Oil and the environment

Oil and the environment

Pollution is many things. It is dirty water and a littered beach. It is the disappearance of fish from a stream. It is ear-splitting noise, noxious fumes, or offensive smells. It is the destruction of natural species and devastation of land around us. Pollution is a health problem, an economics problem, and an aesthetic problem all rolled into one. Obviously, we must fight it if we are to continue living on this earth.

This isn't a new fight. The battle against silt in streams, for example, began 8,000 years ago in Mesopotamia, where irrigation was invented. London in 1660 was described by Restoration diarist John Evelyn as having "her stately head in clouds of smoke and sulfur". A century ago, Montrealers and Torontonians suffered sore eyes from the dust that rose from unpaved streets.

In general, pollution is the result of more people living in larger cities, consuming more goods and services, and using more energy to maintain a high standard of living. With three billion people on earth, man cannot help but contaminate the environment to some extent, and regulations to control pollution are being put into effect.

Imperial Oil's efforts to protect the environment go back many years. Separators to remove oil from waste waters were built into Imperial's Dartmouth refinery in 1918. Imperial technicians were studying water quality at Sarnia in the 1920s. During the 1960s, the company spent more than $40 million to

protect the environment. From 1970 to 1974, it spent $131 million for that same purpose. Among the expenditures, more than $13 million was spent on pollution-control facilities at Imperial's new Strathcona refinery near Edmonton. By 1980, the company will have spent about $200 million during one decade just on environmental protection.

Imperial realizes that control of wastes is the most important way to protect the environment. However, the oil industry is also working on better methods of restoring the environment if an accident does happen.

Imperial Oil and 11 other companies formed PACE (Petroleum Association for Conservation of the Canadian Environment) to preserve land, air, and water wherever they are affected by the oil industry. And for its employees, Imperial has conducted a cross-Canada study course in environmental biology.

Here is what Imperial is doing about the problems of water, air, and noise pollution.

Water

Water never wears out. There is just as much of it – in one form or another – as there was millions of years ago. The water you used in your last bath, recycled thousands of times, may have been the same water Cleopatra used in hers.

This perpetual supply exists because of the water cycle. Water is taken in and given out by all plants and animals, carrying wastes with it. Then, one of two things happens: 1) It evaporates into the atmosphere to form clouds. The wastes are left on the earth or enter the atmosphere. The water returns to earth as fog, rain, sleet, or snow. 2) Or it sinks into the ground. Sandy soils filter out part of the wastes. When the water reaches a stream, lake, or ocean, it is cleansed by the action of oxygen, bacteria, sunlight, and dilution.

When water becomes overloaded with wastes, fish, plants, and other wildlife may be killed or driven away; swimming and other recreational activities may become unsafe or unpleasant; the water's taste, color, and smell may become offensive.

The Canada Water Act of 1970 defines waste as "any substance that . . . would degrade or alter . . . the quality of waters to an extent that is detrimental to their use by man or by animal, fish or plant that is useful to man . . ."

The major sources of water-polluting wastes are cities, industries, and farms.

In cities, sewage is discharged into the water.

Agriculture pollutes with animal wastes, silt, pesticides, and phosphates and nitrates. These last two chemicals are used in making fertilizers, which are capable of polluting.

Phosphates and nitrates that get washed away into surface waters or underground streams may lead to pollution.

Water heated and returned to its source may cause a rise in temperature that will harm marine life. The waste in this case is heat.

In oil-industry operations, water plays a large part. Millions of gallons are used daily in refining. Oil exploration is carried out in watery environments. Large volumes of oil are moved in ships; pipelines often cross bodies of water.

In seismic exploration on land, oilmen use small charges of dynamite. At sea, dynamite can kill fish, so gas exploders are used. One type, developed by Exxon, employs a mixture of oxygen and propane ignited by a spark in a rubber sleeve. The resulting "pop" inflates the sleeve and gives off an echo, but doesn't harm marine creatures. The burned gases escape to the surface through a snorkel.

This technique doesn't work in shallow waters with thick layers of ooze on the bottom. In such places, oilmen drill holes in the ocean floor and set off explosions as they do on land. This technique poses no more danger to animal life than dynamiting on land does.

Ocean drilling is done from specially built ships or giant platforms, and the drilling bit itself never touches the water. Drilling takes place within a steel sleeve that runs from the platform to deep beneath the ocean floor.

When an oil field is discovered, whether on land or sea, great care is taken to prevent a sudden, uncontrolled gush. Special devices, called blowout preventers, shut down the flow if an accident occurs.

To make sure that the oil does not contaminate the environment, wells are lined with steel pipes. The salty water that sometimes comes to the surface with crude oil is returned underground or to some other brine-bearing formation.

