AIR POLLUTION

REPORT OF THE
VIRGINIA ADVISORY LEGISLATIVE COUNCIL
to
THE GOVERNOR
and
THE GENERAL ASSEMBLY OF VIRGINIA

COMMONWEALTH OF VIRGINIA
Department of Purchases and Supply
RICHMOND
1965

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AIR POLLUTION

REPORT OF THE

VIRGINIA ADVISORY LEGISLATIVE COUNCIL

Richmond, Virginia, December 28, 1965

To:

HONORABLE A. S. HARRISON, JR., *Governor of Virginia*

and

THE GENERAL ASSEMBLY OF VIRGINIA

Air pollution is not a modern invention. For instance, in the days of the "wide open spaces," there was pollution of the air as a result of campfires. However, intensification of air pollution, with consequent disagreeable and harmful effects, is of a more modern vintage. This is due to increasing urbanization and industrialization. The State of Virginia, as has been stated so often, is becoming more urban and more industrialized. Therefore, the problem of air pollution becomes a matter of increasing concern to this State. Accordingly, the General Assembly of Virginia at its 1964 Regular Session (by House Joint Resolution No. 65) directed the Virginia Advisory Legislative Council to make a study of air pollution The text of this resolution is as follows:

HOUSE JOINT RESOLUTION NO. 65

Directing the Virginia Advisory Legislative Council to make a study of air pollution.

Whereas, large areas of Virginia are fast changing from agricultural to industrial, urban and suburban developments, and along with this change there has been a marked increase in air pollution; and

Whereas, air pollution is brought on by many complex and interrelated factors resulting from urbanization, industrial development, ever greater use of the motor vehicle, and other facets of our civilization, which increase air pollution, bringing on resulting dangers to the public health and welfare, damage to and deterioration of property, hazards to transportation upon the ground and in the air, and inconvenience and, in some cases, danger to individuals; and

Whereas, hasty action and unwise legislation might well have untoward results on our industrial development program, as well as on existing industry, and informed and active leadership by the Common wealth is required to coordinate the existing air pollution studies in order to provide for cooperative programs, State, regional and local, to protect the public health and welfare and the well-being of business and industry; and

Whereas, legislation has been enacted by the Congress which will undoubtedly result in grants to states with programs to curb air pollution problems and the time is now at hand in which the Commonwealth should make an evaluation of the extent to which air pollution is a problem and is likely to become greater, measures which might be employed to reduce this threat, and, the most appropriate course which the State should take, now, therefore, be it

Resolved by the House of Delegates, the Senate concurring, That the Virginia Advisory Legislative Council is hereby directed to make a study and report upon air pollution and, in making the same, may avail itself of the advice of persons of recognized standing and ability throughout the State. All agencies of the State shall assist the Council in its study.

The Council shall consider the experience and legislation of other states in the matter of air pollution and their actions relative thereto. The Council shall seek the advice of all persons, firms, corporations, associations and governmental entities, State, local and federal, which the Council is of opinion might assist it in its study. The Council may accept and expend gifts, grants and donations from any and all sources for the purposes hereof, which shall be available for the payment of such expenses as the Council certifies to any such donor; provided the report shall set forth the source, amount and purposes for which such payments are made. The Council shall conclude its study and make its report to the Governor and General Assembly not later than September one, nineteen hundred sixty-five.

The Council selected Lewis A. McMurran, Jr., Newport News, a member of the House of Delegates and a member of the Council, as Chairman of a committee to make the initial study and report to it. Selected to serve with Mr. McMurran on the committee were: Willis M. Anderson, Attorney and member of the House of Delegates, Roanoke; Leslie D. Campbell, Jr., Attorney and member of the Senate, Ashland; Stuart C. Crawford, Consulting Engineer, Franklin; W. J. Hecht, Allied Chemical Corporation, Inc., Hopewell; G. P. Heller, Research and Development Division, Albemarle Paper Manufacturing Company, Richmond; Mark C. Hopkins, Manager, Yorktown Refinery, American Oil Company, Yorktown; Mrs. Dorothy S. McDiarmid, Sponsor of House Joint Resolution No. 65 and member of the House of Delegates, Vienna; Robert D. Morrison, City Manager, Lynchburg; Rosser H. Payne, Jr., Director of the Virginia Section of the American Institute of Planners, Warrenton; Edwin K. Phillips, Sr., Treasurer, Benson-Phillips Company, Newport News; Dr. Edward S. Ray, Associate Professor, Medical College of Virginia, Richmond; J. D. Ristroph, Manager, Power Production, Virginia Electric and Power Company, Richmond; Dr. Charles L. Savage, Medical Director, E. I. duPont de Nemours and Company, Incorporated, Waynesboro; G. R. C. Stuart, Attorney, Abingdon; Dr. Woodrow W. Wendt, Executive Director, Virginia Tuberculosis and Respiratory Disease Association, Richmond; and Landon R. Wyatt, member of the Senate, Danville.

The Committee organized and elected Mrs. McDiarmid as Vice-Chairman. John B. Boatwright, Jr. and Wildman S. Kincheloe, Jr. were appointed Secretary and Recording Secretary, respectively.

The Committee considered the air pollution control statutes of those states which have such statutes, and the federal "Clean Air Act" (Public Law 88-206 of 1963, as amended by Public Law 89-272 of 1965). Several members of the Committee attended a program on air pollution on October

1, 1964 at the Hotel Jefferson, Richmond, sponsored by the Virginia Tuberculosis and Respiratory Disease Association. Also, several members of the Committee attended an air pollution program at Beltsville, Maryland from January 11 to January 15, 1965, sponsored by the Metropolitan Washington Council of Governments.

The Committee collected considerable data and information on the subject under study. A public hearing was held in the State Capitol and was well attended. It formed subcommittees which gave detailed consideration to the several aspects of the study.

Based upon the voluminous data before it, and the views expressed to it, the Committee made its report to the Council. Having reviewed the Committee's report, the Council now presents its findings and recommendations.

BACKGROUND

The sources of emissions which may contribute to air pollution are classified in six broad categories. The major pollutants from these sources and the presently available methods of control are hereinafter presented. In most cases, methods are available to achieve almost any degree of emission control desired. Costs depend on so many factors that it is not possible to predict what any specific program might require; however, it may be expected that costs will rise geometrically as the degree of control is increased.

In a study of air pollution control equipment installed in Los Angeles County, the cost of control equipment exclusive of operating costs amounted to 14% of the cost of the basic devices causing air pollution. A Manufacturing Chemists Association survey indicated that yearly operating costs for control equipment amounted to 10% of the cost of the equipment. Individual installations may vary widely from these overall averages.

Air pollution control is a problem of balancing the equities involved for the total good of the community. An ill-conceived program to control emissions from homes, automobiles, or industry might well be more damaging than the original problem. Any legislation in this field should be sufficiently flexible to allow each community's needs to be served.

Air is a natural resource. It is needed for life, combustion of fuels for heat, power, and transportation, and for the purification of natural and man-made wastes. Although never inexhaustible, this air resource is, at certain times and places, further limited by atmospheric inversions, low wind speeds and urban crowding. Especially under these conditions, a portion of the emissions to the air must be limited and is generally known as air pollution control.

We have considered the sources of emissions to be (A) Power Plants, (B) Residential and Commercial Heating, (C) Disposal of Solid Waste, (D) Manufacturing Industries, (E) Transportation and (F) Agriculture. Set forth in Appendix B to this report is a discussion in full of the sources and types of emissions which may contribute to air pollution and the currently available methods for their control.

Public Law 88-206 of the 88th Congress, approved December 17, 1963, is known as the "Clean Air Act." This was amended by Public Law 89-272 of the 89th Congress, approved October 20, 1965. Among the provisions of this Act is that for program grants. Briefly, these grant funds may be made available to state and local agencies for the purpose of developing, establishing, or improving air pollution control programs. Federal funds

will be available on a matching basis—two dollars for every one dollar for single jurisdictional programs, and three dollars for every one dollar for programs operating on a regional basis. For this phase of the Act $4,180,000 were available in the fiscal year 1965, and $5,000,000 are available in the current fiscal year 1966. In response to requests concerning availability of such grants, personnel of the Virginia State Health Department and the United States Public Health Service have had conferences in nine local jurisdictions. As a result, the city of Roanoke received a grant of $1,823.34 of the federal funds matched by $911.67 of local funds. The Metropolitan Washington Council of Governments received $25,000 of federal funds matched by $7,000 of local funds, some of which came from Arlington and Fairfax Counties and the city of Alexandria; and Roanoke County received $15,956.40 matched by $5,318.80 of local funds from Roanoke County and the towns of Salem and Vinton. The State Health Department is eligible for a grant, but a necessary condition is that at least $1 be spent by the Department for every $2 of federal money. The Department presently does not have the matching money.

A summary of the "Clean Air Act" is included in Appendix A of this Report. The 1965 amendment undertakes to provide standards for the control of air pollution from motor vehicles, and to authorize a research and development program with respect to solid waste disposal.

Virginia does not have an air pollution control statute. The State Department of Health renders limited service in air pollution control at the request of local governments or local health departments. Such activities utilize the equipment and skills of industrial hygienists. There are severe limitations on the amount and kind of work which can be done with existing equipment and staff having other responsibilities. The Department has been designated by Governor Harrison as the official air pollution control agency for the purposes of the "Clean Air Act". In this capacity, the Department participated in conferences with local officials and representatives of the United States Public Health Service, as mentioned hereinabove.

The Depaltment acts in a coordinating and advisory capacity to the local health Departments in the Metropolitan Washington Area. These agencies are participating in a program of the Metropolitan Washington Council of Governments for conducting a sampling network to determine the levels of smog-producing oxidents associated with automobiles and sulfur dioxide associated with fuel burning. The network includes ten sampling stations, four of which are in Virginia (one in Alexandria, one in Arlington County and two in Fairfax County). Equipment in these sampling stations is owned and maintained by local health departments, and the stations are operated by local health department personnel.

The United States Public Health Service established a network of air sampling stations in 1958. Eight of these stations are in Virginia, being located in Danville, Hampton, Lynchburg, Norfolk, Portsmouth, Richmond, Roanoke, and Shenandoah National Park Headquarters.

A summary of the air pollution control statutes of the states which have such statutes is included in Appendix A of this Report. Also included is a review of local ordinances on air pollution throughout the State of Virginia.

FINDINGS AND CONCLUSIONS

1. According to the definitions of those who studied the problem and from data collected from various areas in the State, there are certain localities throughout the State in which the problem of air pollution of varying degrees exists.

2. There is no evidence to date that air pollutants produce disease process, but they do contribute to the aggravation of chronic respiratory diseases.

3. There is evidence from other sources that certain air pollutants can be of economic significance.

4. It is the consensus of the Council that the changing complex of this State is such that air pollution will be an increasing problem in the future.

5. Some type of air pollution control statute is necessary. However, State-wide standards and requirements should not be imposed, as conditions vary from locality to locality. The agency vested with the powers and duties of air pollution control should have discretion to dispose of each case on the peculiar circumstances of that case.

