Engineers and the Knowledge of the Environment

Amir Hossein Hamidian*[1] and Mohammad Babapour[1]
Department of Environmental Science and Fisheries, Faculty of Natural Resources

Abstract

Engineering and related sciences are among the most important compartments of the knowledge, which has been developed during centuries in order to provide a better life for human being. Unfortunately, during the expansion of this knowledge, the aim has been sometimes neglected. In fact, human being has been destroying and depleting the natural resources, which is related on them for his life. Therefore, it is needed in our recent education system to train engineers with at least basic and enough knowledge of the environment. It is necessary to educate engineers who would be able to recognize and solve the problems not in a solitary manner, but rather in a comprehensive way understanding the products and processes as part of the *biosphere*. In this paper, some of the problems, arose by overlooking the environmental aspects of the design and implication of the products, have been discussed. The basic environmental knowledge which is needed for our engineers to be capable of evaluating the significance of the problems and releasing advice on solving these problems are discussed.

Keywords: Engineering, Environment, Education

Introduction

In the Lord of The Rings [1] Erestor explains that there are only two possibilities to deal with the menace of the Ring: "to hide it forever, or to unmake it. But both are beyond our power." The dilemma declared by Erestor is analogous to many environmental problems such as concerns related to long-life hazardous wastes which have being produced worldwide at an alarming rate. Once nuclear or hazardous waste is generated, you cannot "unmake" it. Today, mankind is facing many issues; among them the most significant ones are related to the quality of the environment. This is partly because of the fact that in the past decisions environmental factors were not considered as critical elements. The issues related to the environment are multidisciplinary, ranging from science and economic to social, regulatory and engineering issues. Engineers have been providing the human-being with many different facilities for a better life; however the purpose of the design and the production has been sometimes forgot. In order to provide a better life for mankind, we need to make our current daily decisions so that they reflect the importance of the environment. Therefore, we expect our engineers to proceed with industrial development that maximizes the productions of materials, while minimizing or ideally eliminating the amount of waste produced. This process should also include the selection of raw materials, production efficiencies and process modification and enhancement. The information presented in here is to increase awareness of the need to "do it right" in the first instance, and to look at the future considering the ultimate goal.

Why engineers should be environmentally educated?

Environmental issues affect every aspect of human life. We need to live sustainably on this planet and protect the ecological processes on which our life depends. Is this possible to live sustainably, while still providing a healthy, fulfilling life for everyone? This question is a dilemma lies at the heart of environmental science. As we have more people aware of the importance of the ecological and environmental processes, providing a sustainable life for humankind is more feasible. Engineers, as pioneers of humankind development must know how ecosystem works and in which way their product is going to affect the environment. They should also consider that we are living in this earth, and the resources of the planet are not unlimited.

* Corresponding Author: Tel: 0064-21 1267846 , Email: amihamidian@yahoo.com

Recent progress in environmental protection gives us hope to reach the goal of meeting human needs while still preserving the earth's fragile life-support system. For instance, releases of CFCs into the atmosphere have decreased dramatically since the passage of the 1987 Montreal Protocol and destruction of UV-absorbing stratospheric ozone appears to be slowing [2]. Still, many problems remain. Increasingly, human-caused global climate change is already underway. It seems that loses of biodiversity occur at rates unmatched since the demise of the dinosaurs 65 million years ago. It has been predicted that in a few decades, three-quarters of all humans will live in countries where freshwater supplies are inadequate to meet the population's need. Water wars could become a major source of conflict in the future [3]. Bioconcentration and bioaccumulation of trace metals such as mercury and other toxins in food webs is a growing concern, not only in industrialized countries but even in remote areas where long-range transport of air pollutants can result in contamination problems [4]. Currently, more than 800 million people are chronically undernourished, and more than 1.2 billion do not have enough money to provide clean drinking water, shelter, medicine, education and sanitation needed for a healthy, productive life [5].We should educate our public to understand how science works and how to evaluate the difficult situations we face. But, we also need good scientists and engineers to provide answers for solving these problems, and avoid the creation of any further problems.

What should an engineer know about environmental issues?

A broad-based environmental science course is an excellent way to teach a wide range of students about both scientific and social issues. It can show how valid information is gathered and analyzed, as well as how to think critically and creatively about complex issues. The course should provide a strong foundation in the basic principles of environmental science. It should integrate information from a wide range of disciplines from both the natural and social sciences. It is very important to have a balanced course which presents both sides of controversial issues. While much current environmental news is discouraging, the course can also present positive examples in which progress toward sustainability is being made. One of the difficulties is to provide the basic principles to improve the environmental knowledge of our engineers, while the course and textbook is not more like encyclopaedic. This can be reached by more concise focusing on key principles, on scientific methods and ideas, and on life-long learning skills for students. However, any lecturer can choose to organize their courses around their own outlines and suits their course's needs. Another aspect is the benefit of using the knowledge of any subject of engineering to solve the existing environmental problems. For instance, knowledge in mechanical engineering can not only be applied to the engineering oriented applications, but also be applied to environmental issues. Recently, in New Zealand, engineers have applied Computational Fluid Dynamics, CFD, to investigate morphological changes in sand dune due to sediment erosion/deposition over time [6]. In East Asian countries including China, Korea and Japan problems caused by sand movement across the national boundaries. Korea and Japan suffer from yellow dust and sand storm (DSS) every year. In spring, dry weather and strong winds move millions of tons of sand from China to Korean peninsula and Japan. These dust storms sometimes extend over Chinese industrial regions, taking up chemicals including heavy metal in emitted smog, before reaching North-, South-Korea, and Japan These particulates can cause respiratory disorders [7]. As such, engineers with environmental background can potentially contribute great benefit to societies and countries.

