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A Pilot Study of Air Pollution in Jacksonville, Florida

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A PILOT STUDY OF AIR POLLUTION IN JACKSONVILLE, FLORIDA

James P. Sheeky et al., U.S. Department of Health, Education and Welfare-Public Health Service, April 1963

SUMMARY

"National attention was focused on air pollution in Jacksonville, Florida, in 1948, when nylon apparel disintegrated on local residents; the cause: air pollution. In the years that followed, an ever increasing number of complaints were registered regarding air pollution in the Jacksonville-Duval County area. In the spring of 1961, damage to vegetation occurred; the prime suspect: air pollution."

"The air quality data collected during these studies indicated that certain air pollutants (flourides, sulfur dioxide and oxidants) were present in significant levels in the air over Jacksonville."

"Airborne flouride concentrations capable of causing damage to sensitive plants under proper growth conditions were found during the study. The data indicated that conditions for transport of objectionable concentrations of airborne flourides across the St. John's River into the Arlington area do occur."

"Although no high concentrations of hydrogen sulfide were observed during this study, darkening of lead-base paints and paints containing mercury-base fungicides in the Arlington area subsequent to the study indicates that a problem due to hydrogen sulfide does exist there."

"Oxidant concentrations observed during this study, although less than those measured in Los Angeles during severe pollution, indicate that photochemical-type smog similar to that produced in the Los Angeles area is being produced in the city of Jacksonville. The maximum oxidant level measured by the phenolphthalin method during August 3 to 10, 1961, was 0.162 parts per million (ppm) by volume (as hydrogen peroxide)."

"Sulfur dioxide concentrations observed during the nonheating season in which the study was conducted were generally low. The maximum concentration observed during this study was 0.174 ppm, a value similar to maximums observed in larger cities of the country. This high value probably was due to emission of sulfur dioxide from a major source. It can be expected that sulfur dioxide levels would be higher during the winter months in Jacksonville. Major sources of sulfur dioxide may cause periodic occurrence of concentrations higher than those observed, at certain locations in the Jacksonville area, possibly reaching levels that would cause damage to sensitive plants.

CONCLUSIONS

As a result of the urban and industrial area investigations it is concluded that:

1. Photochemical smog is being produced in the air over Jacksonville.
2. Concentrations of flourides occurred in certain parts of Jacksonville during the study that could cause damage to sensitive plants.
3. Pollutants from the city of Jacksonville are transported across the St. John's River.

RECOMMENDATIONS

Levels of certain air pollutants found during these studies indicate that the Jacksonville-Duval County area has air pollution problems. The following recommendations are therefore made:

1. A full-time air pollution control program should be activated. This program should encompass the area affected by the air environment receiving the pollutants emitted in the Jacksonville-Duval County area. The study conducted in August-September, 1961, demonstrated that pollution from the city of Jacksonville can affect areas outside of the city. Visual observations indicate that meteoroligical conditions do occur that could transport pollutants from outside the city into the Jacksonville area. The air pollution control program should encompass the area within a distance of 25 miles or more from the city of Jacksonville.

2. The air pollution control program should include further evaluations of air pollutant levels and source emissions, and monitoring of possible effects of air pollutants on plants and property. Such studies are necessary to determine whether progress is being made in protecting the air environment of the Jacksonville area, and whether new air pollution problems are arising.

3. A continuing micrometeorological study should be an integral part of this program. Such a study would not only allow a better understanding of relationships between source emissions and ground level concentrations, but would provide the necessary scientific data required for planning proper utilization of the air environment.

4. Since completion of this study, certain of the industrial plants have instituted additional control procedures, and have made operational changes to decrease pollutants emitted to the Jacksonville atmosphere. A repeat of the study conducted in the industrial area would provide information on the effectiveness of these control procedures and process changes.