RECOMMENDATIONS

1. That a Virginia Air Pollution Control Act be adopted.

2. That a State Air Pollution Control Board be established in the Executive Department of the State.

3. That the 1966-68 State Budget provide for the operation of the State Air Pollution Control Board the amount of $75,000 for the year 1966-67, and the amount of $125,000 for the year 1967-68.

4. That the Board, after having made an intensive study of air pollution in the various areas of the State, shall have the power to adopt rules and regulations abating, controlling and prohibiting air pollution throughout the State or in such areas of the State as may be affected by air pollution. The Board may create, within any area of the State, local air pollution control districts comprising one or more cities and counties or parts thereof. All local ordinances, rules and regulations relating to air pollution, insofar as they affect the area included within such district, shall be superseded by the rules and regulations of the State Board. The Board shall operate in accordance with the powers and subject to the limitations set forth in the proposed Virginia Air Pollution Control Act submitted herewith.

CONCLUSION

We wish to thank the members of the Committee for the time and effort which they have contributed to the conduct of this very important study. The problems involved in this matter are complex, and the Committee has given us invaluable aid in our consideration of these problems.

Attached is a bill to carry out the recommendations in this Report, and we respectfully urge passage thereof by the General Assembly.

Respectfully submitted,

EDWARD E. WILLEY, *Chairman*
TOM FROST, *Vice-Chairman*
C. W. CLEATON
JOHN WARREN COOKE
JOHN H. DANIEL
CHARLES R. FENWICK
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*WILLIAM F. STONE

* See attached statements of J. D. Hagood and William F. Stone

STATEMENT OF J. D. HAGOOD

I concur in the objectives of the report. However, the members of the creation of another State agency in this instance. Instead of establishing a State Air Pollution Control Board, the powers and duties relating to air pollution control should be vested in the State Water Control Board.

J. D. Hagood

STATEMENT OF WILLIAM F. STONE

I concur in the objectives of the report. However, the members of the city and town councils are elected representatives of the people, and I strongly dissent from giving an appointed board the power to adopt rules and regulations that will negate and declare void valid ordinances enacted by town and city councils.

William F. Stone

A BILL to create the State Air Pollution Control Board; provide for the appointment of members and prescribe their qualifications and compensation; authorize the employment of a staff and technical assistants; prescribe the powers and duties of the Board; permit the creation of local air pollution control districts and local air pollution control committees in such districts and prescribe their powers and duties; provide for enforcement of rules, regulations and orders of the Board, and appeals therefrom, and prescribe punishment for failure to comply with same; and designate when local air pollution ordinances are superseded by such rules, regulations and orders,

Be it enacted by the General Assembly of Virginia:

1. § 1. The following words, for the purposes of this act, shall have the following meanings:

(a) "Board" means the State Air Pollution Control Board, sometimes hereinafter referred to as "Board" or "State Board".

(b) "Air pollution" means the presence in the outdoor atmosphere of one or more substances put there by man or man-made devices in concentration sufficient to cause an unreasonable interference with human, plant or animal life or the reasonable use of property.

(c) "Owner" means the State, a county, sanitary district, municipality, a public or private institution, corporation, association, firm, or company organized or existing under the laws of this or any other state or country, person or individual, or group of persons or individuals, acting individually or as a group.

§ 2. There is hereby created in the Executive Department of the State the State Air Pollution Control Board to be composed of five members to be appointed by the Governor and subject to confirmation by the General Assembly. The first appointments shall be made as follows: two for a term of four years; two for a term of three years; and one for a term of two years; successors to the first appointees hereunder shall be appointed for terms of four years each. Vacancies other than by expiration of term shall be filled by the Governor by appointment for the unexpired term.

§ 3. The members of the Board shall have the following qualifications: They shall be citizens of the State; they shall be selected from the State at large for merit without regard to political affiliation; the Governor in his appointments shall select persons for their ability and all appointments shall be of such nature as to aid the work of the Board to inspire the highest deglee of cooperation and confidence. No officer, employee or representative of any industry, county, city or town which may become subject to the rules and regulations of the Board shall be appointed to the Board.

§ 4. All members of the Board shall serve without compensation but shall receive twenty dollars per day for attendance at meetings and their actual expenses incurred in attending meetings of the Board and in the performance of any duties as members or by direction of the Board.

§ 5. The Board shall elect its own chairman and employ such technical assistants and staff as it deems necessary to carry out its functions, and is authorized to employ an executive secretary who shall serve as executive officer and devote his whole time to the performance of his duties, and he shall have such administrative powers as are conferred upon him by the

Board. The Board may call upon any State department or agency for technical assistance. All departments and agencies of the State shall, upon request, assist the Board in the performance of its duties.

§ 6. The Board shall meet at least once every three months. Special meetings may be held at any time or place to be determined by the Board upon the call of the Chairman or upon written request of any two members. All members shall be duly notified of the time and place of any regular or special meeting at least five days in advance of such meeting. Three members of the Board shall constitute a quorum for the transaction of business.

§ 7. The Board shall keep a complete and accurate record of the proceedings at all its meetings, a copy of which shall be kept on file in the office of the executive secretary and open for public inspection. Any rules, regulations or other requirements adopted by the Board to have general effect in part or all of the State shall be filed with the Secretary of the Commonwealth, at least thirty days before they are to take effect.

§ 8. The Board shall make, or cause or be made, such inspections, conduct such investigations and do such other things as are reasonably necessary to carry out the provisions of this act, within the limits of the appropriations, study grants, funds, or personnel which are, or become, available from any source for the purposes of this act.

§ 9. (a) The Board at all times shall have the power to control and regulate its internal affairs; initiate and supervise research programs for the purpose of determining the causes, effects and hazards of air pollution; initiate and supervise State-wide programs of air pollution control education; cooperate with and receive money from the federal government or any county or municipal government, and receive money from any other source, whether public or private; develop a comprehensive program for the study, abatement and control of all sources of air pollution in the State; advise, consult and cooperate with agencies of the United States, and all agencies of the State, political subdivisions, private industries and any other affected groups in furtherance of the purposes of this act.

(b) The Board, after having made an intensive and comprehensive study of air pollution in the various areas of the State, its causes, prevention, control and abatement, shall have the power to formulate, adopt and promulgate, amend and repeal rules and regulations abating, controlling and prohibiting air pollution throughout the State or in such areas of the State as shall be affected thereby; provided, however, that no such rule or regulation and no such amendment or repeal shall be adopted, nor shall any order be entered, except after public hearing to be held after thirty days prior notice thereof by public advertisement of the date, time and place of such hearing, at which opportunity to be heard by the Board with respect thereto shall be given to the public; and provided, further, that no such rule or regulation and no such amendment or repeal, or no such order, shall be or become effective until sixty days after the adoption or entry thereof as aforesaid.

(c) After any rule or regulation has been adopted by the Board pursuant to subsection (b) of this section, it may in its discretion grant local variances therefrom, if it finds after a thorough investigation and hearing that local conditions warrant. In the event local variances are permitted, the Board shall issue an order to this effect, after a hearing held in the locality, which order shall be subject to revocation or amendment at any time if the Board after hearing determines such amendment or revocation is warranted.

(d) After the Board shall have adopted the rules or regulations provided for in subsection (b) of this section, it shall have the power to: initiate and receive complaints as to air pollution; hold hearings and enter orders diminishing or abating the causes of air pollution and the enforcement of its rules or regulations; institute legal proceedings, including suits for injunctions for the enforcement of its orders, rules and regulations and the abatement and control of air pollution and for the enforcement of penalties, all in accordance with this act.

(e) The Board, in making rules and regulations and issuing orders, and the courts in enforcing the provisions of this act, shall take into consideration all of the facts and circumstances bearing upon the reasonableness of the activity involved and the regulations proposed to control it, including:

(1) The character and degree of injury to, or interference with safety, health or the reasonable use of property which is caused or threatened to be caused;

(2) The social and economic value of the activity involved;

(3) The suitability or unsuitability of such activity to the area in which it is located; and

(4) The practicability, both scientific and economic, of reducing or eliminating the discharge resulting from such activity.

(f) In all cases the Board and the courts shall exercise a wide discretion in weighing the equities involved and the advantages and disadvantages to the residents of the area involved and to any lawful business, occupation or activity involved resulting from requiring compliance with the specific requirements of any order, rule or regulation.

(g) Expressly excluded from this act are all aspects of employer-employee relationships.

§ 10. (a) The Board may create, within any area of the State, local air pollution control districts comprising a city or county or a part or parts of each, or two or more cities or counties, or any combination or parts thereof. Such local districts may be established by the Board on its own motion or upon request of the governing body or bodies of the area involved.

(b) In each district there shall be a local air pollution control committee, the members of which shall be appointed by the State Board from lists of recommended nominees submitted by the respective governing bodies of each locality, all or a portion of which are included in the district. The number of members on each such committee shall be in the discretion of the State Board. When a district includes two or more localities or portions thereof, the State Board shall apportion the membership of the committee among the localities, provided that each locality shall have at least one representative on such committee. The members shall not be compensated or reimbursed for expenses out of State funds. Such localities may provide for the payment of compensation and reimbursement of expenses to the members, the portion of such payment to be borne by each locality to be prescribed by agreement, and may appropriate funds therefor.

(c) When such local committee is created, all local ordinances, rules and regulations relating to air pollution, insofar as they affect the area included within such district, shall be superseded by the rules and regulations of the State Board. The powers and duties of the local committee shall be those delegated to it by the State Board, provided that such committee may initiate studies and make recommendations to the Board.

(d) The governing body of any locality, wholly or partially included within any such district, may appropriate funds for use by the local committee in air pollution control and studies.

§ 11. The Board is authorized to name technically qualified citizens

§ 12. Every owner which the Board has reason to believe is causing, or may be about to cause an air pollution problem shall on request of the Board furnish such plans, specifications and information as may be required by the Board in the discharge of its duties under this Act. Any information as to secret processes, formulae or methods of manufacture or production shall not be disclosed in public hearing before the Board, and shall be kept confidential. If samples are taken for analysis, a duplicate of the analytical report shall be furnished promptly to the person from whom such sample is requested.

§ 13. Whenever it is necessary for the purposes of this act, the Board or any member, agent or employee when duly authorized by the Board may at reasonable times enter any establishment or upon any property, public or private, for the purpose of obtaining information or conducting surveys or investigations.

§ 14. Any owner violating, failing, neglecting or refusing to obey any rule, regulation or order of the Board may be compelled to obey the same and comply therewith by injunction, mandamus or other appropriate remedy.

§ 15. Any party aggrieved by any rule, regulation, order or requirement issued by the Board under this act may secure a review of the reasonableness of, necessity for, or legality of any such rule, regulation, order or requirement in the manner set out in the following sections.

§ 16. Such party may, at any time prior to the effective date of the rule, regulation or order or requirement complained of, first file with the Board a petition asking for a rehearing on such rule, regulation or order or requirement and setting forth specifically and in full detail wherein he considers the rule, regulation or order or requirement unreasonable, unnecessary or illegal, his reasons and grounds therefor, and the qualifications or changes, if any, that he desires.

