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NUCLEAR POLLUTION: FORTHCOMING UNSOLVABLE GLOBAL PROBLEM

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ABSTRACT

After Second World War, the nuclear knowledge that was under military control had led to the production of atomic weapons was redeployed for peaceful purposes in many countries. Atomic energy counted several benefits and realized that this energy source was not risk-free. There was the danger of nuclear war, the spread of atomic weapons, and nuclear terrorism. But intensive international cooperation and a number of negotiated agreements suggested that these dangers could be avoided. The Non Proliferation Treaty, drafted in 1969, included a promise by signatory governments possessing nuclear weapons and undertake nuclear disarmament strictly for peaceful purposes only. Other problems, such as radiation risks, reactor safety, and nuclear waste disposal were all acknowledged as very important. Very strict codes of safety practices were implemented in nuclear plants. However, accidents occurred in reactors in certain rare cases, where chances of external release of radioactive substances could be possible. Depending upon the level of exposure, people were under a certain level of risk of becoming ill from various radiation effects. The health risks for the development of peaceful uses of nuclear technology, including nuclear electricity, were very small when compared with the benefits from the use of nuclear radiation for medical diagnosis treatment. The safe application of nuclear radiation technology promises many benefits in environmental clean-up and in increasing world food supplies by eliminating spoilage. With a recent and very notable exception, the international cooperation that had marked the development of nuclear power technology provided an excellent model.

INTRODUCTION

Nuclear Pollution is caused due to unwanted radiations. Radiation is able to permeate the universe, the solar system and the earth. Radiation from the sun is so intense that life would be in danger if the surface of the earth would not surrounded with atmosphere. The atmosphere is able to screen out much of the sun's radiations. Cosmic rays continuously penetrate deeply into the surface of the earth. On the other hand, naturally occurring radioactive elements are found in the rocks, water, and air and in all living organisms. Some of the incoming radiations get trapped by the earth's magnetic fields. The magnetosphere of the earth is having Van Allen region which is high energy radiation level. This naturally occurring radiation in many forms is relatively constant for million of years. Besides, man-made radiations from different sources such as X-ray machines, radio-active fallout from nuclear explosions, effluent from nuclear power plants, radio-active materials and other radio-active sources in research laboratories, industrial plants and hospitals, wastes from reprocessing nuclear fuels, and from mining and processing radio-active products. Extreme small amounts of radiations can be profoundly injurious. But different forms of radiation are having different biological effects. Nuclear power is characterised by the very large amount of energy available from a very small amount of fuel. The amount of waste is correspondingly very small. However, much of the waste is radioactive and therefore must be carefully managed as hazardous waste.

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Kinds of Radiations

Radiation is a form of energy which may be transferred from one body to other through empty space. It is divided into two types viz. 1. Electromagnetic Radiation and 2. Particulate Radiation

Electromagnetic Radiations

Sunlight is a most familiar example of Electromagnetic Radiation. It covers a broad spectrum of radiant energy and a wide range of physical and biological effects. Besides, Radio-waves, infrared rays, visible light rays, Ultra-violet rays, X-rays and gamma rays are also categorized under Electromagnetic Radiation

Microwaves

Microwaves are radio-waves and hence they are electromagnetic radiations in the more energetic portions of the radio wave spectrum. Microwave energy has been much too low to disrupt living tissues by ionization. Instead, the energy gets absorbed as oscillation energy and is converted to heat. This makes possible to use microwaves for cooking. But the same radiation have been capable of heat injury to tissues in the body when exposed to the radiations, thus making it necessary to carefully maintain the door seal of microwave ovens..

Ultraviolet rays

Ultraviolet rays have profound physical and biological effects. It is shorter in wave length. This ray is produced abundantly by the sun and can be generated artificially by the carbon arc or the mercury vapour arc. Ultraviolet Radiations penetrates human skin only superficially to a maximum depth of 1 millimeter, which, however small is enough to cause serious injury.

X-rays

X-rays are produced when a fast moving electron is suddenly accelerated/decelerated, releasing electromagnetic radiations. These ray include a broad spectrum of wavelength. Therefore, the energy, penetrating power and disruptive force of x-rays differ greatly depending on the wave length. It has an average wavelength of 0.1 nanometer nearly equal to the diameter of a molecule of water.

