



POLLUTION IS EVERYBODY'S BUSINESS

H.R. HOLLAND
Engineering Division
Logistics Department
Sarnia, Ontario
January 30, 1970

INTRODUCTION

The Oxford dictionary defines pollution as "the destruction of purity or sanctity". In relation to providing protection to our environment, a better definition is "the addition of foreign matter to an ecological system in such quantity that the system cannot adjust successfully and so suffers an undesirable change."

As an example, consider the fate of the buffalo herds of the great plains. To these herds, the Indians were a foreign and hostile addition to the environment. Fortunately, the number of Indians was small and their arms were primitive so that the herds could adjust to their presence. Then the white men came with repeating rifles and the degree of interference became intolerable. The environment of the buffalo was polluted, and the great herds vanished. Typically the results of this pollution were varied: for the buffalo - extinction; for the Indians - the end of their nomadic way of life; for the white men - the plains became available for agriculture and settlement.

This example illustrates the four most important aspects of the pollution of our environment:

1. Pollution occurs when the foreign addition reaches a specific critical level to which the total environment cannot adjust.
2. For any given pollutant the susceptibility of the individual components of the environment varies considerably. (The buffalo vanished, the buffalo grass flourished.)

3. The localized high concentrations of pollutants which cause pollution episodes are due mainly to the activities of man augmented by such natural phenomena as eruptions, tidal waves and forest fires. However, the total production of pollutants from natural sources dwarfs man's contributions as shown in Table No. 1. Fortunately, the concentrations usually are far below the critical levels.

4. The individual is conscious of pollution mainly as it affects his own interests; e.g. a swimmer thinks of pollution in terms of a beach closed because of contamination with sewage; to a naturalist it is the disappearance of a species of bird or flower; to an asthmatic, a choking spell; to a sociologist, slums or juvenile delinquency.

Since pollution means disaster to the affected species, the only satisfactory course of action is to prevent it -- to maintain the addition of foreign matter at such levels that it can be diluted, assimilated or destroyed by natural processes -- to protect man's environment from man.

The problems encountered in providing this essential protection to our environment are extremely large and very complex. There are many areas in which our scientific and engineering knowledge and skills are inadequate but even more which pose unresolved questions in economics, law and social and political organization. To many of these questions there is no completely satisfactory answer since legitimate but opposing interests are involved.

Table 1
ESTIMATED GLOBAL EMISSIONS OF SOME AIR POLLUTANTS

COMPOUND	SOURCE	EMISSION	T/YR.
*SO ₂	Combustion - coal	51 x 10 ⁶	as S
	" - petroleum products	11	"
	Refining Petroleum	3	"
	Smelting	8	"
*H ₂ S	Industrial Sources	3	"
	Marine	30	"
*SO ₄	Terrestrial	70	"
	Marine	130	"
Total S Compounds	All Sources	306	"
	Natural "	230	"
<hr/>			
*NO ₂	Combustion	16.1 x 10 ⁶	as N
	Biological Action	150	"
*NH ₃	Combustion	3.5	"
	Biological Action	4900	"
*N ₂ O	Biological Action	410	"
Total N Compounds	All Sources	5480	"
	Natural Sources	5460	"
<hr/>			
*CO	Combustion Sources	221 x 10 ⁶	as C
	Incineration	25	"
	Forest Fires	11	"
	Marine - Undetermined but very large		
**CO ₂	Oxidation of Plant and Animal Matter	150,000	"
	Combustion	4,500	"
Total C Compounds	All Sources	154,757	"
	Natural Sources	150,000	"

References: * Gaseous Atmospheric Pollutants from Urban and Natural Sources - Robinson & Robbins, APCA 69-155.
 ** Carbon Dioxide Affects Global Ecology - E.K. Peterson, P. 1162 - Environmental Science and Technology, November, 1969.

The costs of reaching the solutions will also be very large, not only in dollars but in additional restrictions on individual freedom of action. The Ontario Water Resources Commission requirement for sewage holding tanks on private boats with sleeping accommodation is a typical example.

