An Account of Marine Water Pollution

Debojyoti Mitra
Visiting Faculty, Department of Machanical Engineering
Kalyani Govt. Engineering College

Environmental pollution is the talk of the day at each and every corner of the world today. Both the developed and the developing or under - developed nations are facing serious problems due to pollution caused by the human civilisation as well as by nature herself ! Uncontrolled pollution is posing a great threat towards the ecological system of living organisms. The three main types of pollution affecting living organisms are air-pollution, land-pollution and water pollution. Other types of pollution directly or indirectly affecting the mankind and the whole ecology are sound-pollution, smell-pollution, sight-pollution and so on. However, the present topic attempts to concentrate on water pollution, specially the 'sea-water pollution'.

Water pollution means different things to different people. British lawyers, concerned about personal and property rights, define the pollution of rivers as the addition of anything to the water which changes its properties so that the riparian owner does not receive it in its natural state. It is interesting to note that there is no reference here to the existing condition of the water–the offence is to add something which would pollute it if it were pure. The riparian owner has a right to have water in a natural state and has the right of action against anyone polluting it, even if he sustains no actual damage. However, a legislation in the State of California appears to limit this attitude; pollution is defined as any impairment of water quality which adversely and unreasonably affects its subsequent beneficial use. For purposes of rapid enforcement, the term 'contamination' is used to distinguish pollution which causes a public health hazard. British law similarly divides offensive discharges into poisonous, noxious or polluting categories implying respectively destruction of life, injury to a lesser degree and addition of materials which are foul or offend the senses. Dictionary definitions also refer to the fouling or contaminating aspects of pollution. 'Fouling' also means to marine scientists the undesirable growth of seaweeds, barnacles and other encrusting organisms on a ship's hull or harbour structures. Biologists might define pollution, more broadly, as 'the addition to an environment of any material which has a detrimental effect on the ecosystem'. By this standard, the pollution could be natural rather than man-made (for example, a flow of fresh water or mud into a marine environment not normally subject to such intrusions) whereas small discharges of non-poisonous substances (such as domestic sewage) could be biologically favourable even though offensive in human terms.

From the point of view of control and enforcement, pollution of the sea differs from that of fresh waters mainly in that the sea has no owner. Around the British isles there is no effective control of individual domestic discharges into tidal waters unless they create a nuisance on public beaches. The powers of river authorities have recently been extended to tidal estuaries, where they overlap with those of the sea Fishery Committees. Discharges into estuaries or the sea from sewage works, factories and other large undertakings are subject to scrutiny by these and other bodies in the course of obtaining planning consent, and must be licensed by the Department of Trade and Industry. There is no control over the disposal of wastes more than three miles off

the coast unless they are radioactive, oily or constitute a danger to navigation.

Pollution, whether it is chronic (arising from a continuous or regular discharge) or acute (the result of one accidental spillage or intentional dumping) is likely to have more obvious and severe effects in the constricted waters of a lake or river. Much of the information dealing with such fresh-water pollution has been assembled by Klein (1962). Many problems arising from river pollution also apply to the sea, simply because that is where most rivers ultimately empty. The scale of human population growth and of modern industry, together with the potency of some synthetic chemicals such as persistent biocides and war gases, already threatens to overcome the benefit of dilution previously offered by the great volume of the seas. However, marine waters present differences other than mere scale; for example heavy metals are constantly precipitated in sea-water and the charge surrounding suspended colloidal particles is altered, causing them to flocculate and settle. The variable characteristics of fresh water affect the toxicity of some pollutants – heavy metals have greater effect in soft water than in hard waters, while high temperatures and low oxygen concentration combine to increase the effect of any unfavourable discharge. It has already been pointed out that marine waters are subject to such variations only in estuaries or on the sea-shore. The inhabitants of the open sea are poorly adapted to cope with alterations brought about by off-shore pollution in these normally constant environment.

