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Synthetic Chemicals in South Africa

Much has been written about various methods of obtaining synthetic fuels. But the South African efforts, although mentioned, have not received as much attention as they merit. The Sasol (South African Coal, Oil and Gas Corporation) installation is the largest synfuel plant based on coal operating anywhere. It converts an inferior high-ash (35 percent) coal into a broad spectrum of products. These may include ethylene, propylene, butylene, gasoline, and long straight-chain alcohols and hydrocarbons. The Sasol plant has been operating for about 24 years. During that time efficiency has increased and much has been learned about control of products. Sasol is a profitable operation while selling gasoline at the refinery gate for about 50¢ a gallon (14¢ a liter).

South Africa has substantial deposits of coal but no oil, and it obtains 75 percent of its energy from coal. The plant at Sasolburg is located on a huge coal field. Sasol I, the existing synthetics plant, is part of a versatile chemical complex that supplies much of South Africa's needs for materials such as nitrogen fertilizers, plastics, and pipeline gas. Consumption of coal at Sasol is 5 million tons a year. Coal is gasified in Lurgi reactors with steam and oxygen at total pressures of about 20 atmospheres. Principal products are H_2, CO, CO_2, and CH_4. The key components are H_2 and CO. Their ratio can be adjusted by varying the amounts of H_2O and O_2 used in the gasification. Constituents present in addition to the major gaseous products include NH_3, H_2S, and other sulfur-containing substances. To purify the raw products the gas is cooled, condensing out water and phenolic-type substances, and the remaining gas is passed through three absorption trains employing very cold methanol. This removes essentially everything except H_2, CO, and CH_4. Sulfur abundance in the purified gas is less than 1×10^{-8}. This guarantees relative freedom from sulfide poisoning of catalysts and a low sulfur content in the final products. Reactions between H_2 and CO can give rise to an enormous number of products. The outcome depends on the initial concentration of H_2 and CO, pressure, temperature, and catalysts employed. The South Africans have made substantial discoveries about formulations and performances of catalysts. However, ultimates in specificity have probably not been reached.

When the plant was first operated in 1955, very great problems were encountered. All segments of the plant had been tested successfully on a pilot scale. But the full-scale synthetic part did not function as expected, and 5 years of discouraging struggles followed. Today, the plant performs well above its design capability.

In October 1973, when the international price of oil was raised, South Africa began intensified efforts to cut its dependence on imports. A large-scale synthetics plant, Sasol II, designed principally to produce gasoline, was authorized. This will be coming on-stream in 1980. When the Shah of Iran was deposed, oil from that country was no longer directly available. South Africa was forced to go to the spot market and pay high prices. Very quickly an additional major synthetics plant was authorized. The two installations, which are designed for zero emission of liquid wastes, will produce more than 100,000 barrels of hydrocarbon liquids a day and will supply more than half South Africa's consumption. Both installations will probably be in full production by 1984. Construction costs will total about $7 billion. Considering South Africa's gross national product and energy consumption, its effort is comparable to a $300-billion crash program for the United States.

The South African synthetic fuels program is well designed to fit their particular needs. Our needs and opportunities differ. We have heavy oils, tar sands, and oil shale. A number of schemes for direct hydrogenation of coal are being developed. Efforts to use bioenergy are being expanded. However, if we wish to obtain synthetic liquids quickly, on schedule, and at predictable costs, we might do well to look closely at the extensive South African experience.—PHILIP H. ABELSON