Inevitably, in a task of such magnitude, progress will be slow and mistakes will be made. Nevertheless, the essential protection can be provided for the environment so long as man is prepared to pay the price. (In the case of Lakes Erie and Ontario this is estimated to be \$8,000,000,000.)

It must be emphasized that as the result of these efforts, the environment can be protected but not preserved. Perhaps a few remote wilderness areas can be preserved in their present condition, but all visitors will have to be denied entrance.

LEGAL CONTROLS ON POLLUTION

A problem of such size, complexity and importance cannot be dealt with on a voluntary basis. The protection of the interests of society as a whole requires the establishment of legal controls on pollution as on other anti-social acts.

At the moment, this control lies mainly in the hands of the provinces. The effectiveness of their grasp varies considerably.

Ontario has the largest problems and the best control organizations. Separate agencies to guard air, water and soil are located in the Department of Energy and Resource Management with reasonable budgets.

Alberta has concentrated authority in the Department of Health, mainly in the Environmental Health Services Division and is following development closely.

Manitoba has a newly organized Clean Environment Commission which has made a vigorous start.

Saskatchewan has adequate legislation and a skeleton staff since their problems are largely in the future.

Quebec has assigned a low priority to pollution control on the basis that it is a nuisance rather than a health hazard. This is a valid political decision, since for the time being, their problems are largely internal.

B.C. is evolving a system balancing the necessity of resource development against the needs of environmental protection.

The Maritimes and Newfoundland have adequate legislation but are handicapped by lack of funds. Control of municipal sewage is a major problem.

Where there are interprovincial problems, there has been a reasonable degree of cooperation - the prairie provinces are sharing the North and South Saskatchewan successfully. The Canadian Council of Resource Ministers is a vehicle for attaining such cooperation. It has sponsored two major national conferences on resource management, the latter dealing with pollution.

Up to now, the federal role has been confined mainly to research and advice except in clearly international situations. The International Joint Commission handles problems between Canada and the U.S.A. while such acts as those on Navigable Waters, Migratory Birds, and National Harbours have established federal jurisdiction in a number of specific fields. Recently there have been significant changes in the federal approach:

(1) The Canada Water Act, given first reading in November, 1969, provides for massive federal entry into the fields of water resource and water quality management. While the provinces have been crying for federal sharing of water pollution control costs, in this case they may find that they have exchanged King Log for King Stork.

(2) The Torrey Canyon and Santa Barbara disasters have emphasized the vulnerability of the environment to major catastrophes.

They have led to investigations approving the continued drilling for gas in the Canadian Waters of Lake Erie and banning such operations in the Straits of Georgia. In addition, there is a continuing vigorous debate on the establishment of sovereignty over the Arctic waters and the protection of the delicate arctic fauna and flora from damage due to the development of the oil resources of the area.

(3) The Department of National Health and Welfare is expanding the national air quality monitoring network.

No matter what governing body has jurisdiction, control of pollution is obtained by licensing the sources (municipalities, institutions or industries) to discharge wastes to the environment provided that they comply with the standards established by the controlling agency. Such standards may apply to the ambient atmosphere, the receiving water body or the waste disposal facility handling mainly solid wastes or to the composition of the individual effluent or to both. There are, quite properly, considerable differences in the requirements of the various licensing agencies since they must take into account the nature and amount of the wastes and the capacity of the receiving system to dilute, neutralize or digest them. One of the potential dangers of federal intervention is the imposition of uniform but inappropriate standards.

DEVELOPMENT OF CRITERIA, OBJECTIVES AND STANDARDS

Criteria are the scientifically determined critical concentrations of pollutants which if exceeded, result in pollution. They must take into account the sensitivity of the individual receiving systems and the possible reinforcing action of various combinations of pollutants.