Gamma rays

Gamma rays are similar to x-rays, with which their wave-lengths overlap, but because most gamma rays are of shorter wave length, they generally have higher energy and are more penetrating then x-rays. Gamma rays are having wavelengths of about 0.1 nanometer and shorter. This ray is emitted from the atomic nucleus of a radioactive element. For example, some atoms of radium, uranium and plutonium give off gamma rays.

Particulate Radiations

Particulate Radiation gets produced when one or more of the various components of the atom, for example, an electron, a proton, or a neutron, have been emitted from a radioactive element. Such particles may get ejected from the atom with great force, sometimes along with gamma rays as the atom gives up its energy. The force is so energetic that they can do great damage to living cells and tissues.

Alpha particles

Some radioactive isotopes emit fast moving particles, called alpha particles, containing two protons and two neutrons. This is equivalent to helium nucleus. Since alpha particle contain no electrons, they are positively charged particles. Alpha particles are less penetrating. They could be stopped by a sheet of paper. Alpha radiation, therefore, is dangerous only when the emitter is in direct contact with tissue, such as when inhaled or ingested. But in such cases, the alpha particles are readily absorbed by tissue, so the danger is very great.

Beta particles

Beta Radiation is made up of high speed electrons called beta particles. They get emitted by many of the radioactive substances during their decay to more stable states. An electron is exceedingly small; it weighs only 1/1850 as much as proton. When an electron is ejected at high speed from the atom of a radioactive element, it ionizes substances it collides with in its path. They can able to damage tissue but are less penetrating than x-rays or gamma rays.

Protrons

Protrons are 1835 times heavier than electrons. While the energetic electrons drives into tissue like a tiny particle of sand, the proton lumbers along like a rock, knocking off pieces of atoms and molecules at it goes. The proton does not penetrate as far as an electron of the same energy, but it causes more disruption in a small area. The effect is similar to that of an alpha particle.

Neutrons

Neutron is a kind of nucleon which means one of the building blocks of atomic nuclei. The neutron has a mass of $1.8x10^{-30}$kg and 1fm in diameter. It is similar to the proton but is electrically neutral. Neutrons are uncommon in nature because they decay radioactively with a half life of 11 minutes. The practical importance of neutrons comes from the fact that a neutron can stimulate a nucleus of a fissile substance. Further, it can be absorbed by some metals like lithium with the production of fusion fuel tritium.

Energetic neutrons

As said earlier neutrons are having approximately same mass as protons but have no charge. They are obtained from either a neutron beam or from the atomic disintegration of one of the radioactive isotopes. Fast neutrons have been four or five times more lethal than x-ray radiations. Major sources of neutrons have been nuclear reactors for irradiation chemical and biological specimens. It is also available from neutron generators and cyclotrons.

Cosmic rays

Cosmic rays are energetic sub-atomic particles, from the sun and outer space. They strike the earth at high velocities, some of them penetrating several thousand feet of solid rock. The dosage from cosmic rays at sea level is estimated to be equal to be 0.001 roentgen per day. The amount of radiation that can be tolerated by humans without detectable injury is about 0.01 roentgen per day. As the difference is small, cosmic rays probably have significant effects on cells and tissues causing mutations and other chromosomal aberrations.

Kinds of Radiations on the basis of ionization

It is observed that Radiation is energy and is being propagated from one place to another through space. On the basis of ionization, there are two types of radiations identified such as 1.Non-ionising radiations and 2.Ionising radiations

Non-ionising radiations

Radiations of shorter wavelength and greater energy able to harm the microorganisms but can injure only the surface tissues of higher plants and animals. These radiations are also known to increase the rate of mutations.

Ionising radiations

Ionising radiations are the potent sources of energy. Their toxicity is 100 million times more than that of cyanides. Ionising radiation is sufficiently great energy to ionize atoms and molecules. An atom gets ionized when it gains sufficient energy for one or more of its electrons to get separated from the atom.

Biological Effects of Radiations

The greatest danger of ionizing radiations has been that it is insidious. Damaging exposure can thus take place without awareness of it at the time. Biological damage is irreversible and the damage is caused without any symptom. The dangers from ionizing radiations are quite different from UV radiations. These radiation can able to decay cells and break chromosomes. A large radiation dose given for short time creating acute sickness and small dose given for large period causing the chronic effect. Some of the common physiological effects for human beings are described below-

Leucopenia

Continuous exposure to radiation is exhibited by decrease in the total white blood cells called as Leucopenia. A low RBC count is never seen due to the greater radiation resistance of red cells.

