

Great Plains Synfuels Plant



Basin Electric, through its for-profit subsidiary, Dakota Gasification Company, owns and operates the Great Plains Synfuels Plant. Located five miles northwest of Beulah, ND, the Synfuels Plant has been owned and operated by Dakota Gas since 1988.

This \$2.1-billion plant began operating in 1984. Using Lurgi gasifiers, the Synfuels Plant gasifies lignite coal to produce valuable gases and liquids. The average daily production is about 160 million cubic feet of natural gas, the majority of which is piped to Ventura, IA, for distribution in the eastern United States.

Dakota Gas captures and sells CO₂ produced at the plant to two customers and transports it through a 205-mile pipeline to Saskatchewan, Canada, to be used for enhanced oil recovery (EOR) in the Weyburn and Midale fields.

The first CO₂ was sent to Canada in October 2000. Today, Dakota Gas exports about 152 million cubic feet per day of CO₂ to Canada – about 50 percent of the CO₂ produced when running at full rates. As of Dec. 31, 2008, Dakota Gas has successfully captured more than 16 million tons of CO₂ for delivery.

The Synfuels Plant is unique

It is the only commercial-scale coal gasification plant in the United States that manufactures natural gas.

It supplies carbon dioxide to the world's largest carbon capture and storage project in the world in Saskatchewan. About 3 million tons of CO₂ from the Synfuels Plant are sequestered annually.

This process results in a CO₂ stream that is very dry and about 96 percent pure, so it requires no further processing. This is in contrast to CO₂ from power plants, which is very wet and diluted with nitrogen and oxygen, and would require further processing.

The Synfuels Plant has been the focus of worldwide attention and has been visited by groups from Germany, China, Italy, Korea, England and Japan; by national media like 60 Minutes, The History Channel, Modern Marvels, Fox News; and international media from London, Tokyo and Montreal.

It is the cleanest energy plant operating in the state of North Dakota, according to a comparison of emissions data available from the North Dakota Department of Health.

Dakota Gas shares natural gas sales revenue with the U.S. Department of Energy through an agreement established in 1988 when Dakota Gas purchased the plant from the DOE.

When Basin Electric purchased the plant, it committed not only to share revenue with DOE, but also to not take advantage of production tax credits for producing

synthetic fuels that were available at the time. The tax credits expired in 2002 with a value of about \$753 million.

The total amount paid to DOE – as part of the revenue-sharing agreements – is \$379.8 million. Combined with the unused tax credits, the government has recovered more than \$1 billion of its losses.

Besides the revenue sharing, close to \$400 million has been invested in the plant since 1988 to achieve environmental compliance, improve efficiency, and invest in new co-product development.

How it works

Gasifying coal involves dismantling its molecular structure with heat and pressure and reassembling the resulting hydrogen and carbon as methane gas (methanation), which is sent to a pipeline.

The heart of the Synfuels Plant is its 14 gasifiers. These gasifiers are cylindrical pressure vessels, 40 feet high with an inside diameter of 13 feet.

Each day 18,000 tons of lignite coal is fed into the top of the gasifiers. Steam and oxygen are injected into the bottom of the coal beds causing intense combustion at 2,200 degrees F.

The hot gases break down the molecular bonds of coal and steam, releasing compounds of carbon, hydrogen, sulfur, nitrogen and other substances to form a raw gas that exits the gasifiers.

The raw gas is cooled. Tar, oils, phenols, ammonia and water byproducts are condensed from the gas stream, purified, and sent on. The gas moves to a cleaning area where further impurities are removed.

The Rectisol unit washes the stream with cold methanol, separating carbon dioxide.

Methanation occurs when the cleaned gas passes over a nickel catalyst causing carbon monoxide and remaining carbon dioxide to react with free hydrogen to form methane.

The gas is then cooled, dried and compressed. It enters the pipeline with a heating value of 975 Btu per cubic foot.

Co-products of the gasification process

Ammonium sulfate is an agricultural fertilizer marketed under the name Dak Sul 45®. Approximately 100,000 tons are produced yearly by a flue gas desulfurization system.

Anhydrous ammonia is used as fertilizer for farming and as a feedstock for producing various chemicals. Dakota Gasification Company has the ability to produce about 400,000 tons per year and operates a railcar fleet of about 238 cars.

Carbon dioxide is used for enhanced oil recovery. About 152 million cubic feet are sent to Canada daily.

Dephenolized cresylic acid is used in the manufacture of pesticides and products such as wire enamel solvent, phenolic and epoxy resins, and antioxidants. About 33 million pounds are produced annually.

Krypton and xenon gases are used for specialty lighting, such as high-intensity lighting and lasers, and for thermopane window insulation. About 3.5 million liters of krypton-xenon are produced annually.

Liquid nitrogen is used for food processing refrigeration, as an oil well additive, and in chemical processes. About 200,000 gallons of liquid nitrogen are produced each year.

Naphtha contains products that can be used as a gasoline blend stock, in making solvents, and in benzene production. About 7 million gallons are produced annually.

Phenol is used for the production of resins in plywood manufacturing and in the casting industry. About 33 million pounds of phenol are produced annually.

Neon is the latest co-product to begin development. Production is anticipated to begin in 2010. Its common uses include manufacture of semi-conductors, lighting, environmental and medical applications, ion propulsion, window insulation and plasma display panels.