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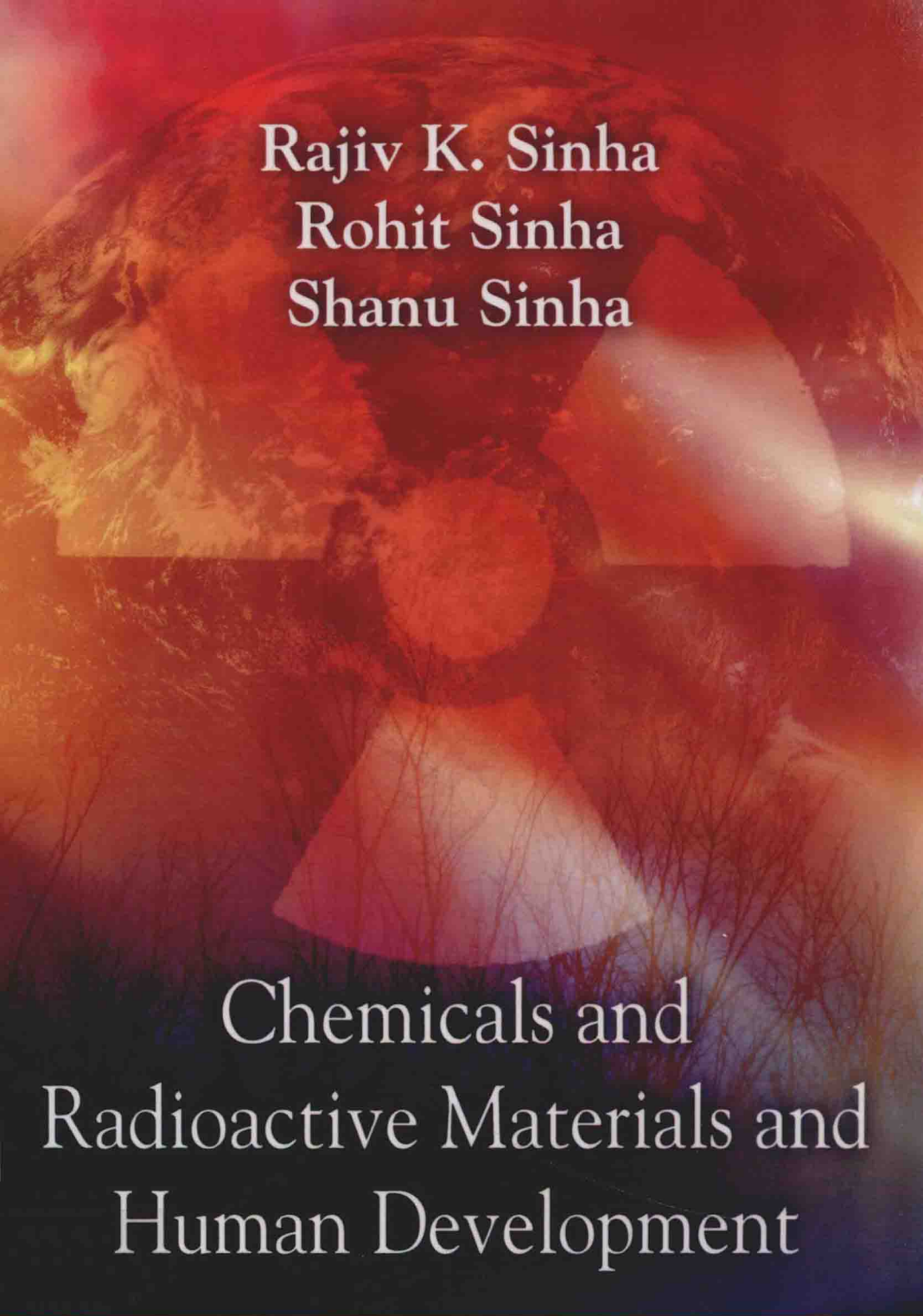

Chemicals and Radioactive Materials and Human Development

Chemical Engineering Methods and Technology Series

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CHEMICAL ENGINEERING METHODS AND TECHNOLOGY SERIES

CHEMICALS AND RADIOACTIVE MATERIALS AND HUMAN DEVELOPMENT

RAJIV K. SINHA
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SHANU SINHA

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PREFACE

Hazardous chemicals and radioactive substances have permeated the human environment and the ecosystem. They are now in our basic life support systems- air, water, food and soil. Scientific investigations have shown over 350 'synthetic chemicals' in human environment. The matter of more serious concern is that human beings have become exposed to synthetic chemicals for which there has been no past evolutionary adaptation and experience. The chemicals are completely 'foreign' to all living organisms. Some synthetic chemicals mimic natural body hormones and send false messages. Others 'block the messages' by disruption and prevent true ones from getting through. Any chemical which interferes directly or indirectly with hormone function can scramble vital messages, derail development and undermine health. Industrial chemicals may disrupt normal function of body's 'hormonal system' causing reproductive and developmental abnormalities, neurological and immunological problems and cancer.