§ 17. If the issues raised by any such petition have, in the opinion of the Board, theretofore been adequately considered and properly determined, the Board may determine the same by confirming, without hearing, the previous rule, regulation or order or requirement. If it appears to the satisfaction of the Board that no sufficient reason exists for taking testimony or further testimony the Board may reconsider and redetermine the original cause without setting a time and place for any further hearing. If it appears to the Board that a hearing or rehearing is necessary to determine the issues raised or any one of such issues, the Board shall order a hearing or rehearing thereon and hear such additional evidence as may be offered on either side and consider and determine the issue or issues raised by such petition. In either event the Board may take such action as it deems proper. Ten days notice of the time and place of such hearing or rehearing, if any be ordered, shall be given the applicant and to such other persons and in such manner as the Board may order. A petition for a hearing or rehearing shall be deemed to have been denied by the Board, unless it shall have been acted upon within thirty days after the date of filing. The filing of the petition for a hearing or rehearing shall operate to suspend the rule, regulation or order or requirement complained of until the validity

of such rule, regulation or order or requirement has been finally adjudicated.

§ 18. Any owner aggrieved by any rule, regulation, order or requirement, shall have the right to apply to the Circuit Court of the city of Richmond, in term or in vacation. Such application shall be by petition which shall be filed in the clerk's office of such court within the following prescribed time: within sixty days after the date of the rule, regulation, order or requirement complained of, provided no application for rehearing has been made; within thirty days after an application for rehearing is denied, if such application had been filed; within thirty days after the rendition of the decision of the Board, if any application for rehearing is filed, and the matter reconsidered or redetermined by the Board either with or without a rehearing. The filing of the petition with the court shall be deemed to commence the proceeding in such court.

Within fifteen days after such petition is so filed, the petitioner shall serve on the executive secretary or on any member of the Board a copy of the petition and a notice in writing that petitioner will on a date stated in the notice, not less than fifteen days nor more than thirty days after the date of the filing of the petition, move the Circuit Court of the city of Richmond or the judge thereof to grant the prayer of the petition. The Board shall be named as a party defendant to such petition. The filing of such application shall operate to suspend the requirement, rule, regulation or order complained of, until the validity of such rule, regulation or order or requirement shall have been finally adjudicated. The judge shall hear the proceeding de novo, shall thereupon determine all matters of law and fact without a jury and render his decision approving, setting aside or modifying the rule, regulation or order or requirement complained of.

§ 19. The Commonwealth or any party aggrieved by any such final decision of the judge shall have, regardless of the amount involved, the right to apply for an appeal to the Supreme Court of Appeals. The procedure shall be the same as that provided by law concerning appeals and supersedeas.

It shall be the duty of the Attorney General to represent the Board or designate some member of his staff to represent it.

§ 20. Any owner violating any provision of this act or failing, neglecting, or refusing to comply with any order of the Board, or a court, lawfully issued as herein provided, shall, upon conviction be liable to a fine of not less than fifty dollars nor more than five hundred dollars for each violation within the discretion of the court, and each day of continued violation after conviction shall constitute a separate offense and may subject the system, business, or establishment causing pollution in violation of this act to abatement as a nuisance.

§ 21. Until such time as the authority of any governing body of a locality to adopt ordinances relating to air pollution has been superseded as provided in § 10 hereof

(a) existing local ordinances adopted prior to the effective date of this act shall continue in force; provided that in the event of a conflict between a rule, regulation, order or requirement of the Board and a provision or provisions of a local ordinance, the rule, regulation, order, or requirement or requirements of the Board shall govern; and

(b) the governing body of any locality proposing to adopt an ordinance, or an amendment to an existing ordinance, relating to air pollution after the effective date of this act shall first obtain the approval of the State Board as to the provisions of such ordinance or amendment.

APPENDIX A

A survey of existing federal, State and local legislative enactments on air pollution control is as follows:

FEDERAL LEGISLATION

In 1955 the Eighty-fourth Congress of the United States enacted Public Law 159, referred to as the "Clean Air Act," amended in 1963 by Public Law 88-206 of the 88th Congress, the purposes of which were (1) to protect the nation's air resources, (2) to initiate and accelerate national research and development programs, (3) to provide technical and financial assistance to state and local governments in air control programs and (4) to encourage and assist the development and operation of regional air pollution control programs. The Secretary of Health, Education and Welfare was directed (1) to prepare and recommend research programs for devising methods of air pollution control, (2) to encourage cooperative activity by state and local governments, (3) to collect and disseminate information relating to air pollution, (4) to conduct research to develop methods of prevention and abatement and support such works by other states and local governments, (5) to conduct research surveys and investigations concerning any specific problem of air pollution when so requested by states or local governmental control agencies, and (6) to make grants to and enter into contracts with other governmental and private agencies and individuals for surveys, studies, research, training and demonstration projects. A maximum appropriation of $5,000,000 per year was authorized. It is noteworthy to make special mention of one section of the Clean Air Act which provides that the United States Department of Health, Education and Welfare is authorized to make a grant up to 66⅔% of the costs of developing, establishing or improving state or local control problems. If the control program and problem is interstate, intermunicipal or intercounty, such grant may be in an amount up to 75% of the cost thereof.

The Act provides for suits for abatement, under certain circumstances, of interstate air pollution, and for the control of air pollution from federal facilities.

The "Clean Air Act" was further amended by Public Law 89-272 of the 89th Congress, approved October 20, 1965. The amendment directs the Secretary of Health, Education and Welfare as soon as practicable to prescribe, by regulation, standards applicable to the emission of air pollutants from new motor vehicles which are likely to cause air pollution endangering health or welfare. He shall give appropriate consideration to technological feasibility and economic costs. Such regulations, when prescribed, shall apply to vehicles imported into the United States as well as those manufactured for sale within the country, but shall not apply to those intended solely for export. Actions to restrain violations may be brought in United States district courts, and penalties are prescribed for violations. The amendment also provides for suits for abatement, under certain circumstances, of air pollution in a foreign country resulting from emissions originating in this Country. Also, the amendment provides for federal cooperation in research and programs relating to solid-waste disposal, and makes provision for federal grants.

STATE LAWS

Of the 50 states, 18 have general state air pollution control and one state has limited control. There follows a brief outline of the statutes of these states.

ALASKA

1. *Agency to administer air pollution control:* The Commission of Health and Welfare.

2. *Powers of such agency:* Conduct public hearings, adopt public allowable air quality standards, conduct investigations or institute legal proceedings to compel compliance with the regulations, sue in the name of the state to abate air pollution and prepare guides to help develop a comprehensive program of atmospheric pollution control.

3. *Air pollution defined as:* Emission of smoke, particulate matter, soot, cinders, ashes, toxic and radioactive substances, vapors, gases, industrial odors and dust, which constitute a nuisance or a danger to public health or impair the public comfort and convenience.

4. *Enforcement procedures:* Violation of the regulations of the Commissioner is a misdemeanor.

ARKANSAS

(Recently the 1965 General Assembly of the State of Arkansas amended the Water Control Act to include air pollution and invested the control in the Arkansas Pollution Control Commission. A summary of this statute follows:)

1. *Agency to administer air pollution control:* Arkansas Pollution Control Commission.

2. *Powers of such agency:* Develop and effectuate a comprehensive program for prevention of all sources of pollution of the air; advise, consult and cooperate with other state agencies, political subdivisions and the federal government; encourage and conduct studies, investigations and research; establish reasonable air purity standards; collect and disseminate information; consider complaints, make investigations and hold hearings; encourage voluntary cooperation; administer and enforce all laws and regulations relating to pollution of the air; cooperate and receive moneys from the federal government or any other source for the study and control of air pollution; adopt reasonable and nondiscriminatory rules and regulations requiring a permit before any equipment causing the issuance of air contaminants may be built, erected, altered, replaced, used or operated and grants specific variances from the particular requirements of any rule, regulation or order to specific persons if it finds that strict compliance therewith is inappropriate because of conditions beyond the control of persons to whom the variances are granted or because of special circumstances make strict compliance unreasonable or because strict compliance might cause the substantial curtailment or closing of a business or because no other alternative facility is yet available.

3. *Air pollution defined as:* The presence in the outdoor atmosphere of one or more air contaminants in quantities, of characteristics and of a duration which are materially injurious or can be reasonably expected to become materially injurious to human, plant or animal life or to property or which unreasonably interfere with enjoyment of life or use of property, throughout the state or throughout such area of the state as shall be affected thereby.

Air contamination is the presence in the outdoor atmosphere of one or more air contaminants which contribute to a condition of air pollution.

Air contamination source is any source at, from, or by reason of which there is emitted into the atmosphere any air contaminant, regardless of

who the person may be who owns or operates the building, premises or other property in, at, or on which such source is located, or the facility, equipment or other property by which the emission is caused or from which the emission comes.

4. *Enforcement procedures:* Violation of the rules and regulations is a misdemeanor. Also it is a misdemeanor to knowingly cause air pollution as defined:

To construct, install, use, or operate any source capable of emitting air contaminants without having first obtained a permit so to do, if required by the regulations of the Commission, or to do so contrary to the provisions of any permit issued by the Commission or after any such permit has been suspended or revoked.

CALIFORNIA

1. *Agency to administer air pollution control:* The Department of Public Health.

(a) A Motor Vehicle Pollution Control Board, responsible directly to the Governor, was established in the State Department of Public Health.

2. *Powers of such agency:* Determines and publishes criteria for approval of motor vehicle pollution control devices, issues certificates of approval for certain devices, makes recommendations for necessary legislation to implement or enforce the act and adopts regulations specifying procedures for submitting motor vehicle pollution control devices for testing and certification.

(a) No new automobile shall be registered until compliance with the control device specified.

3. *Air pollution defined as:* None.

4. *Enforcement procedures:* A violation is a misdemeanor.

COLORADO

1. *Agency to administer air pollution control:* The State Board of Public Health.

2. *Powers of such Agency:* Develop air quality vehicle emission standards, identify areas where air does not meet Board's standards, and formulate criteria for approval of motor vehicle pollution control devices.

3. *Air pollution defined as:* The presence in the outdoor atmosphere of one or more of the following: dust, fumes, gas, mist, smoke, vapor, pollen or any combination thereof in quantities with characteristics and of a duration injurious to human plant or animal life or to property throughout the area.

4. *Enforcement procedures:* Local governmental units are means of enforcing the air standards.

DELAWARE

1. *Agency to administer air pollution control:* The State Board of Health.

2. *Powers of such agency:* To develop a program for prevention and control of air pollution in the state, to advise and consult with other agencies and groups, to encourage and conduct studies, investigations and

research, to disseminate information relating to air pollution, to promulgate rules and regulations and to issue necessary orders to promote correction of air pollution problems, to make investigations and hold hearings, to make reasonable inspection and to encourage voluntary cooperation in preserving air purity.

