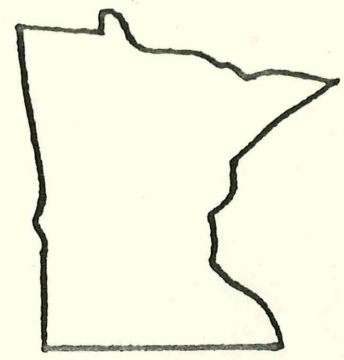


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CONSIDERATIONS IN ELECTRIC POWER PLANT SITING

Air Quality

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STATE OF MINNESOTA

POWER PLANT SITING PROGRAM
MINNESOTA ENVIRONMENTAL QUALITY BOARD

7 DECEMBER 1979

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STATE OF MINNESOTA

Coal-fired electric generating plants are one of the major sources of air pollution in the United States. On a national basis, they contribute approximately 40 percent of the sulfur oxides and a substantial percentage of the particulate pollution. An 800 megawatt plant, for example, burning low sulfur western coal and equipped with modern pollution control equipment, will still discharge approximately 3700 pounds of sulfur dioxide and 240 pounds of particulates per hour. And, although sulfur oxides and particulates constitute the major quantity of air pollutants from coal-fired plants, numerous other trace elements, mostly heavy metals, are also emitted from the stack. This brochure will describe some of the effects of sulfur oxide and particulates pollution, and then discuss some of the equipment currently available to control these emissions from power plants.

SULFUR OXIDES

Oxides of sulfur are produced when sulfur, which is contained in coal, combines with oxygen during the combustion process. Although several chemical reactions can occur in the atmosphere, the sulfur oxides eventually combine with moisture to form sulfuric acid. Eventually, the sulfur acid returns to the earth, contributing to the phenomenon known as "acid rain." The degree of acidity will vary with climatological factors, but several examples may put the problem in perspective. The most severe observation of acid rain occurred in Scotland in 1974; rain was the acid equivalent of vinegar. On a yearly basis, rains over large areas of the world now range from 5 to 30 times more acid than the expected, non-polluted precipitation. Particular storms in particular regions can range to several thousand times more acid than non-polluted rains. *

The effects of acid precipitation are not fully known. It is believed to be responsible for the elimination of several species of fish from many lakes of New York, southeastern Canada and parts of Scandinavia. Large areas of Minnesota have lakes and soils with limited acid-neutralizing ability, and could suffer the same fate. To put the problem in perspective, consider that the International Joint Commission has stated that as many as 4800 lakes in Ontario, Canada could "go acid in the next 20 years.**

* "Acid Rain," Scientific American. October, 1979, page 45-46.

** International Joint Commission. 1979. Great Lakes Focus on Water Quality, Volume (3).

Acid rainfall also contributes to accelerated deterioration of buildings and damages vegetation. Plants vary in their sensitivity to acids, but in Minnesota, economically important crops that are sensitive include: soybeans, wheat, oats, peas, and sugar beets. The overall effect is very difficult to assess because yield, quality, and growth rates are affected before visible damage occurs.

The economic effects of pollution are always difficult to ascertain. However, the International Joint commission has estimated that in the United States health costs of \$1.7 billion and architectural costs of \$2 billion can be attributed to sulfur oxides each year.

