**Nalanda Open University**

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**E-CONTENT 8**

for

Part-I Examination, 2020

**SHORT DESCRIPTION OF THE SUGGESTED TOPICS**

**THEORY PAPER**

**CONCLUDING TOPICS OF PAPER – III**

**(ENVIRONMENTAL CHEMISTRY)**

1. **Synthetic Pesticides; Brief description of harmful effects of synthetic pesticides on humans and other life forms.**

**About Synthetic pesticides;**

The term pesticide generally indicates any chemical or microbial agent or their mixture used as active ingredients of products used for control of crops, pests and diseases, animal ectoparasites and pests in public health. Pesticide is used as a general term for insecticides, rodenticides, herbicides, fungicides, molluscides and similarly active compounds.

The era of synthetic pesticides started around 1940. At present there are more than 10,000 different pesticides. Pesticides are broadly classified according to their general chemical nature into the following main types:

Insecticides : Examples include Malathion, DDT, Carboaryl etc. They kill insects in crop.

Herbicides : Example includes 2,4 dichlorophenoxy acid; they are meant for killing weeds or undesirable vegetation.

Fungicides : Examples include Thiram, Phenylmercury acetate; they are toxic to moulds (fungi) and check plant disease.

The use of pesticides has helped in the eradication of diseases such as malaria and typhus and also in boosting crop production.

However, subsequent researchers showed that there were appreciable quantities of pesticides residues in the biota particularly in certain birds, mammals and human beings and the physical environment. The long term ecological hazards of the persistent pesticides have led to restriction or bans on the use of certain pesticides in many countries in Europe and USA and now in many other developing countries including India.

**Harmful effects of Synthetic pesticides on humans and other life forms:**

The indiscriminate use of pesticides in agriculture as plant protection agent for boosting production, apart from being an occupational hazard, has been posing a serious threats to human and animal life. When carelessly applied, synthetic pesticides can result in acute and long term side effects including sickness and death of people, useful animals, fish, birds and destruction of crops. Even when properly used synthetic pesticides have a number of unavoidable side effects. Their persistence and ubiquitous nature, combined with a tendency of some compounds to concentrate in organisms as they move up the food chain may increase their toxicity to fish, birds and other forms of life including man and cause harmful effects on man, his health and well-being.

Long time pesticide exposure has been linked to the development of Parkinson’s disease, asthma, depression and anxiety, attention deficit and hyperactivity disorder and Cancer including Leukaemia and Hodgkin’s Lymphoma. Reproductive harm from pesticides includes birth-defects, still-birth, spontaneous abortion, sterility and infertility. Heavy treatment of soil with pesticides can cause populations of beneficial soil microorganisms to decline.

Pesticide sprays can directly hit non-target vegetation, or can drift or volatilize from the treated area and contaminate air, soil and non-target plants.

Pesticides have been found as common contaminants in soil, air, water and on non-target organisms in our urban landscapes. Once there, they can harm plants and animals ranging from beneficial microorganisms and insects, non-target plants, fish, birds and other wild-life.

**Note -** It is further advised to consult the following study-material for more detailed preparation on the topic.

1. Study Learning Material provided by NOU Patna Part-I, Paper-III.
2. Environmental Chemistry : A. K. De.
3. Environmental Science : S. C. Santra
4. **Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) as important parameters to assess the quality of water.**

**Dissolved Oxygen:** It measures the amount of gaseous oxygen (O2) dissolved in water or an aqueous solution. Dissolved oxygen is one of the most important indicators of water quality. It is essential for the survival of fish and other aquatic organisms and health of an aquatic ecosystem. Oxygen dissolves in surface water by diffusion from the surrounding air, due to the aerating action of winds and as a product of photosynthesis in water medium. Dissolved oxygen is necessary for respiration and for some chemical reactions in aquatic ecosystem. Healthy water should generally have dissolved oxygen concentration between 6.5 – 8.0 mg/l (ppm).