3. *Air pollution defined as:* None.

4. *Enforcement procedures:* Violation of the statutory provisions prohibiting nuisances is made a crime with a fine of not less than $25.00 nor more than $500 for each day of violation.

FLORIDA

1. *Agency to administer air pollution control:* The Air Pollution Control Commission in the State Board of Health. Also air pollution districts.

2. *Powers of such agency:* (a) Air Pollution Control Commission. Formally adopt and amend rules and regulations, hold hearings, authorize and create within the state such districts as are necessary for the prevention of air pollution, and advise.

(b) State Board of Health. To control air pollution in accordance with rules and regulations adopted by the Commission, conduct research programs, conduct state-wide programs of air pollution control education, require registration of persons engaged in operations which may result in air pollution and require filing of results, enter and inspect any building, except private residences, to ascertain compliance with rules and regulations, if owner consents or Board, after hearings, also directs, and to receive complaints and hold hearings.

3. *Air pollution defined as:* The presence in the outdoor atmosphere of substances in quantities which are injurious or reasonably could be expected to become injurious to human, plant or animal life; air pollution shall not be deemed to include smoke effluent from pulp or paper mills equipped with operating electrostatic precipitators or other mechanical devices where not less than 90% of the solids of such smoke are removed therefrom.

4. *Enforcement procedures:* If the Commission determines a violation of its rules, the defendant is given a time not in excess of 60 days to abate the violation. If such measures are not taken, the Commission institutes injunction proceedings to prevent further violations. Failure to comply with an order of the Commission is punishable by a fine up to $300 and each day of the violation constitutes a separate offense.

In 1963 the statute was amended to empower the Commission to require removal of a nuisance within 24 hours and if not done, the state health officer may remove such nuisance, or institute criminal proceedings or injunction proceedings. Keeping a nuisance injurious to health is made a misdemeanor.

Also air pollutants and gases and noisome odors which are harmful to human or animal life are prima facie evidence of maintaining a nuisance injurious to health. The state health officer investigates an alleged nuisance and when he determines such to exist, notifies owner to remove it within 24 hours or whatever State Board of Health determines a reasonable time. If such is not removed, the state health officer may remove nuisances, institute claim proceedings in county or municipal courts and institute other legal proceedings authorized by the State Board of Health. Creating such a nuisance is a misdemeanor.

HAWAII

1. *Agency to administer air pollution control:* The Board of Health.

2. *Powers of such agency:* Establish an air pollution control section, conduct research, conduct a program of air pollution control education, require all persons and governmental agencies engaged in operations which may result in air pollution to secure a permit prior to installation, to make the inspections and to adopt regulations.

3. *Air pollution defined as:* The presence in the outdoor atmosphere of substances in quantities which are injurious to human, plant or animal life or to property or which unreasonably interfere with the comfortable enjoyment of life and property throughout the state and in the areas affected thereby.

4. *Enforcement procedures:* The Board, if it finds a violation, shall endeavor to correct it by conference, conciliation or persuasion. Also, it may hold hearings and issue orders. If such orders are not obeyed, injunctive relief can be sought. If corrective action is not taken within 9 days of the time set in the order of the Board, a penalty of $100 for each 7 day period is provided. In addition the Board of Health may make regulations concerning nuisances such as gases, vapors, foul or noxious odors, or causes of sickness and disease within the state, and abate such nuisances.

IDAHO

1. *Agency to administer air pollution control:* The Air Pollution Control Commission in the State Board of Health.

2. *Powers of such agency:* To conduct research programs, air pollution control education, develop a comprehensive program for prevention and control, to adopt, amend and repeal rules and regulations to control and prohibit air pollution. Also it is directed to cooperate in requiring registration of persons engaged in operations which may result in air pollution, to police air pollution, and to enter any place except a private residence for the purpose of inspection.

3. *Air pollution defined as:* None.

4. *Enforcement procedures:* Persons found by the Commission to have violated any rule or regulation shall be subject to a fine of $500 per week beginning 10 days after the time fixed for taking of the preventive measures. The Commission can apply for injunctive relief.

Further, the Idaho statute exempts from taxation facilities, installations and machinery or equipment used to control air pollution.

ILLINOIS

1. *Agency to administer air pollution control:* The Air Pollution Control Board.

2. *Powers of such agency:* Develop a general comprehensive plan for control of air pollution, adopt and promulgate rules and regulations, enter orders, including orders to abate, institute legal proceedings to enforce compliance with its orders, and enter at all reasonable times any private or public property, except private residences, to investigate and inspect.

3. *Air pollution defined as:* The presence in the outdoor atmosphere of one or more air contaminants in sufficient quantities and of such characteristics and duration as to be injurious to human, plant or animal life

or to property, or which unreasonably interferes with the enjoyment of life and property.

4. *Enforcement procedures:* After the issuance of an order and attempt to eliminate a violation through conference, conciliation and persuasion, the Attorney General shall, upon the request of the Board, file suit for injunctive relief or for assessment of a penalty not to exceed $200 per day for a continued violation.

INDIANA

1. *Agency to administer air pollution control:* The Air Pollution Control Board as an independent enforcement agency in the State Board of Health.

2. *Powers of such agency:* Make investigations, conduct studies and research relating to air pollution, enter necessary orders and require action to abate air pollution, adopt rules and regulations, enforce its orders under applicable state law.

3. *Air pollution defined as:* The presence in the outdoor atmosphere of one or more air contaminants in sufficient quantities and of such characteristics and duration as to be injurious to human, plant or animal life, or to property, or which unreasonably interferes with the comfortable enjoyment of life and property.

4. *Enforcement procedures:* To enter and inspect at reasonable times all public and private property except private residences. A failure to comply with any rule or regulation or order is made unlawful. A further provision of this act is that every motor vehicle must be equipped with a muffler to prevent annoying smoke, and the engine and power mechanism of every automobile must be equipped to prevent the escape of excessive fumes or smoke.

LOUISIANA

1. *Agency to administer air pollution control:* The Air Control Commission of Louisiana.

2. *Powers of such agency:* To prepare and develop a general plan for the proper control of air resources, to adopt and promulgate rules and regulations, to enter at all reasonable times upon any private or public property except private residences for inspection and investigation, to hold hearings upon complaints or petitions for variance, and to enter such orders or determinations as may be necessary to effectuate the purposes of the law.

3. *Air pollution defined as:* Particulate matter, dust, fumes, gas, mist, smoke or vapor, or any combination thereof produced by processes other than natural.

4. *Enforcement procedures:* The technical secretary of the Commission may cause investigations to be made upon request of the Commission or upon receipt of information, and if he is of the opinion that a violation exists he shall try by private conference to eliminate it. If such fails, a hearing is held and the Commission enters an order. All orders of the Commission are subject to judicial review and the Commission may also institute a civil action for injunctive relief. Variances for periods up to one year may be granted by the Commission if it is determined that strict compliance with a Commission order will result in an arbitrary and unreasonable taking of property or in the practical closing of any lawful business or activity without corresponding public benefit.

MARYLAND

1. *Agency to administer air pollution control:* Air Pollution Control Council.

2. *Powers of such agency:* At the request of the State Board of Health, formulate and recommend to the Board rules and regulations for control of air pollution and may review air pollution policies and programs of the Board. The State Board of Health is authorized to adopt rules and regulations for controlling air pollution, to collect and disseminate information relative thereto, to encourage or enter air pollution control studies, to delegate to the Department of Health any of its duties, and to conduct air pollution control studies, investigations, research, training and demonstrations.

3. *Air pollution defined as:* None.

4. *Enforcement procedures:* The Department of Health enforces the provisions of this act and there is no civil liability for a violation caused by conditions not proximately caused by violator's negligence or willful misconduct. The penalty for violating the rules and regulations of the Board of Health is a fine not in excess of $500 and not over $200 for each additional day of violation. The Attorney General may recover such penalties in an action in a county circuit court of Maryland.

MASSACHUSETTS

1. *Agency to administer air pollution control:* The State Department of Health.

2. *Powers of such agency:* To adopt rules and regulations to prevent pollution of the air, to approve rules and regulations promulgated by local bodies, to advise local bodies concerning air pollution and to assume joint jurisdiction to regulate or control cause of atmosphere pollution arising in another locality.

3. *Air pollution defined as:* None.

4. *Enforcement procedures:* A violation of any order, rule or regulation of the Department or of a local control body is a misdemeanor.

NEW JERSEY

1. *Agency to administer air pollution control:* The Air Pollution Control Commission in the State Department of Health.

2. *Powers of such agency:* To formulate and promulgate codes, rules and regulations, hold public hearings, organize county air pollution control associations, conduct and supervise research programs and state-wide programs of air pollution control education, require registration and filing of reports, enter and inspect any building or place except private residences, receive or initiate complaints of air pollution.

3. *Air pollution defined as:* None.

4. *Enforcement procedures:* If the Commission finds a violation exists, it may order such violation to cease and, if not, the penalty is not less than $25 nor more than $500; this may be recovered in a civil action.

Recently New Jersey created a Motor Vehicle Air Pollution Control Study Commission to study the problem of motor vehicle caused air pollution and smog conditions, and the methods of control.

NEW YORK

Agency to administer air pollution control: The Air Pollution Control Board in the State Department of Health.

2. *Powers of such agency:* To promulgate codes, rules and regulations for air pollution, to enter and inspect any property or any motor vehicle and to develop a general comprehensive plan for control of air pollution.

3. *Air pollution defined:* None.

4. *Enforcement procedures*: The Board shall try, by conference and persuasion, to eliminate the cause of air pollution. If not, it may hold a hearing and issue an order. Failure to follow such order leads to a fine not to exceed $500 and not in excess of $100 each day in which it continues. Injunctive relief is also provided.

In addition, the power of the Interstate Sanitation Commission was extended in 1960 to enable it to engage in activities with respect to air pollution problems between New York and New Jersey. Also, motor vehicle pollution control is provided.

OREGON

1. *Agency to administer air pollution control:* The Sanitary Authority of Oregon.

2. *Powers of such agency*: To develop a comprehensive plan for control of existing air pollution and prevention of new pollution, encourage cooperative activities and formulate and execute plans for air pollution control, conduct studies, demonstrations, research and educational programs relative to air pollution control and to enforce the statutes relating to air pollution.

3. *Air pollution defined as*: A presence in the outdoor atmosphere of one or more air contaminants, in quantities, of characteristics and of a duration which are injurious to human, plant or animal life or to property, or which unreasonably interfere with enjoyment of life and property throughout the state of such area of the state as shall be affected thereby.

4. *Enforcement procedures*: Adopt rules and regulations, conduct hearings, compel compliance with its orders by judicial proceedings, and enter and inspect any premises after four hours notice. All rules, regulations and determinations are subject to judicial review and the Authority may ask for injunctive relief. Further, the Authority may bring an action without administrative proceedings to abate or restrain threatened or existing pollution when such creates an emergency or requires immediate action to protect health, safety or welfare.

PENNSYLVANIA

1. *Agency to administer air pollution control:* The Air Pollution Commission.