INVENTORY OF EMISSIONS

The values in this emission inventory are estimates and should not be construed to be absolute. For this reason, all estimates have been rounded off to two significant figures. Equally important is the fact that the Tables do not include all pollutants that are emitted to the air over Jacksonville. Estimates were made only for those classes of pollutants that have been implicated as possibly having an adverse effect on man or his environment and for which emission factors are available. As further investigations are conducted in the field and new findings are published, estimates such as those contained in this report would be listed for a far greater number of pollutants.

ORGANIC GASES- Hydrocarbons: It is estimated that 120 tons of hydrocarbons per day are emitted to the air environment in the Jacksonville area (Table 3). Approximately one-third of these emissions come from transportation sources. In the Jacksonville area the hydrocarbon emission rate of approximately 1 ton per square mile per day approached the rate estimated in Los Angeles. Hydrocarbons and oxides of nitrogen in sufficient quantities can react in the presence of sunlight to form photochemical smog. This inventory indicated that the city of Jacksonville has a potential photochemical smog problem.

Aldehydes, Ketones and Other Organic Gases: There is an expected increase in emission from summer to winter, resulting from the load imposed on the air environment by domestic heating.

INORGANIC GASES-Oxides of Nitrogen: Approximately 93 tons of oxides of nitrogen are emitted per day during the summer months in the Jacksonville area. It has been estimated that this amount doubles during the winter months because of domestic heating activities. Emission rates of oxides of nitrogen are comparable on a unit area basis to those of other communities experiencing photochemical smog. As was the case in the estimated hydrocarbon emissions, these data indicate that Jacksonville has a potential photochemical smog problem.

Oxides of Sulfur: During the summer months, 240 tons of oxides of sulfur are emitted to the atmosphere per day. Ninety-nine percent of these emissions are from local sources. It is indicated that problems resulting from oxides of sulfur might occur in areas near these sources.

During the winter months, it is estimated that emissions of oxides of sulfur increase to more than 400 tons per day. This expected increase is due to home heating activities.

OXIDES OF CARBON - Carbon Monoxide: Approximately 98 percent of the daily emission of 360 tons is from transportation sources. Although the total amount emitted to the air is large, it is felt that carbon monoxide does not constitute an area wide problem in the Jacksonville area. Because the major source is the automobile, however, problems might occur among individuals working in the environment immediately adjacent to main thoroughfares.

Carbon Dioxide: Most investigators do not include carbon dioxide in their consideration of air pollution problems. Certain researchers however, are concerned about the long range effect of this pollutant on man's environment. Plass, in 1959, stated that a relationship exists between the increase in carbon dioxide content of the atmosphere due to man's activities, and an increase in the annual average temperature of certain European cities. Kaplan, on the other hand, has presented evidence that the increase in carbon dioxide content could only account for 10 percent of this annual increase in average temperature.

What the long term effect of increasing carbon dioxide emissions to the atmosphere will be, only time will tell. Carbon dioxide in combination with water vapor, however, can cause the deterioration of building materials such as limestone and also cause the corrosion of magnesium.

Estimated daily summer and winter emissions of carbon dioxide to the air over the Jacksonville area are 16,000 and 31,000 tons, respectively. All these emissions result from combustion processes. This pollutant could be used as an index of over-all combustion activities in the Jacksonville area. Other investigators have used carbon dioxide in this manner. Carbon dioxide concentrations over any city would be much higher than any other pollutant, and, therefore, easier to measure.

OTHER INORGANIC GASES - Hydrogen Sulfide: The summer and winter estimates are 5.1 and 7.7 tons per day, respectively. The water aeration plants in the city, which emit 0.15 tons of hydrogen sulfide per day, are a particularly troublesome cause of nuisance complaints since the pollutant is emitted near ground level.

Sulfide-type damage to paints containing lead pigments and/or mercury base fungicides has occurred in the Jacksonville area. It can be presumed that emissions of hydrogen sulfide may cause an air pollution problem in this community.