**WHO standard for Dissolved Oxygen:** Depending on the water temperature requirements for particular aquatic species at various life stages, the criteria values range from 5-9.5 mg/l (ppm) i.e. a minimum of 5 - 6 mg/l for warm water biota and 6.5 - 9.5 mg/l for cold water biota. When Dissolved Oxygen becomes too low fish and other aquatic organisms cannot survive. Low Dissolved Oxygen primarily results from excessive algal growth caused due to Eutrophication. Die-off and decomposition of submerged plant also contributes to low Dissolved Oxygen.

The amount of Dissolved Oxygen in elevation increases. Contrary to it, salty water holds less oxygen than fresh water.

**Experimental measurement of Dissolved Oxygen in natural water /waste water**: Experimental measurement of Dissolved Oxygen levels in natural water and /or waste water plays a key role in water pollution control activities and waste treatment process control. For the measurement the following two methods are used. They are-

1. Winkler or Iodometric method.
2. Electrometric method using a membrane electrode.

**Note -** For short description of Dissolved Oxygen, experimental method of determination of Dissolved Oxygen is not required to be described. However, if someone is desirous to know the details of experimental steps, he/she is advised to consult-

1. SLM provided by NOU Patna, Part-I, Paper-III and
2. Environmental Chemistry : A K De.

**Biochemical Oxygen Demand (BOD)**: Biological Oxygen Demand (BOD) is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at a certain temperature over a specific time-period. The BOD value is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days of incubation at 20o C and is often used as a surrogate of the degree of organic pollution of water. Thus BOD is an important water quality parameter because it provides an index to access the effect of discharged waste water will have on the receiving environment.

In fact most natural and waste water contain some quantities of organic compounds. Aquatic microorganisms use some of these organic compounds as food. Microorganisms living in oxygenated water use dissolved oxygen to oxidatively degrade the organic compounds releasing energy which is used for growth and reproduction. Populations of these microorganisms tend to increase in proportion to the amount of food available. This microbial metabolism creates an oxygen demand proportional to the amount of organic compounds useful as food. Under some circumstances microbial metabolism can consume dissolved oxygen faster than atmospheric oxygen can dissolve into the water or the autotrophic community (algae, cyanobacteria and macrophytes) can produce. Because of higher value of Biological Oxygen Demand fishes and other aquatic organisms may die when oxygen is depleted to very low value (D.O value of 2 ppm or below it) by microbial metabolism. A BOD level of 1-2 ppm is considered very good, it means that there will not be organic waste present in the water sample. A water supply with BOD level of 3-5 ppm is considered moderate clean. In water with BOD level of 6-9 ppm the water is considered somewhat polluted with organic matter. At BOD levels of 100 ppm or greater, the water supply is considered very polluted with organic waste.

**Experimental measurement of BOD:** Experimental measurement of BOD requires two measurements. One is measured immediately for dissolved oxygen (called initial DO) and second is after incubation in the laboratory for 5 days and then tested for the amount of dissolved oxygen remaining (called final DO).

**Chemical Oxygen Demand (COD):** Chemical Oxygen Demand is an important water quality parameter because, similar to BOD, it provides an index to assess the discharged waste water will have on the receiving environment. Chemical Oxygen Demand is a measure of the capacity of given sample of water to consume oxygen during the decomposition of organic matter and oxidation of inorganic oxidative chemicals such as ammonia and nitrite. COD measurements are commonly made on samples of waste waters or of natural waters contaminated by domestic or industrial wastes. Chemical Oxygen Demand is measured as a standard laboratory assay in which a closed water sample is incubated with a strong chemical oxidizing agent under specific conditions of temperature for a definite period of time. A commonly used oxidant in COD assays is Potassium dichromate (K2Cr2O7) which is used in combination with boiling concentrated Sulphuric acid (H2SO4). Because this chemical oxidizing agent is not specific to oxygen consuming chemicals that are organic or inorganic, both of these sources of oxygen demand are measured in a COD assay (i.e. COD determination). The common unit of COD is milligrams per liter (mg/l or ppm).

The most common application of COD is in quantifying the amount of oxidizable pollutants found in surface water (eg. lakes and rivers) or waste water. COD is useful in terms of water quality by providing a metric to determine the effect an effluent will have on the receiving body, much like Biochemical Oxygen Demand.

