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Clean Fuels from Coal

Coal seems destined to become a major source of energy and chemicals. But present technology for its use is primitive. Direct combustion of coal results in the formation of oxides of sulfur and nitrogen. These gases have been linked to acid rain, which has become an increasing source of concern. Flue gas desulfurization is being practiced in new power plants and removes as much as 90 percent of their sulfur oxides, but this is accomplished at the cost of reliable operation of power plants and the production of enormous amounts of calcium sulfate sludge.

Improved technology for utilization of coal is on its way. Of special significance are developments in gasification. By this means one can quantitatively remove in the form of hydrogen sulfide and ammonia the sulfur and nitrogen that were originally present in the solid. When the gasification is accomplished at a high temperature with oxygen and water, the coal is completely destroyed and synthesis gas (carbon monoxide plus hydrogen) is formed. This gas can be burned as a fuel, processed to yield methane, or used as a feedstock for synthesis of many chemicals.

A number of processes have been devised for gasification. These include the Lurgi, the Koppers-Totzek, and the Texaco processes. It seems likely that the Texaco process will become widely applied. Its principal feedstock is a coal slurry, and coal slurry transportation will have a large future role. The process is flexible in its utilization of a wide variety of coals. The gasifier operates at temperatures of 1250° to 1500°C and pressures of 350 to 1200 pounds per square inch. Under these conditions the organic matter in the coal is completely gasified. There are no tarry residues. The Texaco process is highly suitable for integration with combined cycle electric power generation. This application is now about to be tested in a \$300 million installation being built in southern California.

An article in a forthcoming issue of *Science* describes the overall system.* It is designed to convert efficiently the thermal and chemical energy of the hot gases into electricity. In order to remove particulate matter and H₂S and NH₃ from the gas, it must be cooled. This will be done by using heat exchangers, from which hot water and steam will be obtained. The steam will drive a turbine. Once the gas has been cleaned it will be burned in a gas turbine. Heat from the hot combustion gas will also be used to make steam.

The demonstration plant is designed to use 1000 tons of coal a day and to produce 100 megawatts of power. It is scheduled to become operational in 1984. Many tests will be conducted on it. Different coals will be burned. Its performance as one of the components of a generating system will be studied. Of particular interest will be the response of the plant to sudden changes in electrical demand. One of the hoped for advantages of this type of plant is that it will be cost-efficient on the scale of 100 to 300 megawatts. It is further believed that such plants could be constructed more rapidly than the 500- to 1000-megawatt installations currently being built. This would give the utility companies much more flexibility in matching capacity to unpredictable demand.

The demonstration plant is being constructed under the sponsorship of the Electric Power Research Institute, Southern California Edison, General Electric, Bechtel, and Texaco. No federal funds are involved. Siting of the plant in California makes good sense. As much as 79 percent of electricity generated by Southern California Edison is derived from oil or natural gas. The plant will easily meet the rigorous state standards for air pollution.

Sponsors of the demonstration plant merit congratulations for their initiative and risk-taking. It is likely that they will be rewarded. This new venture shows great promise, and its success would solve many of the problems of the utilities while giving them an opportunity to have a role in the synthetic chemicals field.—PHILIP H. ABELSON

*D. F. Spencer, M. J. Gluckman, S. B. Alpert, *Science*, in press.