed gasifier has a convective syngas cooler that offers heat recovery through steam generation.



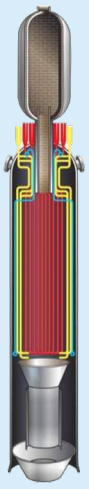
Air Products GP Dry-Feed Bottom Quench

This dry-feed gasifier offers a robust quench design and part of the MP steam.



Air Products GP Slurry-Feed Bottom Quench

This slurry-feed gasifier offers a robust quench design.



Air Products GP Slurry-Feed Syngas Cooled

This slurry-feed gasifier has a radiant syngas cooler that offers heat recovery through steam generation.

Performance advantages

Our options offer:

- Low coal and oxygen consumption, typically 510–615 kg coal and 310–350 Nm^3 oxygen per 1,000 Nm^3 of effective syngas respectively.
- High throughput and availability, and low maintenance costs by using proven features of technologies such as reactor membrane wall, burner technology, refractory-lined gasifier with quench, and radiant syngas cooler design configuration.

The Air Products Gasification Process syngas cooler line-up:

Has a higher thermal efficiency; produces less wastewater; and generates high- and medium-pressure steam, which can help to reduce operating costs.

Air Products gasification with heat recovery through syngas cooler design offers higher thermal efficiency and generates high- to medium-pressure steam. Plants with higher operating costs can bank on these design configurations for optimum plant economics.

Our bottom water-quench line-up:

Requires up to 30-50% less capital expenditure and offers more stable operation through its simplified configuration—and widens coal suitability.

Air Products Quench gasification design offers lowest capital cost up to 30-50% while offering wide feed and capacity operating range. Its potential local fabrication and simple design enable quicker plant construction and start-up duration.

Case Studies

Converting coal to chemicals

Air Products GP syngas cooler technology has successfully supplied syngas and steam to a Baling fertilizer plant since 2006. Feeding 2,000 tons of dry pulverized coal per day produces syngas for urea/fertilizer and caprolactam (nylon) manufacture.

An Air Products high-pressure gasification system has been in successful operation since 2015, and the 2,000 ton (coal) slurry-feed gasifier pressure is 87 bar resulting in significant operating cost and energy saving for downstream chemical process.

An Air Products slurry-feed gasification system has been running on 100% petcoke since 2000, producing ammonia-based fertilizers with all syngas CO_2 recovered and sent to a CO_2 pipeline for enhanced oil recovery. Syngas availability in this plant has been as high as 99.7% on an annual basis and averages over 98 % for the life of the plant

Since 2016, Air Products has operated high-capacity methanol plants fueled by 15,000 tons of coal per day.

Generating IGCC power

The first coal-based IGCC operated in 1980. Across multiple plants we have demonstrated feedstock flexibility, processing more than 20 different coal types and blends running successfully with up to 30 wt% biomass for dry feed. In slurry-feed systems, more than 40 coal and petcoke blends with up to 100% petcoke have been run in commercial operation. Both systems had emissions less than 30 ppm NOx and 15 ppm SOx.

The United States' largest coal-based IGCC produces 600 MW (net) using a slurry-feed syngas cooler technology and has been in commercial operation since 2012 on high chloride Indiana subbituminous coal.

South Korea's first IGCC plant is now in operation. This facility uses a dry-feed syngas cooler to produce 300 MW (net) of electric power from 2,670 tons per day of bituminous and sub-bituminous coal.

Value

Our coal gasification technology can be tailored to meet different needs, including:

- Providing an alternative feedstock for chemical manufacture
- Producing synthetic liquid fuels and lubricants
- Generating power with lower emissions than from burning coal or even natural gas, with the option of high-pressure carbon capture and storage.

Both dry- and slurry-feed technologies compliment their various key features in offering an optimum solution for a specific type of feed and downstream applications while considering customer economical and operational objectives.

The multiple-burner designs can be easily scaled up, and high reliability reduces or eliminates the need for a spare gasifier. This enables construction of fewer, larger units, which helps reduce capital and operational costs by requiring fewer operators, less maintenance, and a smaller spare parts inventory. Units with a dry coal intake capacity of 3,200 tons per day have already been put into operation.

More than 100 types of coal have been processed. Using a blend of coal and petcoke greatly increases gasifier reliability and can significantly improve operational stability, efficiency and syngas output, particularly for operators using high-ash coal.

Have you considered how you can . . .

- Produce chemicals and hydrocarbon liquids without relying on oil and gas imports?
- Generate power with lower emission levels?
- Adapt to lower-quality coal?
- Reduce risk and save capital by allowing Air Products to finance/run the gasification complex?

For more information, please contact us at:

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