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Diminishing the Role of Sulfur Oxides in Air Pollution

Each year, in the United States, more than 20 million tons of sulfur are discharged into the atmosphere, most of it in the form of SO_2. This gas is slowly converted into sulfuric acid, which is corrosive to many materials, including metals, building stones, and clothing. The toxicity of SO_2 and H_2SO_4 to plants and animals is controversial, as is the effect of these compounds when they are inhaled along with other components of smog. Because of the complexities of long-term and synergistic effects, many years must elapse before precise conclusions can be reached concerning the role of the sulfur compounds. In the meantime, the public is becoming impatient with slow progress made in overcoming air pollution. Already, in various cities restrictions are being placed on the amount of sulfur fuel may contain.

Principal targets for such restrictions are electric power generating plants. These are a major source of air pollutants when they use coal or residual oil as fuel. Coal, the principal fuel, contains various quantities of sulfur; a typical amount is 3 percent. Concern about air pollution has been a factor in the sudden acceptance of nuclear energy. Unless the pollution problems attending use of coal are solved, the coal industry will face a gloomy future, caused in part by regulation, in part by competition from other energy sources.

Five means of meeting the sulfur pollution problem seem feasible. One is to use fuel containing only small amounts of sulfur. A second is to discharge the fumes from tall smokestacks (more than 200 meters high). If stacks are tall enough to pierce the inversion layer, the pollutants are thoroughly diluted before reaching the ground. A third method is to add a material such as powdered limestone to the flue-gas stream, following combustion, to convert the gaseous sulfur oxides into a solid form. A fourth is to convert the coal to gas and to remove the sulfur from the gas prior to combustion. A fifth method, which seems very interesting, is to pass the flue gases through a chemical processing plant, the sulfur being recovered in elemental form or as H_2SO_4. A number of variants of this method are under investigation. The U.S. Bureau of Mines has been conducting pilot-plant tests of an alkalized alumina process. Oxides of sulfur are removed from flue gas by absorption on a hot alkaline solid. The absorbent is regenerated with a reducing agent such as $H_2 + CO$, yielding H_2S as a product. The latter is readily converted to elementary sulfur. In a variant of this process, announced recently by Atomic International, a molten mixture of carbonates is used as the absorbent. Monsanto Chemical Company is active in the development of a catalytic oxidation process. Flue gas is freed from fly ash and passed over a catalyst bed containing V_2O_5, the SO_2 being oxidized to SO_3. This substance, on cooling, reacts wth water vapor to form H_2SO_4.

Both the sulfur and the H_2SO_4 are consumed on a large scale. The price of sulfur has advanced sharply during the last year and is currently quoted at close to $50 a ton. With present technology the value of the sulfur recovered from coal-fired power plants would about offset the cost of investment and operation of the processing plants. A combination of better technology with a higher price for sulfur may eventually convert a nuisance into a valued asset.—PHILIP H. ABELSON