Hydrogen Fluoride: It is estimated, based largely on data provided by industrial representatives in the area, that an average of 0.06 tons per day of fluorides are emitted annually from industrial processes. Because of variations in production rates, however, emissions

on any given day may be considerably more or less than the average. In the space heating season, an additional 0.01 tons of fluorides are emitted per day from domestic sources. It is doubtful whether the fluoride contribution of the areawide domestic source constitutes an air pollution problem. This inventory indicates that the industrial process emission of 0.06 tons per day from local sources might be a problem in the vicinity of certain industrial operations. This should be the subject of further study.

PARTICULATES - Thirty tons are discharged daily during the summer months; this increases to 48 tons per day during the winter season, the increase being due to domestic heating activities.

It is improbable that these amounts of particulates discharged to the atmosphere would constitute a potential areawide air pollution problem. A potential nuisance might exist, however, in areas close to local sources.

Classification of sources in estimating pollutant emissions:

Classification	Source Type
Local sources	Power generation - power production for municipal and domestic consumption
	Incineration - municipal incinerators
	Water aeration - municipal plants for removal of hydrogen sulfide from well waters
	Industrial combustion
Area sources	Commercial - stores, office buildings, hotels, launderies, dry cleaners, gasoline handling and marketing, and bulk petroleum storage operations
	Domestic - home heating, cooking, and hot water heating
	Transportation - automobiles, diesel vehicles, diesel switch engines

METEOROLIGICAL STUDIES

Jacksonville, Florida, in general is quite well located topographically for the dispersion of waste material emitted to the atmosphere. There are no hills to act as barriers to air flow over the terrain, or valleys to hold and concentrate pollutants in the air. Unfortunately, there are other conditions in the area conducive to concentrating contaminants released to the atmosphere.

In the southeastern portion of the United States, it is not unusual for large high pressure systems in the atmosphere to move very slowly. This causes stable conditions near the earth's surface and, frequently, at some point above the ground because of the subsidence in the air mass and radiational cooling during the hours of darkness. Surface-based inversions in the Jacksonville area occur throughout the year and are generally accompanied by light surface winds. In addition, the industrial area and the principal business district of the city lie along the west bank of the St. John's River, which flows from south to north for approximately 4 miles. At both ends of this 4-mile stretch, the river makes a 90-degree turn. The river and city buildings have a direct influence on wind direction and speed in this area.

The dispersion of gaseous and fine-particulate wastes emitted to the atmosphere is associated with the height at which they are released, wind speed and direction, and the stability condition of the atmosphere, among other things.

Good dispersion of any contaminant is favored by its release at high levels above the ground, high wind speeds (with associated turbulence), and unstable conditions in the lower levels of the atmosphere. Even under such conditions, strong winds may bring some contaminants to ground level in relatively high concentrations. This would result from looping of the stack plume associated with turbulent air currents (gusty winds) developed in the atmosphere because of surface obstructions and/or changes in direction and speed of the wind.

Poor dispersion of pollutants emitted to the atmosphere occurs when stable air layers (inversion) form either at the ground or within a few hundred feet above the surface. The development of such stable conditions in the lower levels prevents vertical mixing of pollutants and holds them within or below these inversions. Low wind speeds accompany such stable conditions. In the Jacksonville area, conditions for poor dispersion of contaminants frequently exist during all months of the year.

The analyses of meteorological conditions in the area establish the strong possibility that air pollution problems will intensify unless some preventive action is taken.

SUMMARY OF METEOROLOGICAL STUDIES

The results of the preceding observations are summarized as follows:

1. Jacksonville has weather conditions throughout the year that are conducive to accumulation of pollutants emitted to the atmosphere.

2. If dispersion of pollutants from particular sources is to be studied, a wind and direction recorder located within the specific study area will be necessary. Also, an instrument to measure on a continuous basis or at frequent intervals the lapse rate in the lowest few hundred feet would be essential. Meteorological data from the USWB station at Imeson Airport and from the Naval Air Station would be inadequate for such detailed studies.

