

meet the nation's ever-mounting energy demands, further emphasizes the need to develop economically feasible methods for control. Two approaches are being pursued: (1) removal of sulfur from fuel, and (2) removal of the sulfur oxides formed during combustion from the stack effluent. Coal contains sulfur as inorganic pyrite and also as combined organic material; sulfur in oil is in the combined state.

Investigations are currently under way to reduce the sulfur content of both coal and residual fuel oils; the roadblocks involve the technology of the basic processes involved as well as economics of application. Investigations of removal of sulfur oxides from stack effluents are proceeding along several lines: use of packed or falling beds for sorption of sulfur dioxide and sulfur trioxide, with recovery of the sulfur as elemental sulfur or sulfuric acid and regeneration of the bed material; conversion of the sulfur trioxide to sulfate by chemical reaction with additives, and removal as particulate; and conversion of the sulfur dioxide to sulfur trioxide by catalytic conversion, and removal as sulfuric acid or as sulfates. Several of the processes are in the pilot stage of development; their ultimate acceptance will be based on their over-all economic feasibility. Here is an area where a technological breakthrough would be of major significance.

Control of nitrogen oxides also is being investigated in some depth. The search for more efficient vehicle power plants or the use of tailpipe converters theoretically postulates increased fixation of atmospheric nitrogen, a reaction that occurs in all types of combustion. Methods for reduction of nitrogen oxide production from all combustion processes, including vehicle power plants, are under study. Three avenues are being investigated: (1) the use of catalytic converters, (2) recirculation of combustion products to reduce the over-all con-

centration of oxygen available for combustion, and (3) the use of two-stage combustion to reduce the over-all temperatures involved, thereby inhibiting the rate of reaction for nitrogen fixation.

Associated Research Needs

The problems in research in the physical and biological sciences have their counterpart in the social sciences. Methods for assessing the economic impact of air pollution on our society need development and application. There is need for better methods of informing the public of existing and potential environmental health situations and, in turn, of proper interpretation of the public wishes by responsible officials. The social structure of our society plays an important role in economic problems, particularly in relation to the impact of control measures needed to meet minimum air quality criteria. The need to incorporate air resources management into urban planning is just now being recognized as another of the many problem areas of importance in urban resource development. With our burgeoning population and urban development, we can no longer logically hold to the concept of growth based on chance; space no longer is available to provide the factor of safety against severe air pollution situations that we have relied upon up to the present stage in our national development.

Summary

What, then, is the over-all status of current research in air pollution? Great strides have been made in the 15 years since World War II, which gave sufficient impetus to our industrial growth and urbanization so that in certain areas our air resources were overtaxed. This growth has continued, adding to the over-all problem. Assessment nation-