Objectives are the maximum concentrations of pollutants which are acceptable in the receiving system. They are based on the criteria which cannot be exceeded without serious damage from pollution. However, the margin of safety between the objectives and criteria can be varied depending on social, political and economic considerations.

Standards are legally enforceable limits on the maximum allowable concentrations of pollutants. Usually they are applied to individual waste discharges, but it is possible to apply them to the whole system. They are in effect the means of sharing the waste receiving capacity of the system between the sources.

Reliable criteria are the key to obtaining control over pollution by law. Their determination presents some unique problems:

(1) If all regulations governing air and water pollution are met, the criteria for solid waste disposal are mainly aesthetic. Provision of shelter belts to screen what is at best an unsightly operation and control of insects, rodents, odours, litter and noise are essential.

(2) The problems of establishing criteria for water are formidable but solvable. There are very large numbers of flora, fauna and water qualities to be considered as well as uses to be protected, but effective techniques have been developed. Fortunately, most health problems have been solved although there is still uncertainty over the fate of viruses.

(3) Establishment of criteria for air pollutants involves difficulties of a much higher order of magnitude because human health is at stake. The medical profession, provided with millions of volunteer experimental subjects, has so far failed to reach agreement on the effects of cigarette smoking on humans. It follows that determining the safe levels of air contaminants both singly and in complex combinations by epidemiological studies and animal investigations is neither an easy nor a completely reliable process. However, the agencies must adopt values based on their best judgement so that differences due to the interpretation of common data can and do occur. Only time and well designed research will eliminate these problems.

The development of ambient objectives from the criteria is subject to additional pressures - political, sociological economic, legal and individual. Many people develop highly personal perceptions of pollution which introduces complications because:

1. It sometimes leads to intense preoccupation with one aspect of environmental protection to the neglect of all others, thus an angler might advocate the eradication of Mergansers because they eat too many fish - from his point of view an eminently sensible

suggestion, but one guaranteed to enrage all bird lovers.

2. Since the individual rarely is responsible for the type of pollution to which he objects most strongly, he can attribute responsibility to some vague "they" rather than to the "us" where it belongs.

Unfortunately, such intense personal involvement can result in the establishment of unwarranted and unattainable criteria. This has already occurred in the U.S.A. as discussed in the following excerpt from an editorial in the January, 1970 issue of the Journal of the Air Pollution Control Association by Mr. A. H. Phelps, a director of the association:

"We are now witnessing the disturbing phenomena of well-intentioned citizens, listening to sound proposals for air standards based on study of the criteria and sampling of existing quality, and then demanding 60 micrograms per cubic meter annual geometric mean, or 50, or 10 less micrograms than the next state. They may not know what a microgram is, or a geometric mean. But they will demand that their numbers be adopted and then go home to wait for the skies to clear. And when the skies don't clear as fast as they expect, they'll be back."

The translation of ambient objectives into effluent standards is basically a technical problem. It requires a detailed knowledge of the receiving system and of the processes involved in diluting and digesting the waste streams. Fortunately, even large and complex systems can be simulated successfully with the aid of computers.

URBANIZATION AND ALTERNATIVES

The fundamental problems in protecting the environment in our time arise from the rapid increase in population and the increasing concentration of the people in cities. A great eastern megalopolis already stretches from Boston to Washington. If present population trends continue, an even larger complex will embrace the lower Great Lakes from Chicago to Pittsburgh and well beyond Montreal in 2000 A.D.

With such a prospect, provision of a satisfactory environment within each component of the great complexes is an urgent necessity. It was demonstrated at Expo 67 that people can be happy and orderly in a well planned physical environment even at very high population density. On the other hand, present conditions in many large U.S. cities show the unhappy effects of poorly planned and deteriorating environments.

Pollution control is only one important phase of the total problem of environmental protection and enhancement in the process of urbanization. It shares with housing, education, employment opportunities, race and religious relations, transportation, parks and access to recreation in being essential to an enjoyable and stimulating urban atmosphere.