ESTIMATED EMISSIONS (TONS/DAY) IN JACKSONVILLE URBAN AREA-SUMMER

Local sources	Hydrocarbons	Aldehydes & Ketones	Other Organic Gases	Oxides of Nitrogen	Oxides of Sulphur	Carbon Moncxide	Carbon Dioxide	Hydrogen Sulfide	Hydrogen Fluoride	Particulates	Total
Power generation	4.0	2.9	13.	58.	130.	.021	5700.	1.9	.06	10.	5919.881
Incineration	1.1	1.8	1.4	.70	.35	7.0	700.			3.9	716.25
Industrial combustion	21.	3.5	36.	20.	86.	.026	8200.	1.0		14.	8381.526
Industrial processes	24.	.25	1.0	.06	23.	a	a	2.0		.12	50.43
Area sources											
Commercial	26.	.10	.48	.67	2.0	b	190.	.06		.10	219.41
Domestic	.28	.06	.26	.45	.29	a	3.0	a		.13	4.47
Transportation	39.	46.	.61	13.	1.4	350.	1300.	a		1.6	1751.61
Total	115.38	54.61	52.75	92.88	243.04	357.047	16093.	4.96	.06	29.85	17043.523

aNot applicable
bNot estimated

ESTIMATED EMISSIONS (TONS/DAY) IN JACKSONVILLE URBAN AREA-WINTER

Local sources	Hydrocarbons	Aldehydes & Ketones	Other Organic Gases	Oxides of Nitrogen	Oxides of Sulphur	Carbon Monoxide	Carbon Dioxide	Hydrogen Sulfide	Hydrogen Fluoride	Particulates	Total
Power generation	4.0	2.9	13.	58.	130.	0.021	5700.	1.9		10.	5919.821
Incineration	1.1	1.8	1.4	0.70	0.35	7.0	700.	0.15		3.9	716.4
Industrial combustion	21.	3.5	36.	20.	86.	0.026	8200.	1.0		14.	8381.526
Industrial processes	24.	0.25	1.0	.06	23.	a	a	2.0	0.06	0.12	50.49
Area sources											
Commercial	25.	0.15	0.73	1.0	28.	b	290.	0.10		0.15	345.13
Domestic	9.0	6.5	19.	94.	140.	b	15,000.	2.5	0.01	18.	15289.01
Transportation	39.	0.46	0.61	13.	1.4	350.	1300.	a		1.6	1706.07
Total	123.1	15.56	71.74	186.76	408.75	357.047	31,190.	7.65	.07	47.77	32408.447

aNot applicable
bNot estimated

_____. "Labor Force Projections by State, 1970 and 1980," by Denis F. Johnston and George R. Methee. Monthly Labor Review, October, 1966. (Reprint.)

_____. "Labor Force Projections for 1970-80," by Sophia Cooper and Denis F. Johnston. Monthly Labor Review, February, 1965. (Reprint.)

_____. Occupational Outlook. Career Information for Use in Guidance, 1966-67 Edition. Bulletin No. 1450. Washington: U. S. Government Printing Office, 1965.

_____. Projections 1970: Inter-industry Relationships, Potential Demand, Employment. Bulletin No. 1536. Washington: U. S. Government Printing Office, 1966.

_____. Technological Trends in Major American Industries. Bulletin No. 1474. Washington: U. S. Government Printing Office, February, 1966.

University of Florida, Bureau of Economic & Business Research. Business & Economic Dimensions. Gainesville, Florida: The University. Published monthly.

_____. Projections of the Population of Florida Counties for July 1, 1970 and July 1, 1975, by Ronald E. Beller. Population Series No. 16, May, 1967.

_____. Provisional Estimates of the Population of Florida Counties for July 1, 1965, by Ronald E. Beller. Population Series No. 15, December, 1966.

_____. Statistics of Personal Income, Population, Taxation and Construction for Florida and for Florida Counties. State Economic Studies No. 16. Gainesville, Florida: The University, May, 1964.