New Era: Nanotechnology and the environment

Nanotechnology is a scale of technology and has applications in every economic sector: medicine, energy, industrial applications, material sciences, communications, cosmetics, additives, water purification, food science and agriculture. Here, you can find vast opportunities of the development, and it represents enormous potential for technological innovation. Engineers can meet a breadth of human needs when devise smarter and with more precise solutions. But again, if they only focus on design and the innovation, it might not be "the right thing to do" in the first place. Obviously, nanotechnology can be used for better solutions to enhancing the quality of the environment. Imagine a surface, which is so smooth that water cannot stick to it, and instead rolls off. Imagine a sensor, which is so sensitive that can detect a single molecule of a contaminant in drinking water. There are many of other current applied or proposed applications for nanotechnology [8] for enhancing the quality of the environment such as self-cleaning and air purifying surface coatings, self-healing coatings solar paint and fuel cells. But on the other hand, nanotechnology has some environmental aspects itself. However, it is not clear today what are the potential impacts are from the nanosclae materials in our biosphere, to the air, soil and water. It is not still understood and being investigated whether and how they can affect the ecosystems, such as forests and coral reefs. Therefore, an engineer works on nanotechnology to provide a much advanced and better technology to improve the quality of life, should first think and ask lots of questions of himself. Are nanomaterials going to enter the environment in ways that will allow them to persist and enter or upset the food chain? Will they pass the way of other pollutants, such as trace metals? How will this be determined if data are not being collected? The easy way is to wipe the question and argue that the amounts will be so small. Indeed, in the near future, this might be true. But, as more and more applications adopt nanotechnology, the production, consumption, and release of nanoparticles will dramatically increase [8]. So, our engineers working on new aspects of the technology, such as nanotechnology should bear in their minds: will there be a nano-environmental legacy?

Conclusion

Environmental science is a systematic study of our environment and our relationships to the environment. It is highly interdisciplinary and integrates information from many fields of study to understand how the world works and how we should behave as part of this complicated system. All of us have a responsibility to get involved in the actions toward solving the problems we have created. This is necessary to improve understanding among the general public of natural and build environments and the relationships between humans and their environment. This is somehow because we do not live in another planet, and we are part of this whole system. Engineers have a much higher responsibility to learn about different aspects of the environmental science, because they usually work with design and production of technology which affects the environment, probably with higher risk or at least in new ways. Therefore, it is a need to provide students of engineering with environmental knowledge to meet the objectives such as developing an awareness of and appreciation for our natural and social environment, knowledge of basic ecological concepts, and an acquaintance with a broad range of current environmental issues. They need to be experienced in using investigative and critical thinking and have problem-solving skills in solving environmental problems.

Briefly, an environmentally educated engineer in the natural context understands the scientific concepts and facts that underlie environmental issues and interrelationships that shape nature. In the social context, s/he understands how human society is influencing the environment, as well as the economic, legal, and political mechanisms that provide avenues for addressing issues and situations. In the valuing context, s/he explores her/his values in relation to environmental issues. Then, from an understanding of the natural and social contexts, the engineer needs to decide whether to keep or change those values. Finally, in the action context, an environmentally educated engineer becomes involved in activities to improve, maintain, or restore natural resources and environmental quality for humankind [9].

References

1 - Tolkin, J.R.R., *Lord of the Rings- Part One, The Fellowship of the Rings*. 1986, New York: Ballantine Books edn.

2 - Will, S., *Global Change and the Earth System, Planet Under Pressure*. 2004: Springer Verlag.

3 - Ellis, R., *The Empty Ocean*. 2003: Island Press.

4 - Helvarg, D., *The last fish.* Earth Island Journal, 2003. **18**(1): p. 26-30.

5 - FAO, U., *The State of Food Insecurity in the World*. 2002.

6 - Pattanapol, W., et al. *Modeling of Surface Roughness for Flow Over a Complex Vegetated Surface* in *PROCEEDINGS OF WORLD ACADEMY OF SCIENCE, ENGINEERING AND TECHNOLOGY VOLUME 26* 2007.

7 - AFP (Soul), A. *Chinese yellow sand hits Japan, skorea;*

Http://afp.google.com/article/ALeqM5jki0R_S3dtL7QkGEHwM-tnblCNXQ. 2008 [cited.

8 - Shatkin, J.A., *nanotechnology, health and environmental risks*. 2008, New York: CRC Press.

9 - Minnesota Office of Environmental Education, *A Greenprint for Minnesota*. 1993.