2. *Powers of such agency*: Adopt rules and regulations for control of air pollution, hold hearings, require measures for minimization of air pollution and establish maximum permisible air contaminant qualities.

3. *Air pollution defined as*: None.

4. *Enforcement procedures*: By the courts and it is made unlawful to refuse to comply with the Commission's regulations and any person engaged in unlawful conduct, upon conviction, at summary proceedings may be fined. Conviction of a third or a subsequent offense is a misdemeanor. Injunctive relief is also available to force compliance with the Commission's orders.

WEST VIRGINIA

1. *Agency to administer air pollution control*: Air Pollution Control Commission.

2. *Powers of such agency*: To develop ways and means to control air pollution, to consult and cooperate with public and private agencies, to encourage and conduct research, to adopt and promulgate rules and regulations, to enter private property, to give public notice of imminent public health hazards and to appoint technical advisory councils.

3. *Air pollution defined as*: A discharge into the air by act of man, of substances (liquid, solid, gaseous, organic or inorganic) in a locality, manner and amount as to be unreasonably and materially injurious to human, animal or plant life or property.

4. *Enforcement procedures:* The Attorney General and his assistants, and the county prosecuting attorneys shall provide legal services required by the Commission to enforce its rulings. Whenever the Commission finds air pollution conditions in any area create an emergency and require immediate action for the protection of public health, it may, with the Governor's approval, issue an order to reduce or prevent emissions contributing to such conditions and giving notice of the hearings to be held within twenty-four hours. Appeals to the courts are permitted from the Commission's order. A violation of a Commission order is a misdemeanor leading to a fine of $100 a day. Injunctive relief is also provided.

MINNESOTA

(Limited control) In 1957 the Minnesota statute was amended to authorize the State Board of Health to make regulations regarding atmospheric pollution which may be injurious or detrimental to the public health. Such regulations have the force of law except as they conflict with any statute or charter or ordinance of a city of the first class. The Board may require the taking out of licenses or permits to achieve its purpose of regulation.

LOCAL ORDINANCES

Throughout the State of Virginia

The cities of Alexandria, Danville, Fairfax, Newport News, Richmond, Roanoke, and Winchester were reviewed.

All of these ordinances were written primarily as smoke control measures, and are based on the Ringelmann Chart. Gas pollution is mentioned in most of them, but rather directly tied into smoke and contaminants from heating units.

The air pollution ordinance recently adopted by the Richmond City Council is a true air pollution control ordinance.

This is not to say that the ordinances of some of these cities are not sufficient for their need, but rather that in a good many communities smoke may play a very small part in the total problem.

APPENDIX B

Section I. *Air Pollution From Power Plants*

There are four main types of air pollution produced from power plants. These are smoke, fly ash, sulfur oxides, and nitrogen oxides. Every attempt to control air pollution from power plants is directed at these sources.

Smoke, unburned hydrocarbons, results from incomplete combustion in the boilers. Smoke is that part of air pollution which is responsible for the reduction in visibility. Fly ash is the particulate matter resulting from the combustion of pulverized coal. As its name implies, it is the resulting ash. When uncontrolled, fly ash is discharged from the stacks and settles in the area of the power plant. The gaseous discharges, sulfur oxides and nitrogen oxides, are toxic when concentrated and have objectionable odors.

Smoke is controlled by dust collectors and the use of high stacks. Smoke can also be controlled by complete combustion in the boiler; however, this approach is impractical. Fly ash is effectively controlled by dust collectors up to a certain point. Nitrogen oxides are normally produced in very low concentrations, and in these low concentrations they pose no real problem. There are two solutions to reduce the sulfur oxides from the stack gases. Eliminate the sulfur from the fuel before burning or eliminate the sulfur oxides from the stack gases. The first method is impractical, however, the second method is technically possible, but the concentration of pollutants is so small that they are difficult to remove or utilize economically.

There are many techniques and devices which have been designed to control air pollution from power plants. The most useful and economically feasible will now be discussed.

The use of high stacks is a very satisfactory method of diffusing the stack gases into the atmosphere. This results in a low concentration of the gases and prevents them from settling to the earth. The selection of stack height is a stuly which requires the consideration of many variables. Among these variables are population density, fuels to be used, study of the terrain, meteorological factors, stack gas exit velocity and temperature, and others. Thuse the selection of height is tedious, and usually computers are needed. With the coming of larger power plants, stack heights are steadily increasing. This is because the larger power plants consume more fuel and thereby they produce more contaminants. While high stacks are useful in diffusing the gaseous products of combustion, they can only disperse and not collect the particulate matter.

Dust collectors are used to trap and eliminate particulate matter called fly ash. These collectors are very efficient when properly employed. Three types of dust collectors are in general use. These are electrostatic precipitators, mechanical precipitators, and a combination of both.

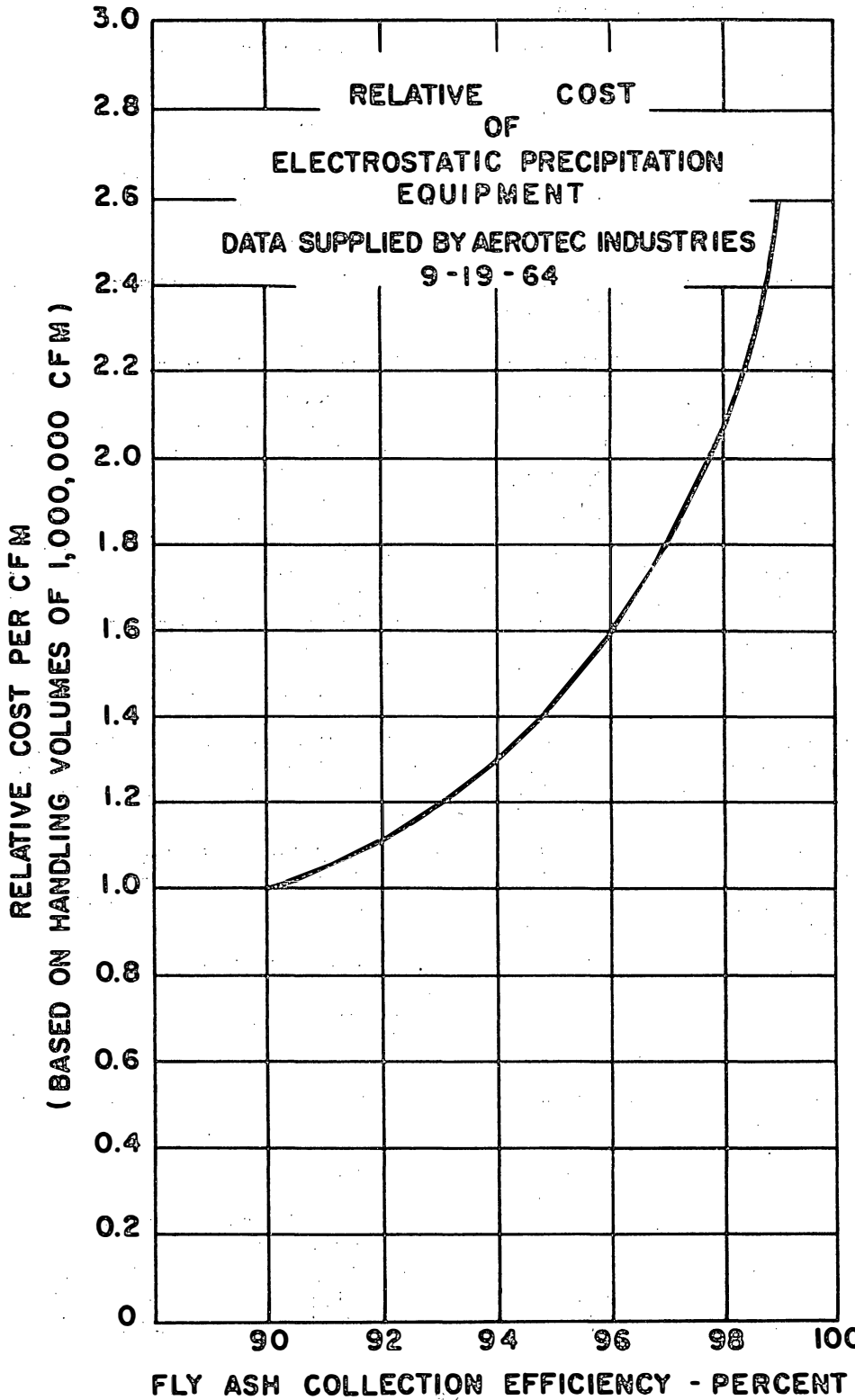
Electrostatic precipitators electrically collect particulate matter for their disposal. This precipitator uses a high direct current voltage, 30,000 to 70,000 volts, to charge and trap the fly ash contained in the flue gas. The electrostatic precipitator is the best type of dust collector, and its efficiency approaches one hundred per cent. However, at these extremely high efficiencies, the comparative capital cost is also much higher. This is illustrated in Chart 1. A precipitator which traps 98 per cent of the

total fly ash costs more than twice as much as one which traps 90 per cent. A two per cent increase in efficiency from 97 per cent to 99 per cent results in an increase of 80 per cent in cost. Therefore, it is not always practical to increase an electrostatic precipitator's efficiency from 97 per cent to 99 per cent. In order to meet the stringent air pollution regulations in the New York City area, Consolidated Edison Company of New York installed an electrostatic precipitator costing in excess of $10,000,000. A balance between efficiency and cost must be reached which will yield a reasonable cost. The electrostatic precipitator is well adapted to the power plant, and has no serious limitations.

There are several classifications of mechanical precipitators. Among these are cyclones, cloth arresters, wet collectors, and fume towers or filters. Bag filters have been used on very small power stations on an experimental basis. However, only the cyclone types are feasible for use in power stations. The other types are not presently capable of handling the volume of gas produced in a power station, or they do not attain the desired level of efficiency. The efficiency cyclone depends on centrifugal action in a volute to separate the fly ash. The efficiency cyclone is useful in power plant applications because its efficiency reaches 90 per cent. The disposal of the fly ash is necessary after it has been separated from the flue gas. This procedure is explained in Section V.

In some cases, both mechanical and electrostatic precipitators are used in combination. This usually occurs when the existing precipitator is not capable of meeting new pollution requirements. Normally, the mechanical precipitator is placed ahead of the electrostatic precipitator, for the purpose of gas distribution; however, this is not always satisfactory and other arrangements must be studied.