The World Health Organization (WHO) reports that 25 % of all preventable illnesses are directly caused by environmental pollution (chemical, radiological and biological) of the life-support systems. On global level, intoxication attributed to chemical pesticides have been estimated to be as high as 3 million cases of acute, severe poisoning annually, with as many or even more unreported cases mostly in the developing countries, and some 220,000 deaths. Any chemical, in the form of a liquid, dust, vapor, gas, aerosol or mist can enter the eye by dissolving in the liquid surrounding the eye. As eyes are richly supplied by blood vessels, many chemicals can penetrate the outer tissues and pass into the veins.

Modern life cannot be imagined without chemicals and some are crucial to our well-being. Production of goods of widespread societal use and consumption such as paper, plastic, leather, textile and even food incur heavy use of chemicals. From transportation to information technology, to the operation of electrical equipments and heavy machines and tools, and in entertainment, some chemicals are used. But some sustainable solution is imminent as it would affect our very survival on earth.

Science has helped us identifying the harmful chemicals specially the carcinogens, teratogens, immunotoxins and endocrine disruptors used in production process and their release into the human environment, making it possible to restrict or even eliminate their production and use. After the

Stockholm Conference on Human Environment in 1972 several nations banned the production of toxic synthetic chemicals through appropriate legislation. A Green Chemistry Movement (GCM) is also going across the world since 1990 to reduce or even eliminate the use of toxic chemicals in industrial production process and search for benign alternatives.

Scientists in the U.S. have identified a 'master gene' that controls the action of 50 other genes whose products protect the lungs against chemicals and pollutants in the environment. The master gene named as 'nrf2' is activated in response to environmental pollutants which then turns on numerous antioxidant and pollutant-detoxifying genes to protect the lungs from developing emphysema.

Keywords: *Exposure to Chemicals in Everyday Life; Chemical Residues in Food; Chemicals in Air, Water and Soil Adversely Affects Human Health; Household Hazardous Wastes-Poison in Homes; Human Disasters Due to Hazardous Chemicals; Radioactive Materials in Human Environment-Potential Risk to Civilization; People's Protest Against Hazardous Chemicals in Consumer Products; Biological Half-time of Chemicals in Human Body; Green Chemistry Movement to Eliminate Toxic Chemicals from Human Environment; Public Opposition Against Nuclear Power; Master Gene in Humans and its Response to Pollution*

ACKNOWLEDGMENTS

We are grateful to all those learned authors, editors and publishers of the books and journals whose papers and articles provided valuable informations on the subject and helped in the preparation of this volume. Their names have been duly referred in the list of references. And, to the best of our knowledge we have taken all care not to violate the copyrights of the learned authors but if that might have had happened unknowingly & untententionally, we all duly apologize to those learned authors and scientists. Our intention is to spread the knowledge about 'potential health impacts of environmental pollutants' among the global human society and to make aware the policy makers and developers to change the current pattern of development and find a more environmentally and socially sustainable alternatives. It has to be 'development without destruction' and development and environment must go hand in hand.

We especially acknowledge the publications of UNEP (United Nation Environment Program) and the WHO (World Health Organization) which provided immense informations on the subject.

Rajiv K. Sinha
Rohit Sinha &
Shanu Sinha

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Chapter 1

INTRODUCTION

Despite significant improvements in pollution abatement and environmental remediation over the past several decades, billions of people around the world continue to live in unsafe and unhealthy physical environment with great risk to their health. The poor are disproportionately at greater risk. The World Health Organization (WHO) reports that 25 % of all preventable illnesses are directly caused by environmental factors, mostly due to the pollution (chemical, radiological and biological) of the life-support systems- air, water and soil. Estimates done by Harvard University (U.S.) research group (1996) suggest that premature death and illness as a result of major environmental health risks account for a fifth of the disease burden in the developing world. Of the 800,000 premature deaths attributed to urban air pollution every year about 65 % occur in Asia. (GEO, 2006). Local air pollution due to use of dirty cooking fuels causes perhaps 4 million premature deaths (mostly of young children under five) every year in developing countries. The Ohio State University Medical Center reported direct link between 'air pollution, obesity and type II diabetes'. Researches found that exposure to air pollution, over a period of 24 weeks, exaggerates 'insulin resistance' and adipose tissues inflammation. Another study implicated air pollution as a major adverse risk factor for 'cardiovascular effects', 'high blood pressure' and acute 'coronary syndromes' (Rajgopalan, 2009). The economic and health costs of local air pollution amount to over US $ 350 billion a year, or 6 % of the gross national product (GDP) of developing countries. (UNEP Report, 2003).