The usual and most obvious effect of pollution is to reduce diversity. Some organisms will be unable to tolerate the toxicant; those which will proliferate and may then exclude further species over which they have been given a competitive advantage. There will be thus fewer plant and animal species present, although the total number of individuals of resistant species may be as large or larger than the total before the polluting discharge commenced. This total is usually measured as 'biomass' – the quantity of living material (generally as dry weight) per unit area or unit volume. Even in some restrictive but natural (such as a non-industrial estuary) the diversity is less than in nearby areas where conditions are less constraining, but the biomass is often much higher. Places where pollution is severe, both diversity and biomass get reduced, in the worst cases to a point where the environment is virtually lifeless. The most resistant organisms are often themselves undesirable in human terms - for example, lower plants such as blue-green algae or 'sewage fungus' which form slimes and scums, or bacteria which produce evil smelling gases in the absence of proper aeration. Such gross impoverishment of the environment has been reported in the vicinity of oil-refinery outfalls, even where they carry no more than an acceptable quantity of suspended oily matter (Konig, 1968 and Baker, 1969). Another selective effect of pollution is an unpleasant accumulation of organic debris in the absence of scavengers (as on some beaches where sand-hoppers were killed by spraying of toxic oil-spill removers) or a marked increase in the numbers of pests such as midges following the elimination of such predators as fish from fresh water habitats. Predators may not be directly affected but nevertheless can be starved or driven away from lack of food. Crustaceans and insects are near relatives, so most modern insecticides also kill (at very low concentrations) the shrimps and other small crustaceans which form much of the diet of inshore and estuarine fish. Toxicants like these persistent biocides are cumulative and can become concentrated as they pass up food-chains, usually affecting the long-lived carnivores at the top much more seriously than the rapidly reproducing primary producers at the bottom. The classic example of food chain

accumulation resulted from the treatment of clear Lake in California with the chlorinated hydrocarbon pesticide DDD against midges (Hunt & Bischoff, 1960) - DDD was already known to be potentially dangerous to fish, so it was applied in amounts calculated to give an average concentration of only 0.015 parts per million in the water. After three applications during a period of six years, unexplained deaths amongst the western grebes, for which the lake was famous, led to investigations which revealed the presence of average quantities of 5 ppm of the insecticide in plankton, 40-300 ppm in herbivorous fish, upto 2500 ppm in carnivorous fish and nearly as much (about 2000 ppm) in the fish eating birds. It is not known what concentrations of DDD were reached in the bodies of human fishermen, perhaps because no deaths were attributed to this cause; but serious or fatal neurotoxic disorders (Minamata disease) and abnormal birds in some Japanese fishing villages have been traced to methyl mercury biosynthesised from industrial wastes, accumulating in a similar way in molluses and fish. Molluses concentrate, in their shells, radionuclides of the alkaline - earth metals (such as the strontium-90 in fall-out from nuclear explosions). Radiation doses lethal for bivalves have been calculated from experiments by Price (1965), but again the danger is greater to man by concentration up the food-chain. This aspect is carefully considered in monitoring British nuclear discharges (Mitchell, 1967-69). Plankton in the Columbia River (USA) has about 2000 times the radio-activity of the water (much of it due to phosphorus - 32 from the Hardford nuclear reactors) while herbivorous fish may have up to 150000 times (Kenny, 1957). Tunicates are known to extract vanadium from the sea, concentrating it from 0.0003 ppm in the water to nearby 500 ppm in some tissues (Nelson & Smith, 1972).

These were only a few examples of multivarious effects of pollution on living organisms in watery environment. Other modes of pollution like marine oil spill, under water nuclear explosions have even more adverse effects on marine ecology which in turn affects the human being when they directly or indirectly consume those living organisms. However, men alone cannot be blamed for pollution. Infact, the nature itself sometimes takes part in it. For example, the volcanic eruptions are tremendous sources of toxic materials which severely affect the living organisms. Thus, day by day pollution is becoming a serious threat towards existence of living organisms on earth and even the relatively calm, far-off places beneath the oceans are no longer getting spared. So, the time has come when the environmentallists all over the world should come forward with new innovative ideas to avert pollution and "make the earth an Eden, Like the heaven above".

The baisc texture of research consists of dreams into which the threads of reasoning, measurement and calculation are woven.

— Albart Szent Gyorgy