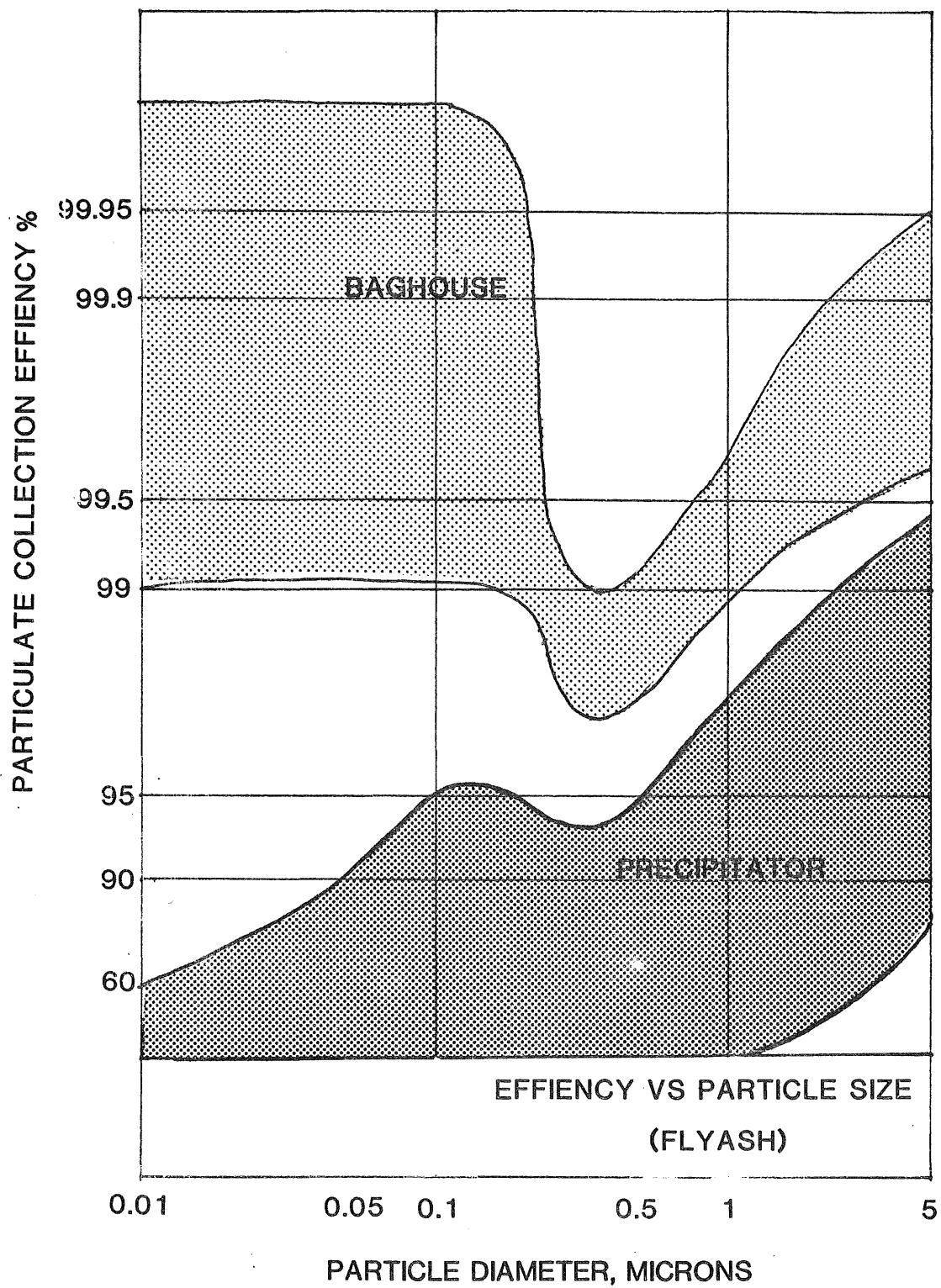
PARTICULATES

Particulates can be defined as dispersed matter, either solid or liquid, in which the diameter of particles ranges from 100 to 0.001 microns. As with sulfur oxides, particulates can remain airborne for several days, travelling hundreds of miles. Although stack pollution control equipment, capable of removing greater than 99 percent of the particulates, is currently available, that percentage is deceptive because it is based upon weight. Large particles, which constitute the majority of the total particulate weight, are relatively easy to remove. However, the very small particles, which constitute only a small portion of the total particulate weight, are difficult to remove. And the small particles are the most hazardous to health.

Small particles remain in the air longer and travel farther than larger ones. And when inhaled by humans or animals, the smaller particles penetrate deeper into the respiratory system. Additionally, it has been established that various trace elements which are present in the coal, such as mercury, selenium, arsenic, and bromine, concentrate mostly on the smaller particles so the trace elements also largely escape. Plant damage also is caused by particulate pollution.

POLLUTION CONTROL EQUIPMENT

Present day air pollution control equipment on coal-fired power plants serves mainly to remove particulates and sulfur oxides. Electrostatic precipitators or baghouse filters are used to remove particulates and scrubbers are used to remove sulfur oxides.



1 MICRON : 10^{-6} METERS

Scrubbers are a more effective sulfur removal process, capable of removing greater than 90 percent of the sulfur oxides from the flue gas. However, scrubbers are very expensive. There are two general types of scrubbers-those called "throwaway process" and "regenerative process." Both introduce chemical reagents into the flue gas. Sulfur in the gas and the reagents then interact chemically.

In the throwaway process, large amounts of relatively inexpensive reagents are used once, then disposed of along with the waste product that contains the sulfur. With the regenerative process the reagents are recycled and, instead of producing a waste sludge, commercial products such as sulfuric acid or elemental sulfur are produced. However, this process requires that a chemical recovery plant be added to the power plant.

The vast majority of scrubbers operating today are of the throwaway type. Many have experienced severe operating problems such as clogging up, and often have forced the power plant to shut down. Additionally, they are energetically expensive, using a significant percentage of the generated power. However, scrubbers are a relatively new part of the power plant system, having been generally required only after the Clean Air Act of 1970 was passed.

New designs appear to be capable of reducing many of the problems associated with first-generation scrubbers. For example, dry scrubbers are now available that have high reliability, lower capital costs, and produce a waste material that may be capable of being used in road construction.

SUMMARY

The need to maintain air quality and a reliable system of electric power presents many difficult problems. The costs of installing air pollution control equipment is high but the costs due polluted air, which not readily apparent, are also high. The Minnesota Environmental Quality Board urges you to make your feelings on this problem known. To express your opinion or to obtain a copy of a report entitled Definition of Model Coal-Fired Electric Generating Stations in the 50 MW to 2400 MW Range please contact:

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