Chemical revolution began to unfold in the mid-1950s. Chemicals –the demons of development- are all around us, with tens of thousands currently in

use and inevitably find their way into our bodies. They have become an intrinsic part of the lives of modern human society and are used in virtually all consumer products- cars, papers, plastics, textiles, electronics, building materials, food and medicine. Workers in mining, metallurgical, fertilizer, paint, plastic and automobile industries often face prolonged exposure to several hazardous chemicals. The persistent organic pollutants (POPs) like PCBs and DDT are found almost everywhere- in our food, soil, air, and water. Humans and wildlife around the world carry amounts in their body that is alarming. Recent studies have confirmed that in some countries of North, 40 to 65 % of women have levels of PCBs in their blood that are up to 5 times higher than recommended. Our babies receive their first dose while still in their mother's womb. More chemicals reach to them through their mother's milk. (UNEP Reports, 2002- 06).

Hazardous chemicals have permeated the human environment and the ecosystem. They are now in our basic life support systems- air, water, food and soil. Recent scientific investigations have shown that over 350 'synthetic chemicals' have been found in the humans (UNEP and WHO Report, 2002). What is the matter of more serious concern is that living organisms including the human beings, have become exposed to synthetic chemicals for which there has been no evolutionary adaptation and experience. The chemicals are completely 'foreign' to living organism. On global level, intoxication attributed to chemical pesticides have been estimated to be as high as 3 million cases of acute, severe poisoning annually, with as many or even more unreported cases mostly in the developing countries, and some 220,000 deaths. Industrial chemicals may disrupt normal function of body's 'hormonal system' causing reproductive and developmental abnormalities, neurological and immunological problems and cancer. The Mexican episode of babies born without brain (anenocephaly) is linked with the toxic and hazardous chemical waste dumps from the industries. (UNEP Report, 1992). Other medically active chemicals recently discovered are *n*-nitrosodimethylamine (NDMA) (a principal ingredient in rocket fuel), methyl tertiary butyl ether (a highly soluble gasoline additive), and phenolic compounds.

The urge to generate 'nuclear power' as a clean source of enormous energy from nuclear fuel uranium (which is of course proving to be 'curse in disguise' today) unleashed enormous amount of radioactive materials into the human environment. All radioactive substances emit 'harmful rays' which can pass through human body destroying the vital cells and genetic materials. They pose serious threat to human health, and the organs most sensitive to radiation are the 'reproductive organs' and the 'eyes'. All over the world the 'male

sperm count' is declining and it is attributed to the background radiation caused by the millions of tones of radioactive wastes in the environment. Radon is a demonstrated cause of lung cancer. Underground uranium miners in the U.S. in 1950s who were exposed to radon suffered from lung cancer. The combination of radon and smoking is particularly deadly. The ingestion of radioactive products from the use of radioactive water in industries can have a somatic effect on human beings, causing malignant tumours, or chromosomal and gene (heredity materials) mutations that might affect the future generations. In the recent years, people all over the world have been up in arms against uranium mining and the nuclear power plants which generates radioactive wastes. The 'Greenpeace Society' and the 'Friend's Of Earth' have been particularly active in arousing public awareness against the ill effects of radioactive wastes on human health.

Scientists working on 'Environmental Health Sciences' in the U.S. have identified a 'master gene' that controls the action of 50 other genes whose products protect the lungs against environmental pollutants. The master gene named as 'nrf2' is activated in response to environmental pollutants which then turns on numerous antioxidant and pollutant-detoxifying genes to protect the lungs from developing emphysema. They indicated that the master gene nrf2 was also activated in response to an anti-cancer agent 'sulforaphane'.

Chapter 2

CHEMICALS IN THE SERVICE OF MANKIND: A BOON OR BANE ?

Modern human civilization is based on copious use of chemicals in every walk of life. There is no sector of human development activity which do not make use of some toxic chemicals and materials which eventually end up as a chemical waste. Life today, cannot be imagined without chemicals. We cannot get away from the chemicals, it is all around us - in the soil where we grow our food, in the food (as residual pesticides) we eat, in the air (as pollutant) we breathe, and in the water (as contaminant) we drink. Approximately 80,000 chemicals have been introduced into the human environment over the last 50 years and about 15,00 new ones are added each year. The global production of chemicals has increased from 1 million tones in 1930 to 400 million tones in 2000 (UNEP Report, 2001). Some chemicals are like 'necessary evil'. Chemical substances recorded in the European Union in 1980s, were over 100,000 of them (UNEP Report, 2004). Since 1950 there has been a tremendous increase in the production of 'organic chemicals' to satisfy our demands for consumer goods. Production of goods of widespread societal use and consumption such as paper, plastic, leather, textile and even food incur heavy use of chemicals and consequently discharge large amount of chemical waste and pollution. The DDT and the PCBs were produced at about 100 million pounds per year during the 1960s and 70s. However, they are banned now. Since 1950 there has also been a tremendous increase in the use of 'heavy metals' to satisfy our demands for consumer goods.

Many chemicals are crucial to our well-being. They are essential for human development and in everyday life. From transportation to information