1. **About**
2. **Montreal Protocol, 1987 and**
3. **Kyoto Protocol, 1997**

**Critical assessment of outcomes of these protocols.**

1. **Montreal Protocol, 1987**

The Montreal Protocol is an International treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. With United Nations Environment Programme (UNEP) in the lead, the Montreal Protocol was agreed on 16th September, 1987 by 34 Industrialized Nations and entered into force on 1st January 1989. The protocol aims at phasing out ozone depleting substances (CFCs and Halogens) by finding nontoxic alternatives and helping developing countries to do the same. Industrialized Country Parties agreed to freeze the production of CFCs at 1986 levels followed by a 20% reduction (compared to 1986 levels) by 1995, and a 50% reduction by 2000. The developing countries were given a 10 years’ grace period over the deadline agreed to by the industrialized countries.

Many developing countries including India and China did not sign the Montreal Protocol and decided to propose amendments to the Montreal Protocol which were partially agreed at the London Conference in June 1990.

Developed countries agreed to 100 percent ban on CFCs by 2000 AD instead of 50 percent as per the Montreal Protocol, with 10 year time lag for the developing countries.

The conference also approved setting up of ‘Montreal Protocol Multilateral Fund’ to help developing countries become less dependent on CFCs and other ozone depleting substances. In years after Montreal Protocol (1987) International meeting of parties of Montreal Protocol has been arranged periodically in different parts of the world to review the progress and discuss suggestions, views and amendments. The aim has been to bring the problem of ozone layer depletion - one among a few select global environmental problems of very serious nature under effective control.

The number of the countries signatory to the Montreal Protocol is now 46 and the countries which have ratified the Protocol has risen to 197. It is an indication of the growing concern of the world community about elimination of various chemical agents that destroy the atmospheric ozone.

**The Present Status:** As a result of this International agreement the ozone hole in Antarctica is slowly recovering. Climate Projections indicate that the ozone layer will return to 1980 levels between 2050 and 2070.

Due to its widespread adoption and implementation it has been hailed as an example of exceptional international cooperation. Kofi Annan former Secretary General of United Nations may be quoted as saying that “Perhaps the single most successful international agreement to date has been the Montreal Protocol.’’

1. **Kyoto Protocol, 1997**

Although the greenhouse effect is necessary for survival of life on earth, an overabundance of greenhouse gas emissions increase global warming beyond what is desirable.

The Kyoto Protocol is an International treaty among industrialized nations that sets mandatory limits on greenhouse gas emissions.

The purpose of the Kyoto Protocol has been to stabilize human generated emissions at a level that will not inflict further harm on the atmosphere. The initial treaty was signed in Kyoto, Japan in 1997. Almost 6000 delegates from more than 160 countries met in Kyoto, Japan in November 1997 to negotiate a treaty to address the possible threats of climate change. The treaty calls for the European Union to reduce its greenhouse emissions by 8 % below 1990 levels, the United States of America by 7 % and Japan by 6 % between 2008 and 2012. Other industrialized nation would have to meet a similar binding target of 5.2 %. The developing nations including India and China were exempted from mandatory emission controls. The six gases targeted for reduction included Carbon dioxide, Methane, Nitrous oxide, Hydrofluorocarbons, Perfluorocarbons and Sulphur hexafluoride. Carbon dioxide was the gas that policy makers were most concerned about. In 2001, the USA rejected the Kyoto Protocol as too damaging to industry. Initially Russia also expressed doubts about it on similar grounds. But later on November 18, 2004, the Russian Federation ratified the Protocol giving new hope that the Protocol can be implemented even without the United States.

The Kyoto Protocol which has adopted in Kyoto, Japan on 16th February, 1997 entered into force on 16th February, 2005.

**Present Status:** There are currently 192 countries (called Parties) to the Protocol. Canada withdrew from the Protocol from December, 2012. Without United States and Canada and with European Union as the main remaining backer to Kyoto Protocol, it may be understood that the main objective of the Kyoto Protocol – Stabilizing Global Climate at non-dangerous levels – is a long term objective that will inevitably take more time than stipulated to achieve its goal.

It is worth to mention that after first commitment period which expired on 31st December, 2012, a second commitment period was agreed during conference in Doha, Qatar in December, 2012 to extend Kyoto Protocol till 2020.