Oil itself can be a pollutant. The amount of oil that entered the world's oceans in 1973 has been estimated at six million metric tons. Of this amount, nearly four million tons originated from non-marine sources – industrial and automotive wastes discharged on land. About two million tons originated from marine activities. Tankers accounted for about two-thirds of this in the course of normal operations. Spills and ship casualties, while contributing a relatively small amount of the total oil to the oceans, can cause significant local environmental damage and are of major concern to the marine industry.

Officers and crews of Imperial ships adhere to established procedures for pollution avoidance and control. In some ports where foreign tankers call, experienced tanker officers, who are specially trained, ensure that pollution prevention and control measures are followed.

The greatest amount of oil discharged from tankers occurs during the ballasting and tank-cleaning operations. When a tanker has discharged her cargo, she must refill some of her tanks with seawater for the voyage to the next port. Without this water, the ship would float high and be difficult to control. Naturally, the ballast water mixes with the oil remaining on the walls of the tanks. If the water is pumped overboard before a new cargo is loaded, some of the oil goes with it. This operation is a necessary one, and a sub-

committee of the United Nations agrees that oily water may be discharged into the oceans. Limits are placed on how much oily ballast may be discharged, where it may be done, and the rates of discharge.

To reduce the amount of oil put into the oceans, a procedure called load-on-top has been developed. Imperial's tankers follow this method of skimming off the ballast water and putting the residue into a separate holding tank. This oily waste is then discharged into a shore tank.

No oily ballast water is discharged into the sea from Imperial ships operating in Canadian coastal trade. It is returned to land storage tanks where the oil is separated from the water. Only the clean water is returned to the sea. Tankers chartered by Imperial must adhere to internationally accepted pollution-avoidance procedures. The tankers are inspected to ensure that good operating standards are maintained.

International agreements are the best way to solve the problem of tanker pollution. Signatory nations submit to regulations governing equipment and pollution-prevention procedures for both existing ships and those to be built. Under such agreements, virtually no vessel in international trade can operate unless it conforms to standards.

Oil companies in Canada have formed more than 130 oil-spill, clean-up cooperatives. In addition, to minimize damage from spills, Imperial has organized clean-up teams at all its major operating points.

Where laws do not provide sufficient compensation for damage from tanker accidents, most petroleum companies and private tanker owners have entered into voluntary agreements to compensate injured parties. Imperial is a participant in two such agreements that provide up to $30 million for any one spill.

Most Canadian refineries receive their crude oil by pipeline. Smaller lines take products from refineries to major terminals. These lines are built to strict government and industry specifications. Extra precautions are taken where a line crosses a river or harbor. For instance, the line is nearly always buried. Sometimes it is encased in concrete as well, or extra heavy pipe is used. During operations, pipelines are monitored for any break. If one occurs, the line can be shut down quickly with minimum damage to the environment.

Despite the large number of products they make, oil refineries are not major sources of water pollution. One reason is that crude oil and the products made from it are confined inside pipes and towers during processing. Another reason is the care taken.

Large amounts of water are used in refining, but these amounts are being reduced. At Imperial refineries, the water is cooled and reused. At Imperial's Sarnia refinery, for instance, one tower can cool 30,000 gallons a minute.

Water used in refining is eventually returned to its source after treatment. Treating plants are continually being improved to meet or exceed guidelines set by an industry-government task force. The performance of these plants is tested by exposing sensitive fish, like rainbow trout, to the refinery effluent.

Methods of treatment vary. Oil and solids can be removed in settling basins where the

solids sink to the bottom and oil is skimmed from the top for return to the refinery. Other waste waters, containing phenols, sulfides, and ammonia, must be specially treated. Using one method, the water passes through a "sour-water stripper", which uses steam to remove ammonia and sulfides. The water is then routed to a biological-oxidation plant where specially-bred bacteria absorb or "eat" the phenols and other organic compounds. In the fall of 1975, at Imperial's Sarnia refinery, improved installations for controlling water pollution were completed. Included in this $15-million program was a new, larger biological-oxidation plant for treating refinery waste water. The first biological-oxidation plant in Canada was built at Imperial's Sarnia refinery during the mid-1950s.

Air

You'll probably never breathe pure air. Pure air contains 78 percent nitrogen and 21 percent oxygen. The other one percent is mostly carbon dioxide and argon, with traces of neon, helium, xenon, hydrogen, methane, krypton, and water vapor. Strictly speaking, air becomes polluted whenever anything is added to that mixture.

To scientists, air impurities are generally classified as gases and aerosols. Some of these gases are:

Nitrogen oxides, formed when anything is burned. A common one, nitrogen dioxide, can damage vegetation and cause sore eyes when it reacts with other gases in sunlight.

Sulfur oxides, which occur mainly in the burning of coal and oil. The commonest is sulfur dioxide, which can cause lung irritation.

