

Chapter 1. An Introduction to Environmental Issues

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Environmental issues gained increasing prominence in the latter half of the 20th century. Global population growth has led to increasing pressure on worldwide natural resources including air and water, arable land, and raw materials, and modern societies have generated an increasing demand for the use of industrial chemicals. The use of these chemicals has resulted in great benefits in raising the standard of living, prolonging human life and improving the environment. But as new chemicals are introduced into the marketplace and existing chemicals continue to be used, the environmental and human health impacts of these chemicals have become a concern. Today, there is a much better understanding of the mechanisms that determine how chemicals are transported and transformed in the environment and what their environmental and human health impacts are, and it is now possible to incorporate environmental objectives into the design of chemical processes and products.

The challenge for future generations of chemical engineers is to develop and master the technical tools and approaches that will integrate environmental objectives into design decisions. The purpose of Chapter 1 is to present a brief introduction to the major environmental problems that are caused by the production and use of chemicals in modern industrial societies. With each environmental problem introduced, the chemicals or classes of chemicals implicated in that problem are identified. Whenever possible, the chemical reactions or other mechanisms responsible for the chemical's impact are explained. Trends in the production, use, or release of those chemicals are shown. Finally, a brief summary of adverse health effects is presented. This chapter's intent is to present the broad range of environmental issues which may be encountered by chemical engineers. Chapter 3 contains a review of selected environmental regulations that may affect chemical engineers. It is hoped that this information will elevate the environmental awareness of chemical engineers and will lead to more informed decisions regarding the design, production, and use of chemicals.

Chapter 1 Example Problem

Efficiency of Primary and Secondary Energy: Determine the efficiency of primary energy utilization for a pump. Assume the following efficiencies in the energy conversion;

- crude oil to fuel oil is 90% (0.90)
- fuel oil to electricity is 40% (0.40)
- electricity transmission and distributions is 90% (0.90)

- conversion of electrical energy into mechanical energy of the fluid being pumped is 40% (0.40)

Solution: The overall efficiency for the primary energy source is the product of all the individual conversion efficiencies.

Overall Efficiency = $(0.90)(0.40)(0.90)(0.40) = (0.13)$ or 13%.

Chapter 1 Sample Homework Problem

Electric Vehicles: Effects on Industrial Production of Fuels

Replacing automobiles having internal combustion engines with vehicles having electric motors is seen by some as the best solution to urban smog and tropospheric ozone. Write a short report (1-2 pages double spaced) on the likely effects of this transition on industrial production of fuels. Assume for this analysis that the amount of energy required per mile traveled is roughly the same for each kind of vehicle. Consider the environmental impacts of using different kinds of fuel for the electricity generation to satisfy the demand from electric vehicles. This analysis does not include the loss of power over the lines/grid.