CHART 1


RELATIVE COST
OF
ELECTROSTATIC PRECIPITATION
EQUIPMENT
DATA SUPPLIED BY AEROTEC INDUSTRIES
9-19-64
RELATIVE COST PER CFM
(BASED ON HANDLING VOLUMES OF 1,000,000 CFM)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
90
92
94
96
98
100
FLY ASH COLLECTION EFFICIENCY - PERCENT

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Section II. *Air Pollution From Residential and Commercial Heating*

The effect of residential and commercial heating in the air pollution problem is often underestimated. This pollution may appear minute, but when the large number of these heating units is considered the overall effect can be important. Coal-burning homes and establishments, where furnace maintenance and combustion efficiency are not normally maintained to quality standards, can lead to a large contribution to the air pollution of an industrial city. Residential and commercial heating and refuse-disposal problems cause from 7 to 32 per cent of the total air pollution of a community. Since the effect can vary from 7 to 32 per cent, it is necessary to study each community separately to determine the portion that residential and commercial heating contribute. This effect approaches a maximum when hand-fired coal furnaces are used and a minimum when gas furnaces are used. This is illustrated by Case I and Case II in Table I. Case I represents a situation in which coal is the major fuel for residential and commercial heating and in Case II gas and oil are the major fuels. At the higher percentages, the pollution due to residential and commercial heating is significant and must be considered to attain a reasonable control of air pollution.

Table I shows the contaminants produced by residential and commercial heating, the amount of the contaminants produced, and the per cent produced of the total. Table II shows the amount of contaminants produced by the different types of fuels.

As previously stated, the type of fuel consumed affects the amount of the pollution produced. The use of coal, for residential and commercial heating, results in a large amount of contaminants, while oil produces approximately one-seventh as much. When gas is used, the amount of contaminants is negligible.

More efficient fuel utilization in these heating units is one approach in curbing their effect on air pollution, but normally this change does not justify the expense involved. A change to a fuel that produces less contaminants is a logical approach to the problem; however, the alternative fuel may not be available or the economics involved in the change may be prohibitive. It is illustrated in Table II, for a specific set of conditions, that the amount of contaminants produced by different types of fuels descends in the order of coal, oil and gas. Naturally, a change to electric heating will completely eliminate air pollution from this source. The benefits of changing fuels have been demonstrated in Pittsburgh and St. Louis.

TABLE I

CONTAMINANTS	POUNDS OF CONTAMINANTS PER 100,000 PERSONS			PER CENT OF TOTAL CONTAMINANTS	
	TOTAL METROPOLITAN ACTIVITIES	RESIDENTIAL AND COMMERCIAL AND WASTE DISPOSAL			
		CASE I*	CASE II**	CASE I*	CASE II**
SO_2 & SO_3	62,840	20,347	2,635	32	4
Oxides of Nitrogen	34,240	4,480	1,462	13	4
H_2S	4,040	5,050	105	12	4
NH_3	2,782	1,241	201	45	7
Aldehydes	3,620	1,456	309	40	9
Organics	129,400	42,760	1,329	33	10
Organic Acids	28,720	15,540	3,433	54	12
Solids	337,200	85,120	3,720	25	11

CONTAMINANTS	POUNDS OF CONTAMINANTS PER 100,000 PERSONS			PER CENT OF TOTAL CONTAMINANTS	
	TOTAL METROPOLITAN ACTIVITIES	RESIDENTIAL AND COMMERCIAL AND WASTE DISPOSAL			
		CASE I*	CASE II**	CASE I*	CASE II**
Total	603,000	172,000	132,000	32	7

*Case I represents a maximum of adverse conditions and thus a maximum of air pollution.

**Case II represents a minimum of adverse conditions.

TABLE II

CONTAMINANTS	POUNDS PER DAY PER 100,000 PERSONS FUEL - HEATING COAL*	OIL	GAS
SO_2 & SO_3	42,000	17,000	.4
Oxides of Nitrogen	8,000	6,000	6
H_2S	1,000	500	.1
NH_3	2,000	800	.3
HCl	2,000	500	.3
Aldehydes	2,000	800	1
Organics	20,000	4,000	1
Organic Acids	30,000	12,000	1
Solids	200,000	800	.1
Total	307,000	42,400	10

*Average grade bituminous coal.

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The Denver Area Air Pollution Problem, U. S. Department of Health, Education and Welfare—June 1957

Section III. *Air Pollution From Disposal of Solid Waste*

It has been found that refuse-disposal problems are coincident with air pollution problems. The open burning of trash produces a large quantity of contaminants, and the small household incinerator is nearly as ineffective as open burning. Apartment incinerators are more effective than household incinerators, but they also leave something to be desired.

Table III indicates the amounts of the principle contaminants produced per day per 100,000 people for different situations such as household and apartment incineration, backyard burning, burning dumps, and so forth.

Household incinerators and open burning units operate on low temperatures which allow only partial combustion and produce large particles and odors. The term open burning refers to backyard burning, municipal open dumps, open burning of cars, sawdust, tires, and etc. All types of this open burning are very detrimental to the problem of air pollution. In Los Angeles, where air pollution has been extensively studied, it is forbidden to eliminate trash by open burning.

Before a suitable control on air pollution can be accomplished, waste disposal must be carried out in a manner which will contribute a minimum to air pollution. To effectively handle these wastes, municipal control is needed.

There are two main ways municipal control can dispose of these wastes: large municipal incinerators and sanitary land-fills. Large municipal incinerators which operate at high temperatures release much less contaminants than the household and apartments incinerators. Combustion is more nearly complete at these higher temperatures and thus smoke, particles, and odors are greatly reduced. Also in these large incinerators, it is possible to employ the benefits of high stacks and dust collectors which cannot be used on small incinerators. Table III indicates the contaminants resulting from large incinerators and land-fills.

Land-fills are another method in which the problem can be approached. Only traces of contaminants result when land-fills are properly employed. They must be carefully used to protect against wind, rats, flies, and other types of nuisances. Land-fills involve laying the rubbish down in layers and packing it with bulldozers and then covering with earth. Open dumping is not a substitute for land-fills. Land-fills must be placed in an area where surface water cannot be contaminated, and they must be at least two feet from the ground-water table.

According to Los Angeles' surveys, the large incinerators are costing around $3.50 per ton of refuse disposed while land-fills can be operated for as little as $1.00 per ton. Rubbish is indeterminate in its calorific value; therefore, it cannot be used in a normal heating process. Thus the incinerator's heat can not help pay any of the expense involved. Finding land suitable for land-fills at a convenient location may be a problem. However, it has been estimated that land-fills can be operatel cheaper than incinerators even when it is necessary to transfer the refuse 55 miles one way.

Another major problem in the disposal of solid waste is "by ash," which results from the combustion of solid fuels and is primarily associated with the manufacturing and utility industry. Recently, fly ash has been successfully utilized as an additive in concrete and cement products. This appears to be an ideal solution to the problem of disposal. However, most fly ash contains carbon and other objectional chemicals in quantities that prohibit its use in concrete. The present market for fly ash is limited, and the fly ash not utilized in industry must be controlled by disposal in suitable areas. These areas must be properly protected to avoid water pollution. Some areas used to store fly ash were formally barrow pits and old strip mines which in many cases were restored to usable land—unfortunately such areas are not normally within an economical hauling radius of the industry or municipality. The cost to construct and maintain these ash storage areas and the cost of transporting the fly ash constitutes a sizeable industrial operating expense.

TABLE III

CONTAMINATES	POUNDS OF CONTAMINANTS PER DAY PER 100,000 PERSONS USING EACH CATEGORY OF REFUSE DISPOSAL					
	BURNING DUMPS	BACKYARD BURNING	HOUSEHOLD INCINERATION	APARTMENT INCINERATION	MUNICIPAL INCINERATION	SANITARY LAND-FILL
SO_2 & SO_3	180	180	1	12	290	---
Oxides of Nitrogen	90	90	1,150	30	320	---
H_2S	-	-	-	24	-	Trace
NH_3	345	345	-	24	45	Trace
Aldehydes	600	600	8,400	72	168	---
Organics	42,000	42,000	12,000	1,800	210	Trace
Organic Acids	225	225	1,900	4,800	90	---
Solids	7,000	3,400	16,500	4,000	3,450	---
TOTAL	50,400	46,800	40,000	10,700	4,570	LOW

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"The Denver Area Air Pollution Problem", U. S. Department of Health, Education and Welfare, June—1957

Fly Ash Utilization, Prime Movers Committee, Edison Electric Institute February 1958

Section IV. *Manufacturing Industries*

For convenience, the many industrial operations which may constitute a source of air pollution are grouped into the type of pollutant likely to be emitted. Obviously many industries will fall into more than one category.

A. *Dusty Industries*

Whenever a solid is broken down into fine particles (by blasting, crushing, grinding, sanding) or whenever the fine particles are subsequently handled (conveying, classifying, mixing, drying, calcining) dust problems may arise. The major dusty industries are shown in Table I along with the operations which may produce dusts.

The particle size of dusts may vary from about 1000 microns down to less than 0.1 micron (.001 mm=1 micron=1/25,000 in). Figure I shows the particle sipe range for several types of equipment. If the gas containing the dust can be contained, one of these methods will remove the dust, but at a cost (consisting of capital, operating and maintenance costs). Relative capital costs are shown in Figure 2.

B. *Smoke and Stack Emissions*

Combustion of fuels for heat and/or power might be considered the common denominator of industry. Emissions from these sources are dealt with in Section I and II. Another possible source is the burning of waste materials. This is discussed in Section III.

C. *Odors*

Industry emits its share of odor which is perhaps the most complex of all air pollution problems. Table 2 gives a list of odor-producing industrial operations. The only good measuring device for odors is the human nose and noses are notoriously variable and undependable. There is disagreement as to what is an offensive odor, unfamiliar odors are more likely to be considered offensive than a familiar one, one can become accustomed to some odors and not notice them.

When the odorous material is emitted from a point source, it can usually be contained and destroyed. The means for this are by absorption or scrubbing (when the odorous vapors are soluble or emulsifiable in a liquid), absorption, particularly on activated carbon (for low concentration) and combustion if the concentration is sufficiently high. Chemical oxidation, masking and counteraction may also be effective in some cases.

Where odorous material is emitted from many sources such as leaky valves, multiple transfer operations or from wide areas such as catch basins, open chutes, of waste lagoons, the problem is considerably more difficult. Good housekeeping will help, but the completely odorless plant, particularly in such industries as organic chemicals, foods, pulp mill, and petroleum is still in the future.

D. *Irritating and Toxic Substances*

1. The most common irritating or potentially toxic gas emitted industrially is sulfur dioxide. Primarily this is again in flue gases from the burning of oil and coal. Scrubbing with water or ammonia can be made to work but at an intolerable price. Short of shutting down the offender or requiring a different fuel, (which may be unavailable), proper dispersion and taking advantage of the diluting power of the atmosphere is the only solution.

When present in higher concentrations, water scrubbing may be used or in some instances sulfur dioxide is used chemically.

2. Fluorides, both gaseous and particulate, represent another potentially toxic industrial pollutant. Chief emitters of fluorides are the steel industry, superphosphate manufacture and brick and tile manufacture. For both gaseous and soluble fluorides, gas-liquid contact apparatus such as packed towers and spray towers are effective. Insoluble fluorides such as calcium fluoride may be collected by the various dust-collecting means referred to in Paragraph A.

3. Carbon monoxide is generally present in such low concentration that it can be readily dispersed in the atmosphere. In the few cases where it is present in high concentration it is burned and heat recovered as in some refineries and steel mills.