Providing such an environment in the face of a rapidly expanding population will be very difficult and very expensive. The Doxiadis-Detroit Edison studies on Metropolitan Detroit in 2000 A.D. suggested a minimum cost of 240 billion dollars to accommodate 15 million people.

In the light of these and similar studies, serious consideration is being given to population stabilization in the U.S.A. For Canada there are additional alternatives in the development of the mid-Canada project and the evolution of larger and more capable units of municipal government to handle the immediate problems more effectively.

WHAT IS IMPERIAL OIL DOING?

The official policy on environmental protection of Imperial Oil Limited is expressed in the following statement.

"Imperial Oil and its employees share the concern of all Canadians for the conservation of the quality of the country's air, water and soil. The company believes that the public interest is best served by regulations that

- a) provide the appropriate protection of the environment at the least possible cost to the economy
- b) are based on standards for environmental quality developed from adequate data
- c) provide reasonable time to develop and implement the methods of control
- d) treat equitably all materials and operations which contribute to pollution
- e) place control with appropriate governmental agencies.

In the field of air, water and soil conservation, it is the company's policy

- to comply with existing regulations
- to provide such additional protection of the environment as is technically feasible and economically practical
- to encourage, support and conduct research to establish standards of quality and to develop and improve methods of measurement and control

- to co-operate with other groups working on protection of the environment, such as universities, control agencies, technical societies and trade associations
- to anticipate future pollution control requirements and to make provision for them in long-range planning
- to keep employees, government officials and the public informed."

So far, this policy has been expressed mainly in designing and controlling the operations of the Company to minimize pollution. Thus in the period 1960 to 1967 about \$16,000,000 was invested in new processes and equipment intended primarily to prevent, reduce or eliminate pollution while an additional \$28,000,000 was spent on plants which contributed substantially to protecting the environment, although not intended primarily for that purpose. About 40% of this sum was spent in the refineries and plants.

As a result of these expenditures and the continuing efforts of the operating groups, the Company is in compliance with the control regulations except that upsets, accidents and human failure still occur. Then too, there are periodic changes in objectives, standards and regulations. So far as possible, an attempt is made to anticipate these and cushion their effect. However, they frequently require time and money to adjust the control facilities.

We cannot foresee any reduction in the rate of expenditure for this purpose, but rather expect a substantial increase. As population and industrial density increase, the allowable emission rate per unit of production must decrease if ambient environmental quality is to be maintained. As usual, each successive reduction in emission rate will be more difficult and more expensive than the preceeding one.

In addition to these massive capital expenditures, Imperial Oil is engaged in or supports financially a wide range of projects and activities designed to protect the environment.

These include: Research

Design

Operations and Training

Waste Disposal

Technical Publications

Education

Cooperation with Governments.

Research is conducted on processes, equipment and products in order to reduce their potential for pollution. Generally these investigations fall into three major classes:

- (a) Those which are concerned with a single plant or process.
- (b) Those which are confined to the operations of the Company.
- (c) Those which are common to the whole industry.

This last category usually takes the form of a cooperative research project to which the Company contributes information and money but which is directed by a trade association such as the American Petroleum Institute.

To the maximum extent possible, the work is done by Company personnel. However, extensive use is made of industrial consultants and university staffs in the more highly specialized fields.

In addition, the Company participates in cooperative industrial agencies which collect data on the quality of the environment in several major refining centres. These data are essential for the proper design of control measures. They also are available to all interested governmental agencies.

Design of equipment and processes is based on the latest techniques for avoiding losses and wastes and minimizing the effects of accidental spills and discharges. This involves:

- (a) Careful search of the technical literature.
- (b) Exchange of experience with other Company departments and affiliates.
- (c) Consultation with the control agencies to ensure that the plant not only complies with current regulations but also has reasonable flexibility and capacity to meet foreseeable future requirements.
- (d) Providing equipment with the desired capability at minimum capital and operating cost. Expenditures on protecting the environment are usually in the range of 5 to 10% of total capital cost.

