Engineers in Environmental Protection

Introduction

Industrialization has brought untold wealth and has transformed the way of life in the last century. Industrialization and urbanization have become a global phenomenon, resulting in serious environmental problems such as resource depletion, climate change, and pollution. Large scale use of natural recourses, their polluting processes and transport infrastructure have exacerbated the environmental problems.

Since the beginning of industrialization humankind has been utilizing natural resources-coal, oil, gas, water, minerals-at an accelerating rate. Energy resources are an obvious example of limited resources whose uses have major impact on environment in the form of emission of harmful gases and other wastes and also, inevitably, generates carbon dioxide, a gas which plays a key role in the greenhouse 'global warming' effect. Rivers are polluted by factories and becoming a health hazard. The dumping of industrial waste into streams is resulting contaminating clean water supplies.

There were reports of rivers that had turned orange or had caught on fire, the smog over some cities was becoming intolerable, and there were signs of negative health consequences from buried waste. Environmental concerns have become increasingly central to social policy. The roles of governments in relation to environmental issue are becoming extremely important. A great many of environmental damage problems are due to industrialization and urbanization.

Human beings have developed a capacity to create and use tools or what is now called technology. Technology can provide the means for modifying the natural environment for human purpose.

Engineers have professional obligations to society. Engineers are called on to seek solutions to problems that have a far reaching impact on society. The solution of such problems requires careful and responsible application of scientific principles. It is necessary for the engineer to address problems professionally in a manner that will ensure broader issues and aspects of a problem.. As per Peter Schulge and others in their book 'Engineering within Ecological Constraints' "the expectations placed on engineers shift with the cultural evolution of societies in which they practice. An important shift has occurred with the growth of human impacts on planet. When the cumulative impact of human was small, the environmental implications of engineering designs were of less concerns. Now that the impact of humans has reached a global scale, there is global concern about the environmental implications of engineering designs. A new set of constraints have become important to engineers-ecological constraints."

Major Impacts on Environment due to Industrialization and Urbanization

Disposal of chemical waste directly into the air, water, and soil results pollution of air and rivers, industrial and automotive smog. Housing and urban development has many environmental consequences; house building consumes raw material and energy and the resulting development affects the wider environment. Energy requirements of housing are significant contributor to global warming. Generation of harmful gases and other waste resulting in global warming. Release of radioactive materials from the various stages of nuclear fuel cycles. Energy use is probably one of the key factors influencing environmental impacts.

Another key effect of environmental degradation is global warming and its immediate effect in the environment is rise in carbon dioxide level. As per United Nations Intergovernmental Panel on Climate Change (IPCC), since the middle of nineteenth century, the average concentration of carbon dioxide in the world's atmosphere has risen from 280 parts per million (ppm) to 370 ppm and will reach between 450 and 500 ppm by 2050 if no precautionary measures are taken. Another effect of global warming is the rise in Temperature. The IPCC estimates that temperature will rise by between 0.5 degrees Celsius and 2.5 degrees by 2050 with an increase of 1.4 degrees to 5.8 degrees possibly by 2100. Rise in sea level also occurs as glaciers melt and warmer water expands in the ocean. Other effects include: shorter winters, shift in seasons, death of marine life.

Protection Measures and the Role of Engineers

Engineers and ecologist need to work together more often than in past. Ecologists and other environmental scientists need to collaborate with engineers to describe the requirements of important ecological conditions and processes in terms that can be incorporated into engineering design considerations, and continue to work together to develop engineering plans. While planning the developments, it is necessary to consider the impacts and environmental damages.

Daly and his colleagues have suggested acceptable boundaries for human environmental impacts. These are: rates of extraction of renewable resources should not exceed regeneration rates, rates of waste emission should not

exceed the assimilative capacity of the environment, rates of extraction of nonrenewable resources should not exceed the rates at which substitutes are found and developed.

These guidelines imply a variety of long term performance standards. For example: pumping from aquifers should not exceed recharge rates; pollutant concentration should not increase; soil depth should not decline; harvesting should not cause reductions in population sizes.

Based on defined ecological constraints, engineers can develop designs or management plans with potential for meeting them. Chemists and chemical engineers will have to work together to address environmental related challenges in the chemical science and engineering. These include: major increase in analytical capabilities-detection, monitoring, and measurement, new methods for waste treatment and pollution prevention, interface of the chemical sciences with biology, physics, engineering, material science, mathematics, computer science, atmospheric science, meteorology, and geology. A systems approach for spatial and temporal management of environmental-impact sources where the impacts are generated in a processing and manufacturing sequences should also be considered.

Engineers should also concentrate on development of new analytical instruments and tools to address three principal areas of measurement: laboratory analysis; field measurement; and theoretical tools for modeling and comparison with experiment to address the challenges of sampling and monitoring-air, water, and soil-more extensively and frequently evolving management requirements for waste water utilities by introducing waste water treatment in total water management system by reducing overall water demand via water reuse. World's demand for Energy is rising. Engineers can transform the energy system by making fuller use of low-carbon fuels as well as carbon-free energy system. Transportation accounts for 20% of total emission, industry contributes another 20 %, the domestic and commercial sector emit around 25% and power generation accounts for another 35%. A wide range of policy is called for. For example, in power generation, switching from coal to less-carbon-intensive natural gas, even coal could be made carbon free.

Transportation can be made more efficient by manufacturing ultra-efficient engines which will consume less fuel for higher mileage. Advanced techniques for gasoline injection also hold promise, as do hybrid electric-gasoline cars already on the road. World Health Organization has developed an action plan for member states on transport, environment and health as given below:

- Integrate environment and health requirements and targets into transport policies
- Promote modes of transport and land use planning which have best public health impacts
- Conduct health and environment impact assessment of transport policies
- Identify the economic cost of transport on the environment and health
- Ensure special care of groups at extra risk of the negative health effect of transport
- Research the risks of public health from transport, not yet quantified
- Establish indicators and monitor progress made towards the targets identified
- Promote pilot projects and research programmes into sustainable and healthy transport
- Increase public participation, public awareness and information

Efforts should also be made towards more efficient buildings, as it would also result in large energy savings; since over one third of today's energy is used indoors. Given that electrification is a central feature of industrial and post industrial societies, innovation must tap the potential for ultra-efficient electric appliances

As emphasized by numerous UN meetings (such as the first United Nations Conference on Human Development held in Stockholm in 1972; the 1992 Earth Summit in Rio de-Janeiro; the 2002 Earth Summit in Johannesburg) and Bruntland Commission on Environment and Development in 1987, greater attention should be given to improving the environment and of achieving sustainable development. Sustainable development is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Engineers have to lay an increasing emphasis on the notion of 'sustainability' whether it be a sustainable environment, sustainable economic development, sustainable agriculture and rural development, sustainable food security, sustainable economic development and so on. Finally, education system needs to be modified to accommodate the inclusion of environmental education and education for sustainable development.