4. Acid and alkali mists are discharged from industrial operations on occasion. These can be removed by filters, electrostatic precipitators and/or scrubbers.

5. Solvents and other organic materials are emitted by a number of industries. In the case of large solvent emissions, it is usually necessary to recover the material for economical operation but smaller emissions may be exhausted to the atmosphere and become a source of air pollution. If not recovered, solvent vapors and other organic materials can be incinerated at high temperatures.

6. Some materials which in themselves may be relatively innocuous are capable of reacting in the atmosphere to produce compounds with effects completely different from the parent materials. For example, ammonia from one source might mix with hydrogen chloride from another source to produce a haze even though the gases separately are invisible. In such cases one or both of the reactants must be reduced or eliminated.

E. *Economics*

Table 3 gives an idea of the costs of control equipment related to the cost of basic equipment. Operating costs are not shown. The cost of control equipment ranges from a fraction of the cost of the basic equipment up to and exceeding the cost of the basic equipment itself. Overall, the cost of the control equipment represented in this study amounted to 14% of the cost of the basic equipment.

The Manufacturing Chemists' Association surveyed their members to determine capital investment and operating costs of their air pollution control facilities as of 1962. This survey is shown as Table 4. Of particular interest are the data from the 24 plants in Virginia. These plants reported a total capital investment of $3,841,000 with a projected additional investment within five years of $893,000. The annual operating cost at the time of the survey was $385,000 per year, or approximately 10% of the capital invested in air pollution control facilities.

It should be pointed out that the air pollution problems of old plants are more difficult to solve than those of new ones. It is simpler and cheaper to include modern control equipment in the design of a new plant than to find space in an old one for even a much smaller unit. In some old plants, it might be cheaper to build a new plant than to provide controls.

Also, the degree of control required has a profound effect on costs. The graph in Section I relates the cost of electrostatic equipment to collection efficiency. In some cases, requiring greater efficiency may mean a change in equipment or two different types in series. In either case, costs may be expected to show a geometric increase with increased efficiency requirements. Demands for 100% efficiency would likely mean closing the plant.

TABLE 1. THE MAJOR DUSTY INDUSTRIES

Industry	Principal dust-emitting operations (See Key)
Carbon black	3,4,7,11
Cement	1,2,4,5,7,10,11,14
Chemicals	
(e.g., soda ash, pigments, dyes)	2,3,4,5,6,7,10,11,14
Fertilizer	1,3,4,5,6,7,10,11,13,14
Food	
Dry goods	4,5,6,7,10,11
Foundries -- ferrous and non-ferrous	4,7,8,9
Grain and feed	4,5,6,7,10,11
Lumber and wood products	9
Machinery	12
Minerals	
Lime, gypsum, asbestos, rock products, etc.	1,2,3,4,5,6,7,10,11,13,14
Mining	1,4,5,6,13,14
Smelters	1,2,3,4,5,7,8,13,14
Steel	2,3,4,5,7,8,10,14

Key to Dust-producing Operations:

1. Blasting
2. Calcining
3. Chemical processing
4. Conveying
5. Crushing and grinding
6. Drying
7. Loading and unloading
8. Metal processing
9. Milling, cutting and forming
10. Mixing
11. Packaging
12. Sanding and finishing
13. Sorting
14. Storage piles

Table 2. ODOROUS INDUSTRIAL OPERATIONS

Industry	*Odorous material*
Chemical manufacture	hydrogen sulfide, ammonia, amines, alcohols, aldehydes, phenols, mercaptans, esters, chlorine and chlorinated organics, etc.
Coke ovens	sulfurous, ammoniacal, and phenolic compounds
Fertilizer	bone meal organic nitrogen compounds, ammonia
Food and kindred products	dairy wastes, canner wastes, fish, baking bread, chocolate, flavors, packinghouse wastes, meat products for rendering, coffee roaster effluents, cooking odors, etc.
Foundries	core-oven odors, quenching oils
General industrial	burning rubber, forming and molding plastics, incinerator smoke, solvents and lacquers, asphalt
Petroleum	sulfur compounds from crude oil, cresols, asphalt
Pharmaceuticals	biological extracts and wastes, spent fermentation liquors
Pulp and paper	sulfurous compounds
Soap and toiletries	perfumes, animal fats
Tanneries	hair, flesh, hides

TABLE 3.—*Typical costs of basic and control equipment installed in Los Angeles County*

Source	Size of equipment	Cost of basic equipment	Type of control equipment	Cost of control equipment
Airblown asphalt system	500 bbls./batch	$10, 500	Afterburner	$3, 000
Asphalt concrete batching plant	200,000 lbs./hr	150, 000	Scrubber	10, 000
Asphalt saturator	6 by 65 by 8 ft	40, 000	Scrubber and electric precipitator.	50, 000
Asphalt tile production	5,000 lbs./hr	150, 000	Baghouse	5, 000
Borax drying and classifying	10,000 lbs./hr	1, 000, 000	Baghouse and scrubber	10, 000
Bulk gasoline loading rack	667,000 gals./day	88, 000	Vapor control system	50, 000
Carbon black plant	2,000 gals./day	5, 000	Baghouse	5, 000
Catalytic reforming unit	2,400 bbls./day	265, 000	Flare and sour water oxidizer.	6, 000
Ceramic tile production	8,000 lbs./hr	200, 000	Scrubber	10, 000
Chip dryer, aluminum	2,500 lbs./hr	3, 000	Afterburner	3, 000
Chrome plating	4 by 5 by 5 ft	2, 000	Scrubber	800
Coffee roaster	3 tons/hr	35, 000	Cyclone and afterburner	8, 000
Concrete batching plant	900,000 lbs./hr	125, 000	Baghouse	10, 000
Core oven	8 by 8 by 12 ft	4, 000	Afterburner	1, 500
Crucible furnace, yellow brass	4 furnaces @ 850 lbs. each/heat.	[1] 2, 500	Baghouse	17, 000
Crude oil distillation unit	37,000 bbls./hr	3, 060, 000	Vapor control system	10, 000
Cupola, gray iron	48" ID	40, 000	Baghouse and quench tank	67, 000
	27" ID	25, 000	do	32, 000
Debonder	500 brake shoes/hr	1, 800	Afterburner	300
Deep fat fryer, food	1,000 lbs./hr	15, 000	do	1, 500
Delayed coker unit	9, 300 bbls./day	4, 000, 000	Scrubber (serving 3 cokers)	385, 000
Drum reclamation incinerator	60 bbls./hr	10, 000	Afterburner	2, 000
	200 bbls./hr	25, 000	do	5, 000
Electric arc furnace, steel	18 tons/heat	75, 000	Baghouse	45, 000
Electric induction furnace, brass	2, 000 lbs./hr	75, 000	do	2, 700
Enamel frit drying	1, 500 lbs./hr	25, 000	do	3, 000
Fiberboard production	32,000 lbs./hr	10, 000	Electric precipitator	15, 000
Fire-retardant manufacturing	1, 000 lbs./hr	25, 000	Baghouse	2, 000
Fixed roof storage tank for gasoline	80,000 bbls	50, 000	New floating roof tank	132, 000
Flue-fed incinerator	Most sizes	4, 000–7, 000	Afterburner	2, 500
Fluid catalytic cracking unit	40,000 bbls./day	7, 460, 000	Electric precipitator	1, 040, 000
			CO boiler	1, 770, 000
			Cyclones	165, 000
			Blowdown systems, vapor manifold, and flare.	363, 000
	7,400 bbls./day	1, 747, 500	Electric precipitator, vapor manifold, and flare.	131, 000
Galvanizing kettle	4 by 30 by 4 ft	25, 000	Baghouse	3, 000
Gritblasting machine	6 cu. ft	9, 300	do	1, 700

[1] Each.

TABLE 3.—*Typical costs of basic and control equipment installed in Los Angeles County*—Continued

Source	Size of equipment	Cost of basic equipment	Type of control equipment	Cost of control equipment
Insecticide manufacturing	1,000 lbs./hr	10,000	do	3,000
Insulation production, including cupola, blow chamber, and curing oven.	5,000 lbs./hr	13,000	Baghouse, scrubber, and afterburner.	30,000
Liquid hydrogen manufacturing	32 tons/yr	8,392,000	Flare	17,700
Lithographing oven	240 ft./min	78,000	Afterburner	15,000
Multiple-chamber incinerator, industrial and commercial.	50 lbs./hr	800		
	500 lbs./hr	6,500		
	6000 lbs./hr	75,000		
Multiple-chamber incinerator, pathological.	50 lbs./hr	1,000		
	200 lbs./hr	4,500		
Multiple-chamber incinerator, wire reclamation.	100 lbs./hr	1,200		
	1,000 lbs./hr	15,000		
Multiple-chamber incinerator, with continuous feed bin.	250 lbs./hr	5,000		
	3,000 lbs./hr	45,000		
Natural gas plant	20,000,000 cu. ft./day	220,000	Vapor manifold and flare	5,000
Oil-water separator	300,000 bbls./day	170,000	Floating roof	80,000
	350 bbls./day	17,000	Cover	700
	3,500 bbls./day	32,000	Floating roof	8,000
Open hearth furnace, steel	60 tons/heat	200,000	Electric precipitator	150,000
Phosphate fertilizer production	2,000 lbs./hr	10,000	Baghouse	5,000
Phthalic anhydride manufacturing plant.	25,000,000 lbs./yr	1,200,000	Afterburner and baghouse	195,000
Pipe coating, including spinning, wrapping, and dipping.	4–10 lengths/hr	23,500	Scrubbers	32,000
Pneumatic conveyors (minerals)	200 to 5,000 lbs./hr	2,000	Cyclone and baghouse	2,000
Pot furnace, type metal	16,000 lbs	9,000	Afterburner	3,000
Rendered grease processing	6 tons/day	10,000	Contact condenser and afterburner.	2,500
Rendering cooker and drier (batch)	4 tons/batch	10,000	Surface condenser and afterburner.	15,000
Rendering cooker system (continuous).	15 tons/hr	100,000	do	25,000
Rock crushing and sizing	300,000 lbs./hr	75,000	Scrubber	2,000
Rotogravure press	5-color, 44-inch web	340,000	Activated carbon filter	40,000
Rubber Banbury mixer	1,000 lbs./hr	25,000	Baghouse	3,000
Sandblast room	8 by 12 by 8 ft	1,600	do	3,000
Sewage treatment digestion	900,000 gals./day	800,000	Water seals and flares	7,000
Sewage treatment headworks	250,000,000 gals./day	550,000	Covers	20,000
Sewage water reclamation	17,000,000 gals./day	1,500,000	Covers and aeration tanks	25,000
Sewer pipe manufacturing	20,000 lbs./hr	1,000,000	Baghouse	10,000
Ship bulk loading	2,500 tons/hr	500,000	do	168,000
Smoke generator and smokehouse	11 by 14 by 11 ft	18,000	Precipitator, scrubber, and afterburner.	42,000
Sulfuric acid plant	250 tons/day	1,900,000	Electrostatic precipitator	150,000
Sulfur recovery plant	2 parallel units, 65 tons/day, each.	1,400,000	Incinerator	30,000
	10 tons/day	265,000	do	5,000
	2,840 lbs./day	30,000	do	1,000
	8,000 lbs./day	60,000	do	1,000
Sweat furnace, aluminum	3,000 lbs./hr	3,500	Afterburner and baghouse	3,500
Synthetic rubber manufacturing	30,000 tons/yr	1,600,000	Vapor manifold and flare	250,000
Synthetic solvent dry cleaner	60 lbs./batch	14,000	Activated carbon filter	3,000
Varnish cookers (2)	250 gallons each	4,000	Afterburner	5,500
Wallboard production	60,000 lbs./hr	1,500,000	Baghouse	100,000