Operations and Training of operating crews to take full advantage of the capability of the equipment to control pollution. Particular stress is placed on emergency procedures.

Waste Disposal processes are designed to deal with those wastes which cannot be eliminated by design and operation. They must meet the particular needs of the area where the unit is situated. There are very considerable differences between the requirements of the environment at Vancouver and Regina for example.

Publication of papers in the technical journals and active participation in the work of the technical societies contribute to the development of efficient effective protection of the environment. The Company also has representatives on a number of technical committees dealing with problems of environmental protection for industrial and trade associations -- Oil Heat Association, Canadian Standards Association, Canadian Chemical Producers Association, Canadian Manufacturers' Association, etc.

Education of the public on facts of the problems of pollution is a prime responsibility of the Company. This is discharged by:

- (a) Semi-technical articles in the Imperial Oil Review and other Company publications.
- (b) Supplying reliable background data to the news media.
- (c) Talks to students in high schools and universities and to service clubs and social groups.
- (d) Discussions of new processes and control measures with Company employees.

Cooperation and exchange of information with government agencies and the universities are maintained by supplying members to several committees dealing with research programmes and the establishment of objectives for environmental quality. The need for industrial participation in these phases was stressed in the guide

lines from the conference on "Pollution and Our Environment".

These widespread activities designed to protect the environment from damage due to the operations of Imperial Oil or the use of Imperial products are the responsibility of the Environmental Quality Committee. This consists of a senior representative from each of the departments directly concerned under the chairmanship of the Environmental Protection Coordinator.

CONCLUSION

In this very brief consideration of the effects of pollution and the problems encountered in controlling it, we have so far

- defined the terms and the areas of human involvement
- reviewed the current Canadian legal system for control
- discussed the processes of establishing control standards
- looked at pollution as a component of urbanization, the all encompassing environmental problem of our time.
- considered the activities of one large company as they are designed to protect the environment.

We come then to an examination of the statement of the title "Pollution is Everybody's Business".

Pollution is everybody's business because essentially all of it results from the activities of men working to satisfy the needs and desires of men. As individuals, we may not approve of each and all of this multitude of activities. Yet as members of the society which sanctions and encourages them, we must accept responsibility for all the consequences, both the desirable and the undesirable which include the pollution caused by the improper disposal of the inevitable wastes.

We must accept also the effective validity of the statement that matter cannot be created or destroyed. We do not consume. We use, employ, change, transform, but for every pound of new material involved in the activities of man, the end product is a pound of waste.

It follows, then, that we cannot eliminate waste and prevent the gradual changes in the environment which will occur as waste products accumulate. We can, however, see to it that the unavoidable wastes are made as inert and innocuous as possible and that their disposal avoids the catastrophic damage to the environment which is pollution.

The problems encountered in controlling and abating pollution are frequently beyond our powers as individuals. Nevertheless, we can solve them through collective action and can make important personal contributions by

(1) Learning and convincing others that pollution is one of the "great" problems - very large, very complex, very expensive - to which there is no simple, single solution that can be reached overnight.

(2) Realizing that the present levels of pollution are generally serious but not catastrophic - cause for concern but not hysteria.

(3) Appreciating that there are many aspects of our environment and the effects of pollutants and contaminants which are not properly understood. Therefore precipitate action is usually to be avoided.

(4) Accepting that pollution is only one portion of urbanization which is the great environmental problem. The other aspects - education, housing, race relations, employment, poverty slums, religious intolerance, etc. - are also of vital importance and cannot be neglected.

(5) Acting on the basis that pollution is everybody's responsibility. It is mine and yours, and it will be controlled when we act to do so. As a start, we must accept our individual personal responsibility to:

- prevent litter and excessive noise
- provide for the safe disposal of sewage, garbage and trash
- control combustion processes to avoid smoke and other objectionable emissions
- exercise civic pride in the design and maintenance of our cities
- Display good manners in using our environment with due consideration of the rights and desires of others.