Carbon monoxide, formed when any carbon-bearing material (wood, charcoal, paper, coal, oil, gas) doesn't burn completely.

Hydrocarbons, which are hydrogen and carbon in chemical combination. Oil and natural gas are mixtures of hydrocarbons.

Aldehydes, particularly formaldehyde, which enter the atmosphere from incinerator smoke, factory chimneys, and motor exhausts.

Aerosols are suspensions of fine solid or liquid particles in the air. They include smoke, fumes, dusts, and mists.

The oil industry affects air quality in two major areas: manufacturing can create dust, smoke, and smells; and use of petroleum products produces smoke and gases. Yet, despite the tall stacks, visitors to a refinery see almost no smoke. Waste gases are mixed with steam to burn them completely. Gas flares are almost always of this smokeless type.

But refineries use large quantities of water, so clouds of steam and vapor are common, particularly in cold weather. These contain no air contaminants.

Oil refiners fight air pollution in several ways. Sulfur compounds are burned off safely or converted into saleable sulfur. Special collectors catch the catalyst dust given off from the fluid catalytic crackers. Carbon monoxide from the same units is burned to generate steam.

Many refinery products evaporate easily, creating the possibility of expensive losses and pollution of the atmosphere. Many Imperial refineries have a combined solution to both problems: large storage tanks holding

volatile products have floating roofs sealed with inflatable gaskets. Reduced evaporation cuts losses and lessens pollution.

The products refineries make, including heavy and domestic fuel oils and automobile gasoline, are potential sources of air pollution when they are put to use.

Although the sulfur content of home-heating fuel is low, cities such as Toronto and Montreal have established controls on it. In Toronto, for instance, the sulfur content of domestic heating oil is .5 percent, while in Montreal, it is .4 percent.

Heavy fuels burned in factories, hospitals, large apartment buildings, and offices contain as much as three percent sulfur in areas where air pollution isn't a problem and the municipalities allow it. Specific levels have been set in metropolitan areas though. In Toronto and Montreal, for example, the sulfur content must not exceed 1.5 percent.

Reducing the amount of sulfur in fuel oil is very expensive. Experiments are under way to try to solve the problem in other ways at lower costs. One of these is flue-gas desulfurization, in which chemical treatment removes the sulfur dioxide before it reaches the atmosphere. An Imperial Oil affiliate, Exxon Research and Engineering, has been carrying out a major research program of this kind, in conjunction with several electric power companies in Canada and the United States.

When the automobile engine burns gasoline into energy, it doesn't burn the fuel completely. Hydrocarbons, carbon monoxide, and other chemical compounds go into the atmosphere, originating from three sources of emissions in an automobile not fitted with pollution controls. The fuel tank and carburetor evaporation are responsible for 15 percent. The crankcase is responsible for another 20 percent. And the rest comes from the exhaust.

Automobile designers have made considerable progress in controlling these emissions. The car of 1970, properly equipped and maintained, gave off 70 percent less carbon monoxide and hydrocarbons than the 1960 car. But the goal for the middle-to-late 1970s is an essentially pollution-free automobile.

Since 1975, many cars have been equipped with catalytic converters that can practically eliminate unburned hydrocarbons and carbon monoxide as pollutants. Unfortunately, tetraethyl lead, which is now added to gasoline to boost octane ratings, considerably reduces the life of known catalysts. The car manufacturers' warranties, therefore, require the use of unleaded fuels.

Plants built at refineries to produce high-octane gasolines without lead can cost up to $25 million each. Also, more crude oil is required to make the same amount of fuel. That's why some of this extra cost shows up in gasoline prices as part of the price of clean air.

Noise

Acoustic experts, reporting to the International Standards Organization in Geneva, Switzerland, have said that if noise continues to rise at the present rate – about one decibel per year – everyone living in a city could be deaf by the year 2000. As a pollutant, noise has received little attention. Yet it is realized that everyday noise can erode health.

The sound level has been rising around us: heavy transports, supersonic aircraft, staccato motorcycles and snow vehicles, motorboats, loud music, rumbling farm machinery, pneumatic drills, and all the clatter of contemporary life.

With their humming, whistling, rumbling, and hissing sounds, refineries are a noisy part of the oil industry. Although most refineries were built in relatively unpopulated areas many years ago, now population has closed in around them, so it is important that noise be kept to a minimum.

Refiners do this with mufflers on exhaust stacks and vents; acoustically lined housing on pumps, motors, and burners; and, in some locations, sound-deadening walls surrounding noisy areas. Sometimes one kind of pollution control can lead to another kind of pollution. For instance, refinery waste gases are burned safely and with little pollution in flare stacks that have steam injected in them. The steam causes the gases to burn without smoke. However, too much steam in a stack makes extra noise, so the stacks have to be carefully monitored, often by closed-circuit television.