States	Number of Reporting Chemical Plants	Number of Different Communities	Total Employment Represented	Air Pollution Control Facilities: Capital Investment To Date *	Projected Additional Investment Next Five Years *	Current Annual Operating Cost *	Current Annual Manpower Requirements (Man-Years)
Alabama	17	14	3,467	$1,194,000	$ 115,000	$ 259,000	9.8
Arizona, Colorado, Kansas, Nevada, New Mexico, Oklahoma, Utah	19	16	9,279	3,379,000	715,000	639,000	45.5
Arkansas	14	9	2,209	483,000	70,000	151,000	8.5
California	69	44	11,003	8,503,000	4,467,000	933,000	66.3
Connecticut	8	8	6,723	1,085,000	325,000	69,000	13.6
Delaware	17	8	11,226	5,313,000	80,000	568,000	26.7
Florida	17	12	11,279	7,395,000	3,011,000	2,017,000	62.2
Georgia	14	10	3,501	1,383,000	232,000	84,000	4.4
Idaho, Minnesota, Montana, Nebraska; No. Dakota, So. Dakota, Wyoming	11	8	2,169	2,768,000	620,000	710,000	30.4
Illinois	51	32	19,029	6,505,000	1,914,000	1,162,000	56.5
Indiana	14	11	2,364	1,044,000	556,000	127,000	3.9
Iowa	10	9	2,224	844,000	337,000	166,000	17.3
Kentucky	19	10	6,427	8,854,000	1,745,000	667,000	37.8
Louisiana	31	17	10,967	6,778,000	2,531,000	769,000	38.8
Maine, New Hampshire, Rhode Island, Vermont	4	4	415	2,000	0	#	0.1
Maryland	18	6	6,726	2,974,000	395,000	535,000	19.4
Massachusetts	25	17	6,918	996,000	249,000	136,000	9.2
Michigan	34	22	18,837	10,339,000	1,566,000	1,715,000	51.9
Mississippi	6	6	1,254	219,000	101,000	27,000	2.6
Missouri	17	10	7,896	5,705,000	1,155,000	739,000	49.8
New Jersey	84	52	43,980	31,762,000	9,477,000	2,322,000	109.2
New York	51	28	51,825	17,704,000	2,963,000	984,000	112.6
North Carolina	16	14	2,949	377,000	53,000	31,000	3.7
Ohio	72	44	26,970	21,819,000	4,415,000	1,876,000	123.7
Oregon, Washington	20	13	1,660	786,000	169,000	86,000	4.9
Pennsylvania	43	36	18,597	9,720,000	1,569,000	1,382,000	73.0
South Carolina	12	8	5,712	839,000	115,000	108,000	4.8
Tennessee	26	15	11,500	7,179,000	2,522,000	979,000	68.9
Texas	82	38	40,239	32,868,000	4,067,000	3,019,000	185.8
Virginia	24	19	22,698	3,841,000	893,000	385,000	29.3
West Virginia	23	18	19,178	8,812,000	2,572,000	1,082,000	66.2
Wisconsin	9	8	1,915	346,000	262,000	38,000	3.4
TOTAL	877	566	391,136	$211,816,000	$49,261,000	$23,765,000	1,340.4

* Rounded to nearest $1,000
\# Less than $1,000

Data courtesy of Manufacturing Chemists' Assoc., Inc.

FIG. 1—PARTICLE SIZE RANGE FOR SEVERAL TYPES OF EQUIPMENT

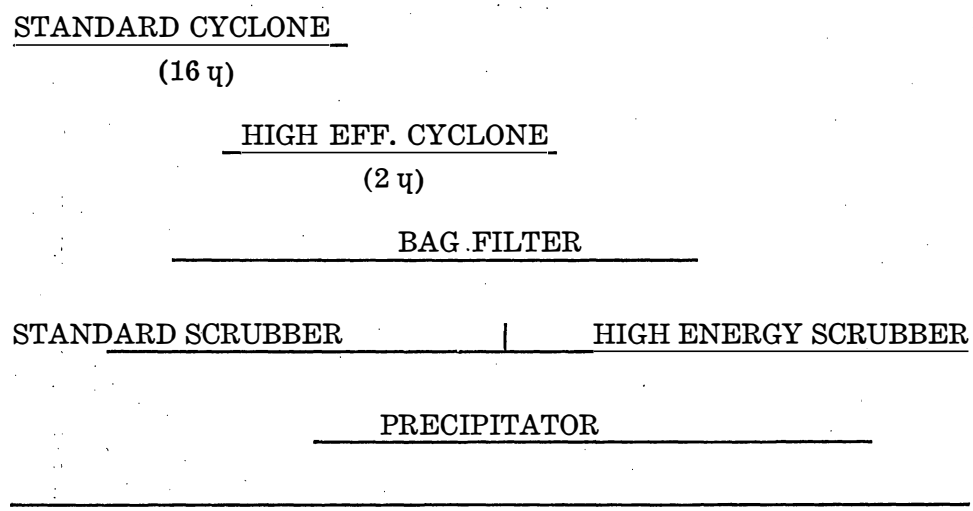
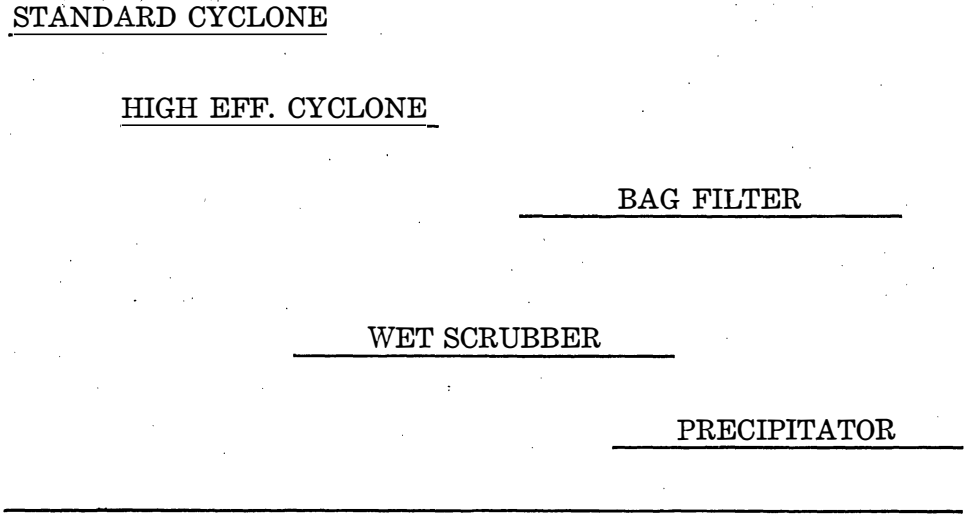


FIG. 2—RELATIVE CAPITAL COSTS OF SEVERAL TYPES OF EQUIPMENT—NOT INSTALLED



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Section V. *Transportation*

A. *Automobiles*

Internal combustion engines emit hydrocarbons and oxides of nitrogen which may form photochemical smog under certain conditions. The conditions for smog formation include (1) an atmospheric inversion, (2) low wind velocity and (3) intense sunlight. Manifestations of this type of smog are plant damage (a characteristic silvering of the under side of leaves), eye irritation, an oxidizing odor and low visibility and haze at low humidity.

This phenomenon is noticed in the Los Angeles area from 150 to 250 days/year. In recent years the U. S. Public Health Service has observed photochemical smog in eastern cities including the Washington, D. C. area. It is not known whether other parts of Virginia are affected but the Public Health Service says that as the automobile population increases, all parts of the country (particularly urban areas) may expect some incidences.

The source of photochemical smog is the reaction between oxides of nitrogen and olefinic portion of the hydro-carbon emission from autos under the influence of sunlight. It has been estimated that crankcase blow-by accounts for 10% and exhaust about 90% of the olefins emitted by automobiles. The California Department of Public Health has estimated that in order to prevent smog in the Los Angeles area a reduction in automotive emissions of hydrocarbons of 80% is required. The reduction needed in Virginia to prevent occurrence is not known.

Controls for prevention of emissions from crankcase blow-by have been adequately developed and have been installed on most new cars since the 1963 model year. Similar devices can be put on older cars with a minimum cost of about $15 per car.

At present, there are no similarly effective controls available for exhaust emissions. Automobile manufacturers individually have promised engine modifications on 1966 models sold in California that will meet the California standards at a cost of about $35 per car. No other state presently requires this type of device. California has also approved one type of device for use on used cars, but has not yet required installations on used cars. The cost estimates for blow-by and exhaust controls made by the California Motor Vehicle Pollution Control Board are as follows:

Device	Initial Cost	Annual Maintenance	Total over 5 Years	Annual Average Cost
Crankcase				
New Cars	$ 5.50	4 yrs. @ 3.00	17.50	3.50
Used Cars	15.70	4 yrs. @ 3.00	27.50	5.50
Exhaust Device				
New Cars	19.00	4 yrs. @ 10.00	59.00	11.80
Used Cars	85.00	4 yrs. @ 35.00	225.00	45.00

The Air Pollution Control Association has also made estimates on the cost of exhaust devices. These estimates are considerably above those given above, running to over $100 per year for installation and maintenance on used cars.

Carbon monoxide will be reduced simultaneously by control of crankcase blow-by and also by exhaust controls when they are available. It is doubtful if present concentrations are hazardous.

There is some concern that oxides of nitrogen should be controlled, but there is no agreement as to need and at the moment no practical means of control.

In addition to the direct use of control devices, two other approaches will aid in the reduction of vehicle emissions. The first is a means of assuring proper maintenance of the vehicle as well as control systems and devices. Good maintenance is a necessity if the control systems are to accomplish their purpose.

Second, anything which can be done to increase the speed of traffic flow in urban areas will accomplish significant reduction in vehicle emissions.

B. *Diesels*

Although often a source of smoke and odor, diesel engines do not contribute significantly to photochemical smog. Smoke can be diminished by good maintenance and good driver habits but there is no present solution to the odor problem.

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Section VI. *Agricultural*

It is noted that certain farm operations, such as plowing, clearing and burning off land and spraying of crops may contribute to air pollution. One California county allows plowing only when the wind is below a certain velocity. This type of control appears to be the only one available, if this possible source is a problem in Virginia.