Epilation

X-ray exposures can give rise to epilation and there was a time when X-ray exposures were used to remove superfluous hair, not without injury from the large dose required. In some cases hair may return after an interval of some months but a large exposure dose, epilation has been permanent.

Sterility

X-rays can cause temporary or permanent sterility. Temporary sterility could be produced with moderate doses and normal functions may return in a few months. Extremely large doses of penetrating radiation may cause permanent sterility.

Tumour production

Radiation is widely used in the treatment of cancer, but cancer may follow because of excessive radiation exposure.

Atomic waste disposal problem

Radioactive wastes are more serious problems. Its disposal have been effected hitherto dumping in the sea, by burial in the ground, by depositing in salt mines, or in discarding it in certain cases by dumps. Two types of atomic wastes are seen-Moderate radioactive and highly radioactive. 1.Moderately active atomic wastes consists of component parts of nuclear power stations rendered radioactive by neutron radiation, radioactive residues from purification processes and waste from nuclear research. Moderately active atomic wastes were formerly dumped in the sea and deposited in salt mines. It must be expected that this and other radioactive wastes deposited in the sea in large quantities will one day be released, be enriched in food chain in the ocean, and sooner or later crop up in the foodstuffs of people.2.The highly radioactive atomic waste is the real problem. No satisfactory solution for the disposal of highly active atomic waste has yet been found. Atomic waste cannot be destroyed. The principal problem is the disposal of the fission products which has a long half life value. Some countries are exploring the possibility of sinking radioactive waste through the ice in Antarctica. Existing international agreement concerning the Antarctic provide for special amendments if all the signatories agree. The heat released by radiation would make the atomic waste containers sink gradually into the ice and melt their way through.

Conclusion

Energy is necessary for daily survival. Future development crucially depends on its long-term availability in increasing quantities from sources that are dependable, safe and environmentally sound (Renewable energy source). At present, no single source or mix of sources is at hand to meet this future need. Concern about a dependable future for energy is only natural since energy provides 'essential services' for human life - heat for warmth, cooking, manufacturing, power for transport and mechanical work. At present, the energy to provide these services comes from fuels - oil, gas, coal, nuclear, wood, and other primary sources (solar, wind, or water power) - that are all useless until they are converted into the energy services needed, by machines or other kinds of end-use equipment, such as stoves, turbines, or motors. In many countries worldwide, a lot of primary energy is wasted because of the inefficient design or running of the equipment used to convert it into the services required; though there is an encouraging growth in awareness of energy conservation and efficiency. Today's primary sources of energy are mainly non-renewable: natural gas, oil, coal, peat, and conventional nuclear power. There are also renewable sources, including wood, plants, dung, falling water, geothermal sources, solar, tidal, wind, and wave energy, as well as human and animal muscle-power.

Nuclear reactors that produce their own fuel (breeders) and eventually fusion reactors are also in this category. All parts of the nuclear fuel cycle produce some radioactive waste. At each stage of the fuel cycle there are proven technologies to dispose of the radioactive wastes safely. For low- and intermediate-level wastes these are mostly being implemented. For high-level wastes some countries await the accumulation of enough of it to warrant building geological repositories;

others, such as the USA, have encountered political delays. Unlike other industrial wastes, the level of hazard of all nuclear waste - its radioactivity - diminishes with time. Each radionuclide contained in the waste has a half-life – the time taken for half of its atoms to decay and thus for it to lose half of its radioactivity. Radionuclides with long half-lives tend to be alpha and beta emitters – making their handling easier – while those with short half-lives tend to emit the more penetrating gamma rays. Eventually all radioactive wastes decay into non-radioactive elements. The more radioactive an isotope is, the faster it decays. The main objective in managing and disposing of radioactive waste is to protect people and the environment. This means isolating or diluting the waste so that the rate or concentration of any radionuclides returned to the biosphere is harmless. To achieve this, practically all wastes are contained and managed – some clearly need deep and permanent burial. From nuclear power generation, none is allowed to cause harmful pollution. All toxic wastes need to be dealt with safely, not just radioactive wastes.

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