Imperial Oil spent three years reducing sound levels at its loco refinery in British Columbia. Included in this project was a 22-ton muffler that looked like a rocket ship and cost $180,000. The project has lowered the noise level at the refinery's property line from 54 decibels (about the loudness of normal speech) to 46 decibels – a little louder than the noise level on a quiet residential street. Projects like this not only cut down on noise outside the refinery where neighbors could be bothered, but also inside where men have to work.

There are other noise hazards in the oil industry. Some neighbors of car washes, for example, have reported that the sound of dryer fans has to be muffled.

As yet, there are few laws regulating noise; Imperial's practice is to conduct its operations so as to be satisfactory to the neighborhood and not injurious to employees' health.

The Arctic

No part of Canada has received more ecological-research attention from oil companies than the Arctic. In 1970, Imperial led in the formation of the Arctic Petroleum Operators Association, a group created to help solve environmental and operational problems in the North. The same year, Imperial cosponsored a study of birdlife in the Mackenzie Delta to help the Canadian Wildlife Service establish migratory patterns. This knowledge will help oil companies to plan their operations for least disturbance to birds. Within the company, Imperial has held Arctic workshops for the instruction of its northern seismic and drilling workers.

Imperial has been exploring the North since the early part of this century. It discovered oil at Norman Wells, N.W.T., 90 miles south of

the Arctic Circle, in 1920. An Imperial refinery has operated there since 1932.

The northland is made up of two kinds of country: the tundra – the treeless area – and the taiga – a Russian word meaning coniferous scrub forest. In either area, but particularly the tundra, the ground cover is fragile. It is often a thin covering of moss and other organic material insulating the frozen ground. If this insulation is destroyed, the ice in the soil may melt, causing the ground to slump, leaving a deep scar of exposed soil without any cover of growing plants.

Because this ground cover is vital to the ecology of the Arctic, Imperial uses tracked and wheeled vehicles only where they will not destroy the covering. Until vehicles are developed that won't disturb the vegetation, summer seismic work is restricted to areas where the tundra is dry and tough. (Experiments are being conducted with tracked vehicles that tread more lightly than a person, in terms of pressure per square inch.)

Even winter operations can damage the ground cover if bulldozer blades are set too low when clearing roads and campsites. To avoid this damage, bulldozers are fitted with "mushroom shoes" to keep the blades high. Operators are instructed to use a technique known as "high blading", which moves and compacts snow without destroying vegetation underneath.

Imperial's drilling rigs in the Arctic are supported on wooden piles or on thick gravel pads to insulate them. Heat given off during a drilling operation can thaw the underlying permafrost even in mid-winter. To prevent this, drillers insert a double-walled conductor pipe into the upper part of the hole. They drill through the centre while a refrigerant is pumped through coils between the two walls of conductor pipe to keep the permafrost frozen. Imperial also uses a special low-temperature drilling mud in the Arctic.

For garbage disposal, some companies bale the waste and fly it by helicopter to dumps in northern communities. Imperial has designed a portable waste-disposal plant for seismic and drilling camps. It burns all combustible camp wastes, and the ashes are buried in deep holes of small diameter. Imperial employees are forbidden to leave litter in the wilderness.

Another matter of concern is the effect of future pipelines on the tundra. Like all oil, northern oil comes out of the earth and is transported at temperatures above freezing. Buried pipelines would need insulation to keep the permafrost from melting. Imperial and others tested a 48-inch line near Inuvik to see how an oil pipeline affects the environment at various temperatures.

An important concern is the effect of pipelines on animal migration, particularly caribou. Simulated pipelines have been built on trestles high enough for animals to walk under, or inside gravel "berms" that can be climbed over easily. Movement of caribou around both kinds is being studied.

Gas pipelines will be buried, since the gas can be chilled to below the freezing point and the permafrost will not be affected by the lines' operations.

Every kind of northern transportation is getting special attention. Wherever possible, frozen lakes are used as airstrips. Elsewhere, airstrips are made by laying gravel on top of the tundra without breaking the surface

vegetation. Winter roads are built by the high-blading technique.

The challenge of the oil industry, as of any industry, is to produce the goods people want, at a price they can afford, without degrading the environment. The oil search must continue as long as Canadians need fuel for home heating, gasoline for automobiles, and petrochemicals for thousands of other objects of our daily lives. The search for anti-pollution measures must go on also. That is why Imperial maintains a department of environmental protection and has supported many private researchers in ventures ranging from a study of the effects of oil on lobster, to the breeding of microbes that may eat up oil spills. Imperial sees its job as helping to meet Canada's growing need for energy while maintaining the environmental quality that Canadians require.

An Imperial Oil Publication

9/75